STUDIA MARITIMA | XXXVIII (2025) | 235–261 | ISSN (print): 0137-3587 | ISSN (online): 2353-303X | DOI: 10.18276/sm.2025.38-10

Joanna Kos-Łabędowicz
University of Economics in Katowice
Department of International Economic Relations
jkos@ue.katowice.pl
ORCID: 0000-0002-9523-9609

Danuta Zwolińska
University of Economics in Katowice
Faculty of Management
Department of Economic Logistics
danuta.zwolinska@ue.katowice.pl
ORCID: 0000-0003-0960-5826

Anna Drab-Kurowska
University of Szczecin
Institute of Spatial Management and Socio-Economic Geography
anna.drab-kurowska@usz.edu.pl
ORCID: 0000-0003-1396-9390

Maritime Transport Resilience – Charted Seas or Unknown Territory?

Keywords: resilience, maritime transport, systematic literature review, COVID-19

1. Introduction

Maritime transport is a key component of global logistics, as it accounts for around 80 per cent of global trade volume, according to the World Trade Organisation, and more than 75 per cent of European's Union external trade.[1] Through an extensive network of ports and maritime connections, it is possible to ensure the international

1 *Communication from the Commission to the European Parliament, the Council, The European Economic and Social Committee and the Committee of the Regions: Maritime safety: at the heart of clean and modern shipping*, 01.06.2023 (report No. COM/2023/268 final, prepared for the European Commission, Brussels: European Commission, 2023), accessed 01.10.2024, https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=COM:2023:268:FIN.

and transcontinental flow of materials, semi-finished and finished products, allowing other industries and the global economy as a whole to grow and develop. The United Nations Conference on Trade and Development report *Review of Maritime Transport 2024 – Navigating Maritime Chokepoints* indicates that, despite improvements in 2023, expectations regarding the future condition of the industry are cautious and not without a number of challenges.[2] Some of the potential problems are well-known and related to infrastructural constraints (e.g. bottlenecks in the form of the Suez and Panama Canals) or pressures to meet sustainability goals and reduce the industry's environmental impact by increasing the energy efficiency of the means of transport used. Nevertheless, maritime transport is an industry that is also susceptible to disruptions that are difficult to predict due to a dynamically changing geopolitical situation, climate change and its impact on weather and topological conditions, and many other factors that are difficult to predict. The overview of the mentioned UNCTAD report, published in October 2024, stressed the challenges faced by the maritime transport sector due to mentioned disruptions highlighting their economic, social, political, and ecological consequences for different stakeholders.[3]

The increasing frequency of unforeseen events that cause disruptions and destabilise the functioning of organisations and markets, including the maritime transport sector, is thus contributing to a growing interest in research into methods of adapting to them more quickly and minimising their overall negative impact. The term "resilience," meaning the ability to return to a state prior to disruption or change,[4] has attracted interest and is the subject of study across various disciplines from engineering and ecology to psychology and others. There are many ways of defining the concept in the literature; Fisher identified at least 70 of them.[5] Also, in economics and management, the concept of resilience is increasingly emerging in the context of research on the resilience of economies, regions, markets and organisations, referring mainly to methods and strategies for dealing with unforeseen events and their consequences.

The concept of resilience in relation to maritime transport is applied both systemically to the industry as a whole (and, according to the aforementioned UNCTAD 2024 report and European Commission 2023 communication, is a desirable feature that

2 *Review of maritime transport 2024: Navigating maritime chokepoints. Overview*, accessed 25.04.2025, https://unctad.org/system/files/official-document/rmt2024overview_en.pdf.

3 Ibidem.

4 The Britannica Dictionary, Britannica.com, accessed 10.11.2024, https://Www.Britannica.Com/Dictionary/Resilience.

5 Len Fisher, "More than 70 ways to show resilience," *Nature* 518 (2015): 35, accessed 11.11.2024. DOI: 10.1038/518035a.

increases the chances of its faster growth) and to the individual actors (such as ports, shipping lines, and others) that make up its ecosystem. Previous studies approaching maritime transport resilience in a systematic way[6] have indicated certain research gaps and further research directions, which this paper attempts to fill. In this paper, the authors aim to examine and add to the state of the art of research on maritime transport resilience in an increasingly uncertain environment.

The article attempts to answer the following research questions:

1. Has the interest in maritime transport resilience increased in recent years with the increasing disruptions in operating conditions?
2. Can the growing interest in maritime transport resilience be linked to specific disturbances coming from the environment?
3. To what extent/aspect (symptoms, tools measurement tools and methods, strategies and actions for creating/improving) of maritime transport resilience are subjects for research?

The authors hope that the study they have undertaken will allow for indicating the state of the art of research on the resilience of maritime transport. In order to answer the research questions and achieve their goal, the authors conducted a systematic literature review, incorporating bibliometric and contextual analysis, using searches on maritime transport and the activities it performs for other sectors of the economy. This study fits in with and complements previous studies on maritime transport resilience, attempting to fill the research gaps identified by them. The article is divided into five parts. The first part presents the background of the study, indicating the basic concept, research goals and assumptions. Section 2 presents the methodology used to conduct a systematic literature review, and then (Section 3) presents and discusses the results of the contextual analysis. In Section 4, references are made to other works before conclusions and summary are presented in Section 5.

2. Materials and Methods

The paper uses the systematic literature review methodology described by Czakon.[7] Subsequent steps were carried out between June and September 2024 (Figure 1).

6 Thanh-Thuy Nguyen, et al., "Managing disruptions in the maritime industry–a systematic literature review," M*aritime business review* 8 (2023), 2: 170–190, accessed 10.112024, DOI: 10.1108/MABR-09-2021-0072; Yui-Yip Lau, et al., "Maritime transport resilience: A systematic literature review on the current state of the art, research agenda and future research directions," *Ocean & Coastal Management* 251 (2024), 2: 107086, accessed 10.11.2024, DOI: 10.1016/j.ocecoaman.2024.107086.

7 Wojciech Czakon, ed., *Podstawy metodologii badań w naukach o zarządzaniu* (Warszawa: Wolters Kluwer Polska, 2015).

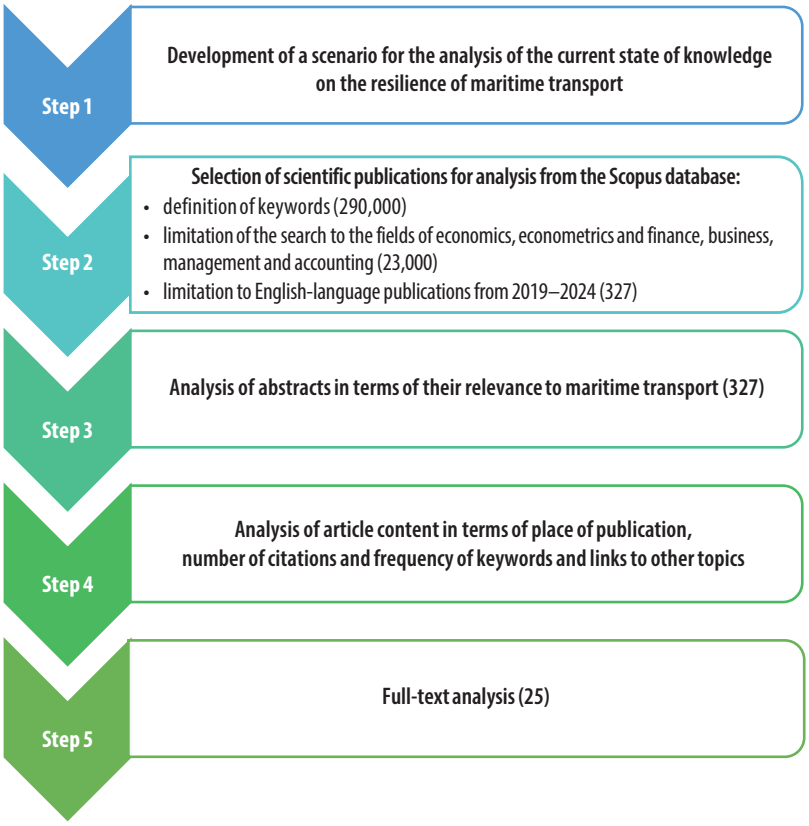

Figure 1: Methodology adopted for systematic literature review, step by step

Source: own study.

Developing a scenario for selecting studies that would allow for a state-of-the-art analysis of maritime transport resilience research was a crucial and non-trivial step, as indicated by the studies of Nguyen et al. and Lau et al.[8] The choice of the database of scientific publications that were the basis for conducting the study was the first and easiest step – the authors decided to choose the Scopus database for two reasons. Firstly, it would be the first time the Scopus database would be used for systematic literature review on the resilience of the maritime transport. In the previous studies only the Web of Science scientific publication database was used.[9] Employing the Scopus scientific journals database in our research would allow for the comparison/confrontation of the obtained results. The second selection criterion was the possibility of precisely matching the search criteria to the needs of the conducted research.

8 Nguyen, "Managing disruptions"; Yui-Yip Lau, et al., "Maritime transport resilience."

9 Ibidem.

Refining the search criteria was the second, and much more complicated, step taken by the authors. "Resilience" is the subject of research in many scientific fields – an initial search using the word "resilience" and its variants such as "resilient" and "resiliency" returned over 290,000 publications. Limiting the search results in the database of scientific publications to the results most similar to the adopted aim of the study and the research questions required the Authors to make several assumptions. Firstly, due to the fact that resilience is very often the subject of research in the fields of engineering, social sciences and computer sciences, it was decided to narrow the search by field to the following "Economics, Econometrics and Finance and Business, Management and Accounting" – which allowed for a significant reduction in the number of results (to approximately 23,000). Subsequently, there was the problem of how to narrow down the searches to refer to resilience in relation to maritime transport. Unfortunately, attempts to narrow down using the terms "maritime" and "marine" proved to be insufficient (over 4,450 results), and many of the results obtained concerned issues related to the agricultural-food, energy, etc. sectors, and not the transport sector. After several further attempts to narrow down the criteria based on a combination of "maritime" and terms indicating the activities of entities involved in maritime transport such as "transport," "logistics" or "shipping," it was decided to use terms describing maritime transport activities without the qualifier "maritime" itself in the final search – on the assumption that these studies would be identified during the analysis of the abstracts, which was planned as the next step. Additional restrictions adopted were the limitation, resulting from the research questions posed, to publications from the years 2019–2024 and, to ensure the possibility of replicating the research, the limitation to English-language articles in open access. The search using the criteria described above allowed the creation of a database of 327 scientific publications based on the Scopus database in July 2024.

The next step taken by the Authors was to analyse the abstracts of the studies from the prepared database in terms of their relationship with maritime transport. At this stage, articles that were not related to the subject of the research were removed from the final database. Unfortunately, in the results, despite narrowing the search criteria, it was possible to find articles referring to other issues, which resulted from, for example, the methods used (e.g. the use of a logistic regression model), or the increased interest of researchers in the topic of resilience and indicating it in keywords despite the fact that it was not the subject of the study. The Authors also decided to remove from the final database those studies that mainly focused on the analysis of supply chains, treating maritime transport issues as a secondary topic. In this way, after the analysis of abstracts conducted in August 2024, 25 studies describing the resilience of entities and activities in the area of maritime transport were obtained – 302 studies were rejected.

Using data from the Scopus database, the selected texts were subjected to a simple bibliometric analysis using MS Excel and VOSviewer version 1.6.20. This allowed us to indicate certain features of texts intended for full-text analysis, such as their place of publication, popularity (in terms of citations) and frequency of keywords and connections with other topics. The texts subjected to analysis were mostly published in 2022 and 2023 and most often in the journals "Maritime Policy" and "Maritime Economics and Logistics" (Table 1).

Table 1. Place and time of publication of the analysed studies

Year of publication	No. of articles	Place of publication	No. of articles
2019	1	"Marine Policy"	5
2020	1	"Maritime Economics and Logistics"	4
2021	6	"Transportation Research"*	2
2022	7	Other: "Asian Journal of Shipping and Logistics"; "Baltic Region"; "Cleaner Logistics and Supply Chain, Decision Support Systems"; "International Journal of Logistics Management"; "International Journal of Physical Distribution and Logistics Management"; "Journal of Economic Dynamics and Control"; "Journal of ICT Standardisation"; "Journal of Shipping and Trade"; "Maritime Business Review"; "Production and Operations Management, Resources"; "Conservation & Recycling"; "Tourism Management"; "Vestnik MGIMO-Universiteta."	14
2023	7		
2024	3		

* Both Part A: Policy and Practice and Part E: Logistics and Transportation Review.

Source: own study.

The data presented in Table 1 indicate a growing interest in issues related to resilience in maritime transport after 2020, which may be due to the disruption caused by the COVID-19 pandemic. Interest in the topic remains at a similar level in the following years (2022–2023), which can also be expected for 2024 (The database was acquired in mid-year). Most of the studies were published in journals dealing with maritime-related topics (11 articles) or transport and logistics (7 articles). The remaining publications (7 articles) are from journals with a different main thematic profile.

A citation analysis based on data from the Scopus database as of 06.10.2024 shows that all studies intended for full-text analysis were cited a total of 620 times (excluding self-citations – 577 times). Of these, one article garnered more than 1/3 of the citations and the 3 most cited articles account for more than half of the citations (Table 2).

Table 2. The most cited publications indexed in the Scopus database containing all words derived from "resilience," in the fields of Economics, Econometrics and Finance and Business, Management and Accounting between 2019 and 2024

Document Title	Authors & Publication Year	Journal Title	Cited by (excluding self-citations)
Disruptions and resilience in global container shipping and ports: the COVID-19 pandemic versus the 2008–2009 financial crisis.	Notteboom, Pallis, Rodrigue, 2021	"Maritime Economics and Logistics"	261 (252)
Analytics with digital-twinning: A decision support system for maintaining a resilient port.	Zhou, Xu, Miller-Hooks, Zhou, Chen, Lee, Chew, Li, 2021	"Decision Support Systems"	67 (60)
Maritime port network resiliency and reliability through co-opetition.	Asadabadi, Miller-Hooks, 2020	"Transportation Research Part E: Logistics and Transportation Review"	56 (52)
The impact of the COVID-19 pandemic on seafarers' mental health and chronic fatigue: Beneficial effects of onboard peer support, external support and Internet access.	Pauksztat, Grech, Kitada, 2022	"Marine Policy"	38 (38)
Adapting our sea ports to the challenges of climate change: Development and validation of a Port Resilience Index.	León-Mateos, Sartal, López-Manuel, Quintás, 2021	"Marine Policy"	34 (31)
Enhancing resilience through port coalitions in maritime freight networks.	Li, Asadabadi, Miller-Hooks, 2022	"Transportation Research Part A: Policy and Practice"	31 (30)

Source: own study based on the Scopus citation overview. Date: 06.10.2024.

Among the analysed studies, 11 have a citation count (excluding self-citations) not exceeding 5, but it should be borne in mind that these are mostly articles published in 2023 and 2024. It is interesting that the most frequently cited study concerns disruptions and resilience in relation to the COVID-19 pandemic – this seems to indicate the existence of a relationship between the increasing popularity of research on resilience in maritime transport and the increasing instability of the environment, resulting, among others, from the pandemic situation.

The last step taken by the Authors before undertaking the content analysis of the selected studies was to examine the keywords indicated by the authors of the selected studies. In the 25 studies selected for analysis, the authors indicated a total of 216 keywords, among which the most common were "resilience" (mentioned 7 times) and "covid-19" and "maritime transportation" (mentioned five times). Table 3 indicates the keywords that were indicated at least three times.

Table 3. Most frequently occurring keywords from publications meeting the selection criteria after abstract analysis

Rank	Keyword	Frequency of keyword occurrence
1	resilience	7
2	covid-19	5
	maritime transportation	5
3	ports	4
	shipping	4
4	container shipping	3
	investments	3
	market condition	3
	stakeholder	3

Source: own study based on the data analysis performed in VOSviewer. Source data from 06.10.2024.

When creating a graphical representation of the frequency and relationships between keywords assigned to the studies selected for full-text analysis, using VOSviewer, the Authors decided to include only the keywords that were indicated by at least two different studies – Fig. 2.

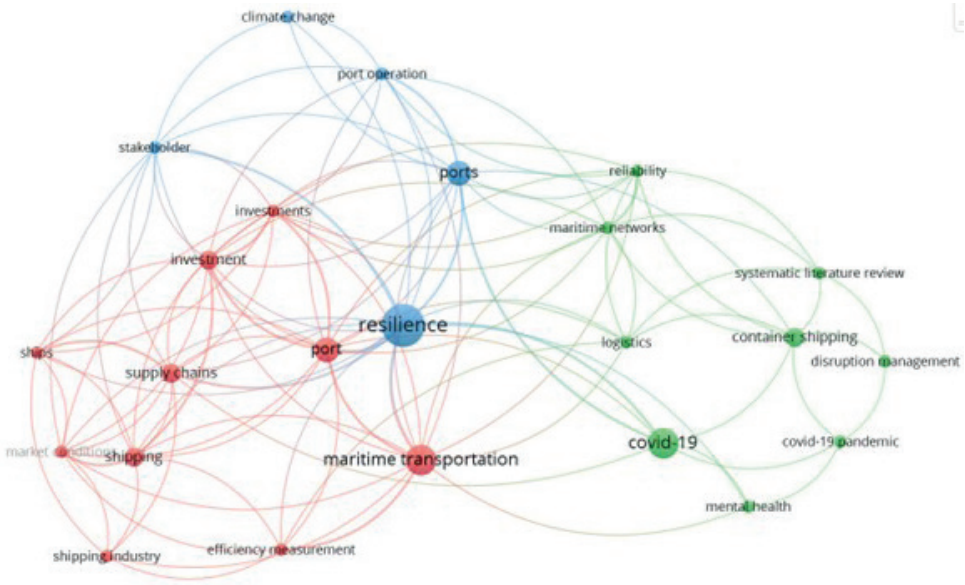

Figure 2: Map of authors keywords co-occurrence in publications related to resilience meeting the selection criteria

Source: own study based on the analysis performed in VOSviewer.

Comparing the visualisation of keyword frequencies (Fig. 2) with data on the most frequently used keywords (Table 3) allowed us to draw attention to an interesting relationship, i.e. the use of both singular and plural form in relation to ports. The verification that the singular number "port" (used 2 times) and the plural number "ports" (used 4 times) were not used simultaneously in any keyword article allows us to assume that ports and/or port resilience was more frequently investigated than the keyword ranking would indicate (Table 3).

3. Results

Selected texts were subjected to full-text analysis, for which the Authors used the narrative review method[10] and the meta-analysis method (taking into account such elements of the analysed studies as: research questions, methods used, considered theories, obtained results, conclusions, indicated further research directions).

Full-text analysis indicated the need to exclude from further consideration several of the studies qualified for further research based on abstracts and keywords. This was mainly due to the fact that the subject of the research, despite referring to resilience, did not directly concern maritime transport or resilience was relegated to a negligible component of the study. Studies by Kuhla et al. and Pauksztat et al., despite referring to maritime transport, do not directly examine its resilience.[11] The first of them concerns the impact of disruptions resulting from worsening climatic conditions and the typhoons caused by them on international trade. Maritime transport disruptions are a destabilising factor and reduce the resilience of both the actors involved in trade and individual economies, and diversification of trade partners is one of the possible strategies to counter these disruptions. Also, a study by Pauksztat points to a maritime transport initiative, the Northern Sea Route (NSR), as a potential trade route and an opportunity to improve relations between Russia and India in terms of counteracting the effects of climate change. In this study, both resilience and maritime transport play a marginal and, at most, auxiliary role in the authors' considerations, which was the reason for rejecting this study at this stage. Also, Druzhinin, despite pointing out the significant

10 Czakon, "Metodyka metaanalizy w naukach o zarządzaniu," in: *Podstawy metodologii badań w naukach o zarządzaniu*, 141.

11 Kilian Kuhla, et al., "Resilience of international trade to typhoon-related supply disruptions," *Journal of Economic Dynamics and Control* 151 (2023), accessed 11.11.2024, DOI: 10.1016/j.jedc.2023.104663; Birgit Pauksztat, et al., "The impact of the COVID-19 pandemic on seafarers' mental health and chronic fatigue: Beneficial effects of onboard peer support, external support and Internet access," *Marine Policy* 137 (2022), accessed 11.11.2024, DOI: 10.1016/j.marpol.2021.104942.

importance of coastal areas in the socio-economic transformation of Russia, especially in the Baltic Sea area, focuses on the aspect of economic growth and development and not on the resilience of maritime transport.[12]

As an example of the low importance of the concept of "resilience" for research in relation to maritime transport, both the study by Nuttall et al. and Papadakis & Kopanaki were rejected from further consideration.[13] In the first case, the authors examine the possibilities of decarbonising shipping between the Pacific islands and indicate resilience as one of the desirable features of shipping, but they stop there and focus on technological possibilities of improving energy efficiency, reducing emissions of harmful substances and alternative sources of energy and fuels.[14] In Papadakis & Kopanaki's study, the main focus is the possibility of using blockchain technology as a way to digitally transform maritime operations and supply chains. Resilience in this paper is a goal to be pursued when innovating in the maritime transport sector, but this goal was not subjectified or specified, which was the reason for rejecting this study from further consideration.[15]

The remaining 20 studies can be divided into three subgroups based on the dominant subject of the study. Ports are the most studied maritime transport actor (described in section 3.1). Issues related to shipping lines, shipping network and their impact on other maritime actors are the second distinguished group (section 3.2). The remaining studies, described in section 3.3, deal with various issues related to the resilience of maritime transport, such as employees or the implementation of modern technologies. A study by Nguyen et al., which, as a literature review is an exception from this classification, is included in Section 4 in relation to the results obtained by the Authors.[16]

12 Alexander G. Druzhinin, "The geopolitical effect of the maritime factor on the spatial development of post-soviet Russia: the Baltic case," *Baltic Regio* 15 (2023), 4: 6–2, accessed 11.11.2024, DOI: 10.5922/2079-8555-2023-4-1.

13 Peter Nuttall, et al., "Pacific island domestic shipping emissions abatement measures and technology transition pathways for selected ship types," *Marine Policy* 132 (2021), accessed 11.11.2024, DOI: 10.1016/j.marpol.2021.104704; Manos – Nikolaos Papadakis, Evangelia Kopanaki, "Innovative Maritime Operations Management Using Blockchain Technology & Standardization," *Journal of ICT Standardization* 10 (2022), 4: 469–508, accessed 11.11.2024, DOI: 10.13052/jicts2245-800X.1041.

14 Nuttall, "Pacific," 104704.

15 Papadakis, "Innovative," 469–508.

16 Nguyen, "Managing," 170–190.

3.1. Ports

Asadabadi & Miller-Hooks examine the resilience and reliability of ports and their potential impact on the resilience of the entire maritime transport system.[17] Making decisions related to investments aimed at preparing a port to withstand unforeseen disruptions is a complex problem and depends on many factors, such as the characteristics of a specific port or the approach to the risk of stakeholders deciding on financing port development. The starting point for the study is the analysis of previous models supporting resilience prepared based on examples of specific ports and disruptive events. Planning investment strategies in protective infrastructure without consideration for the broader perspective – ports are part of a network and actions or problems affecting other elements of this network may directly or indirectly affect their performance – is not acceptable from the point of view of creating resilience of either the ports themselves or the network. The stochastic optimisation model proposed and tested on actual data concerning four Asian ports (Port Klang, Singapore, Belawan, Jakarta) can be a useful tool in planning investments aimed at increasing port resilience. The results indicate the possibility of achieving benefits and improving the resilience of a given port through cooperation and supporting actions aimed at improving the resilience of other ports in a given/considered network. The authors suggest further work on the models, possibly using heuristic solutions, in order to consider more complex scenarios taking into account a larger number of actors/ports that make up a given transport network. The study by Li et al. extends the concept of creating port resilience through cooperation indicated by Asadabadi & Miller-Hooks and proposes and tests coalition strategies as a tool to increase the resilience of ports and the maritime network. The limitation of this approach is testing using numerical experiments and considering a small number of cooperating ports.[18]

The study by León-Mateos et al. addresses the issue of studying port resilience and, in particular, the lack of tools to measure it.[19] Using the Delphi method, the authors proposed the Port Resilience Index (PRI), a composite index to determine port resilience, developed on the example of the Spanish port of A Coruña. The study focuses

17 Ali Asadabadi, Elise Miller-Hooks, "Maritime port network resiliency and reliability through co-opetition," *Transportation Research Part E: Logistics and Transportation Review* 137 (2020), accessed 11.11.2024, DOI: 10.1016/j.tre.2020.101916.

18 Wenjie Li et al., "Enhancing resilience through port coalitions in maritime freight networks," *Transportation Research Part A: Policy and Practice* 157 (2023): 1–23, accessed 11.10.2024, DOI: 10.1016/j.tra.2022.01.015; Li, "Enhancing," 1–23; Asadabadi, "Maritime," 703714.

19 Fernando León-Mateos et al., "Adapting our sea ports to the challenges of climate change: Development and validation of a Port Resilience Index," *Marine Policy* 130 (2021): 4, accessed 11.11.2024, DOI: 10.1016/j.marpol.2021.104573.

on the risks and disruptions arising from climate change and a tool that could support stakeholders in making decisions regarding investment and adaptation of port infrastructure to mitigate risks. A novelty of the proposed tool is the inclusion of external and internal stakeholders involved in port operations in its preparation, which may increase their involvement in building port resilience. A certain limitation of the proposed tool is that it is tailored to one specific type of disturbance/threat. As potential further research directions, the authors indicated the possibility of rescaling the model to include many ports, which would allow for a comparison of the resilience of different ports.

Another tool to improve port resilience by better mitigating the effects of disruptions is the use of the Decision Support System (DSS) using digital-twinning to better support port authorities when encountering complex decisions, proposed by Zhou et al.[20] The authors demonstrate that the proposed DSS using digital-twinning can be integrated with the Terminal Operating System (TOS) as a planning module. The proposed system can be used to assess resilience at the planning stage of actions, taking into account diverse input parameters for preparing experimental scenarios, that would include as much real-life data as possible to better predict actions for the post-recovery timeframe. The proposed model is verified using a numerical experiment (using realistic but synthetic data) assuming three different scenarios of power supply disruptions. The described work is groundbreaking in terms of the detail of the data used, which allows for a more realistic assessment of port resilience; however, the authors indicate further possibilities for extending the proposed approach.

Ayaz et al. undertook the task of identifying and assessing strategies for creating port resilience in the face of the COVID-19 pandemic.[21] They conducted their research based on a literature review and interviews with representatives of Turkish container ports. The selection of Turkish ports for the study was determined by the effectiveness of their operations during the pandemic – while seaborne cargo tonnage and world container port traffic declined, Turkish ports recorded an increase in both. Based on interviews with port authorities and a literature review, the authors identified 15 strategies for creating resilience in a pandemic situation. The identified strategies were prioritised using the Fuzzy Analytic Hierarchy Process (AHP) based on expert assessment (ports' managers) to determine the most effective ones. The obtained results allow for proposing effective actions to increase port resilience; however, their usefulness is limited by the specificity of the ports examined. Further research using the applied methodology

20 Zhou et al., "Analytics with digital-twinning: A decision support system for maintaining a resilient port," *Decision Support Systems* 143 (2021): 7, accessed 11.11.2024, DOI: 10.1016/j.dss.2021.113496.

21 İlke Sezin Ayaz et al., "Resilience Strategies of Ports against Covid-19 in Terms of Chaos Theory," *Marine Policy* 146 (2022), accessed 11.11.2024, DOI: 10.1016/j.marpol.2022.105323.

for ports dealing with other types of cargo or comparing the strategies used by different types of ports under pandemic conditions would allow for the generalisation of recommended strategies for creating ports' resilience. In a similar format, a study was conducted by Gracia et al., where, based on a literature review, semi-structured interviews and workshops, governance best practices that allowed Latin American (LAC) ports the best performance during the COVID-19 disruption, were identified.[22] The study included different types of ports so that the resulting recommendations (for digitalisation and greater stakeholder engagement) could be used to support port resilience during other disruptions. A limitation of the study is the specificity of governance regulations in LAC ports – the large share of public agencies or authorities mapped in the research sample may not translate to the operating conditions of ports from other regions of the world.

Nsikan et al., based on a survey of 67 seaport practitioners from two ports located in Lagos, identified actions that could mitigate the effects of disruptions on port operations and the whole maritime supply chain.[23] Among the suggested actions to reduce port congestion and delays in loading/unloading were actions to optimise the flow of information between individual entities, as well as better integration of stakeholders and implementation of new systems (such as autonomous drones) that have gained popularity during the COVID-19 pandemic.

A study by Fedi et al. links the issue of port resilience with the adaptive behaviour of shipping lines during the COVID-19 pandemic.[24] The authors wanted to investigate whether trade disruptions resulting from the COVID-19 pandemic affected the Mediterranean Sea and Northern Range port resilience and hierarchy. A comprehensive 2018, 2019 and 2020 database of vessels (size, name, alliance membership) arriving at each port was prepared, allowing tracking activity at individual ports and the fleet management methods of shipping companies. The obtained results, using data from 2020 for the assessment, did not show significant changes in the hierarchy of the examined ports; however, they indicated significant differences in their resilience. The ports that showed the highest resilience and activity in 2018 were in a similar or better situation in 2020, but some smaller ports lower in the hierarchy (e.g. in the British Isles) had significant

22 Maria D. Gracia et al., "Assessing the implementation of governance best practices by Latin American ports," *Maritime Economics and Logistics* 24 (2022), 4:806–834, accessed 11.11.2024, DOI: 10.1057/s41278-022-00224-y.

23 John Nsikan et al., "Robust practices for managing maritime supply chain risks: A survey of Nigeria's seaports," *Asian Journal of Shipping and Logistics* 39 (2023), 4: 1–7, accessed 11.11.2024, DOI: 10.1016/j.ajsl.2023.09.001.

24 Laurent Fedi et al., "COVID-19 as a catalyst of a new container port hierarchy in Mediterranean Sea and Northern Range," *Maritime Economics and Logistics* 24 (2022), 4: 747–777, accessed 11.11.2024, DOI: 10.1057/s41278-022-00223-z.

problems and their position deteriorated (although this may be due to the overlap of the Brexit effect with the effects of the COVID-19 pandemic). An interesting conclusion is the identification of the great importance of shipping alliances and their ability to impose solutions on the condition of ports and transport users – which indicates the existence of a disparity in the relations between carriers, transport users and port service providers. The authors' main conclusion is to postulate the need to re-evaluate existing shipping alliances using for this purpose the digital transformation accelerated by the COVID-19 pandemic also in maritime transport.

3.2. Shipping lines, shipping networks and maritime ecosystems

Lee et al. investigated the impact of liner service providers on shippers' resilience based on information about freight schedules and durations.[25] This is a novel approach, as previous attempts to optimise service provider selection have mainly considered freight rates alone. In the approach adopted by Lee et al., taking into account the time that the cargo spends *en route* or waiting for loading/unloading allows for taking into account other costs (operational, downtime, storage) on the shipper's side and allows optimisation of the service provider selection decision. The proposed model allows a shipper to schedule ocean transport of container cargo using multiple service providers, which translates into increased resilience and reduced operating costs. A limitation of the proposed solution is the practice of concluding long-term contracts for cargo transportation between service providers and shippers, which does not allow for a flexible change of service provider depending on the market situation.

Notteboom et al. were the first to attempt to examine how much disruption in the maritime transport ecosystem (a perspective including ports and entities operating in them and shipping lines) was caused by the COVID-19 pandemic from the point of view of supply chain resilience, referring to the experience of the 2008/2009 financial crisis.[26] The data used from the initial period of the pandemic indicated higher resilience in the case of shipping lines than during the 2008/2009 crisis. The situation was more ambiguous in the case of ports and terminal operators. In the case of the latter, the initial reduction in volume affected financial performance, but the implemented strategies allowed to limit the effect. In the case of ports, other factors unrelated to the pandemic (such as location and importance to the maritime transport network)

25 Chung-Yee Lee, et al., "Optimal Global Liner Service Procurement by Utilizing Liner Service Schedules," *Production and Operations Management* 30 (2020), 3: 703–714, accessed 11.11.2024, DOI: 10.1111/poms.13311.

26 Theo Notteboom et al., "Disruptions and resilience in global container shipping and ports: the COVID-19 pandemic versus the 2008–2009 financial crisis," *Maritime Economics and Logistics* 23 (2021), 22: 179–210, accessed 11.11.2024, DOI: 10.1057/s41278-020-00180-5.

often negated or deepened the effects caused by the COVID-19 pandemic. The decisions of shipping lines and retained connectivity levels had a major impact on port resilience – bigger ports with better connectivity fared better, and those that experienced connectivity losses fared far worse. The research by D'agostini et al. confirms better preparedness and resiliencies of shipping lines than during the 2007/2008 financial crisis indicated by Notteboom et al.[27] D'agostini et al. point to the importance of adjusting chartering strategies, both for aggregate values and individual shipping lines, as a way to limit the impact of the COVID-19 pandemic on their operational and financial performance. This is another of the analysed studies, alongside Fedi et al., indicating the high resilience of shipping lines compared to other entities in the maritime transport ecosystem.[28]

The study by Rogerson et al. in an attempt to fill the gap related to the underrepresentation of studies concerning maritime supply chain resilience used the case study method.[29] The study focuses on the flexibility-based tools and strategies used to increase resilience – flexibility is treated as an inherent element of resilience. The authors use the same tool to assess and compare the effects and actions applied in the case of two disruptions of a different nature and scope – a local conflict in the port of Gothenburg, the effects of which were felt for 2 years and the COVID-19 pandemic with an international scope and difficult to predict long-term effects. The study considered various actors participating in the supply chain (ports, terminal operators, shippers and shipping lines) and the methods they used to limit the impact of disruptions, with shipping lines given the most attention. In the case of the first, localised disruption (port conflict), the greatest impact concerned actors conducting operations in the port. In the case of the second, the assumptions of Notteboom et al.[30] and the results of D'agostini et al. about the high resilience of shipping lines to disruptions resulting from the COVID-19 pandemic were confirmed.[31] The authors identified which flexibility-based actions were the most effective for countering effects of different types of disruption.

Wan et al. investigate the resilience of liner shipping networks (LNS) using a global network efficiency index to measure its performance, and then based on the resilience triangle (depth of the efficiency loss after disruption and time needed to reach

27 Enrico D'agostini et al., "Chartering policies and operational efficiency of shipping lines: exploring strategic changes in response to the COVID-19 pandemic," *Journal of Shipping and Trade* 9 (2024): 1, accessed 11.11.2024, DOI: 10.1186/s41072-024-00169-w; Notteboom, "Disruptions," 179–210.

28 Fedi, "COVID-19," 747–777.

29 Sara Rogerson, "Comparing flexibility-based measures during different disruptions: evidence from maritime supply chains," *International Journal of Physical Distribution and Logistics Management* 54 (2024), 2: 163–191. accessed 11.11.2024, DOI: 10.1108/IJPDLM-02-2023-0075.

30 Notteboom, "Disruptions," 179–210.

31 D'agostini, "Chartering."

the pre-disruption performance level) propose a resilience index for the entire network.[32] The obtained values for the index (range 0–1) after a given disruption should help in selecting an appropriate recovery strategy for the network, provided that the costs of this response to the disruption are also an important factor to be taken into account. Wan et al. tested the proposed network resilience assessment model and the selection of appropriate recovery strategies using a case study of the Maritime Silk Road (MSR) under storm threat conditions.[33] Validation carried out using available data on the effects and costs of damage to ports included in the case studies allowed to indicate which are crucial for the resilience of the entire LNS, and what priorities should be adopted to strengthen it. The proposed model can be used by various stakeholders to improve the efficiency of the global liner shipping network when considering proper responses to disruptions and resource allocations as it can be recalibrated for other types of disruptions. However, due to its assumptions and need for more data about lines traffic volumes it should be further elaborated and tested.

Yue & Mangan undertook to systematise the understanding of the concept of "reliability" in transport in relation to container shipping networks. In their systematic literature review, one of the three identified sub-areas of the shipping network reliability was shipping networks' "vulnerability and resilience."[34] The authors pointed out the lack of a clear definition of the term "reliability," often used interchangeably with other terms – including "resilience," which for the purposes of shipping networks in the literature is defined rather explicitly (from a systems perspective). The study was of a theoretical nature in order to organise the concepts for the needs of potential stakeholders, indicating the existing gaps in the studies on the resilience of shipping lines and maritime networks.

Chrysafis et al. proposed a model to evaluate the performance of the three largest entities in the shipping sub-sector, the cruise industry, to assess their resilience to the disruption caused by the COVID-19 pandemic.[35] The conclusions of the study allow recommendations to be made on financial and investment strategies for shipping industry companies. Drawing on the experience of all three entities studied and identifying the most effective actions; Chrysafis et al. emphasise the great importance

32 Chengpeng Wan, "Evaluating recovery strategies for the disruptions in liner shipping networks: a resilience approach," *International Journal of Logistics Management* 33 (2022), 2: 389–409, accessed 11.11.2024, DOI: 10.1108/IJLM-05-2021-0263.

33 Wan, „Evaluating," 389–409.

34 Zhongyun Yue, John Mangan, "A framework for understanding reliability in container shipping networks," *Maritime Economics and Logistics* 26 (2024), 3: 523–544, accessed 11.11.2024, DOI: 10.1057/s41278-023-00269-7.

35 Konstantinos A. Chrysafis et al., "Measuring financial performance through operating business efficiency in the global cruise industry: A fuzzy benchmarking study on the «big three»," *Tourism Management* 100 (2024), accessed 11.11.2024, DOI: 10.1016/j.tourman.2023.104830.

of maintaining liquidity to preserve resilience, which, due to the nature of the cruise industry and its high dependence on revenue generation on the quality and characteristics of its fleet, is difficult in the short term.[36]

3.3. Other focus on resilience in maritime transport

In the database of retrieved articles, the study by McVeigh & MacLachlan on supporting seafarers' resilience qualified for analysis.[37] Despite the fact that the article focuses on the mental health and resilience of seafarers, this issue is treated as part of building resilience in shipping lines by supporting employees and preparing them to cope with difficult situations. The study was conducted using the focus group method among employees of a large shipping organisation and its results were used to implement the employer's resilience programme as part of the holistic health programme for the employees. The second study by Pauksztat et al. on mental health problems of seafarers focused on the impact of the COVID-19 pandemic and related changes in the operations of international shipping. Pauksztat et al. conducted a survey among crews of various types of commercial vessels.[38] The assumption was to focus on crews who had been on board for at least a week at the time of the survey. It was verified which activities were perceived as useful and helpful in improving their well-being. The obtained results allowed for the preparation of recommendations that can be used to improve the working conditions of seafarers and the overall resilience of shipping companies.

In the case of the study by Sugimura & Murakami, the Authors had serious doubts about whether to include it in the full-text analysis – the study concerns an international system of sustainable reverse logistics using Japan as an example.[39] Nevertheless, the content analysis indicated that, in the case of the described network, maritime transport plays an important role in creating the resilience of the entire network. The study takes a comprehensive approach to resilience, breaking it down into further elements (e.g. robustness and redundancy) trying to balance the parameters of the modelled network in terms of efficiency (hub/port and spikes model) and resilience (introducing secondary and tertiary local ports).

36 Ibidem.

37 Joanne McVeigh, Malcolm Maclachlan, "A silver wave? Filipino shipmates' experience of merchant seafaring," *Marine Policy* 99 (2019): 283–297, accessed 12.11.2024, DOI: 10.1016/j.marpol.2018.10.012.

38 Pauksztat, "The impact."

39 Yoshihisa Sugimura, Shinsuke Murakami, "Designing a resilient international reverse logistics network for material cycles: a Japanese case study," *Resources, Conservation and Recycling* 170 (2024), accessed 12.11.2024, DOI: 10.1016/j.resconrec.2021.105603.

The last study analysed, Fjørtoft et al. aimed to propose a methodology for assessing the resilience of a sustainable autonomous maritime transport network, a concept developed as part of the European AEGIS project (*Advanced, Efficient and Green Intermodal Systems*).[40] The study uses the case of the maritime corridor between Trondheim and Rotterdam to compare the conditions, possible events, sources of threats, potential responses to threats and possible mitigation actions (of various types, e.g. human-associated, organisational) between utilising manned vessels and autonomous (or mostly autonomous) vessels in maritime transportation. The obtained results have shown that the implementation of autonomous systems can have a positive impact on safety in maritime transportation, reducing or eliminating certain types of threats (mainly resulting from human errors), but at the same time, by causing the emergence of new risks, it does not significantly affect the overall resilience of shipping.

4. Discussion

The analysis identified eight studies that concerned port resilience, including one by Fedi et al. that linked port resilience to actions and decisions taken by shipping lines.[41] The study by Li et al. developed the concept of creating port resilience through network cooperation proposed by Asadabadi & Miller-Hooks.[42] The remaining studies concerned the measurement of port resilience or methods, strategies (Ayaz et al.) and good practices supporting its creation, also through actions mitigating the risk and impact of disruptions resulting from difficult-to-predict events.[43] In half of the cases, the COVID-19 pandemic was the disruption which prompted the considerations related to resilience.[44] The León-Mateos et al. study considered climate change and Zhou et al. energy supply disruptions as relevant events that needed mitigation - in both cases, the authors indicated that the proposed solutions could be tailored for other disruptions.[45] Both studies focusing on the potential benefits for resilience resulting from cooperation between ports in a given network did not indicate a specific type of disruption. In the analysed papers,

40 Kay Fjørtoft, "Assessing the resilience of sustainable autonomous shipping: New methodology, challenges, opportunities," *Cleaner Logistics and Supply Chain* 9 (2023), accessed 9.11.2024, DOI: 10.1016/j.clscn.2023.100126.

41 Fedi, "COVID-19," 747–777.

42 Li, "Enhancing," 1–23; Asadabadi, "Maritime," 703–714.

43 Zhou, "Analytics"; Gracia, "Assessing," 806–834; Mateos, "Adapting"; Ayaz, "Resilience," 806–834; Nsikan, "Robust."

44 Ayaz, "Resilience," 806–834; Gracia, "Assessing," 806–834; Nsikan, "Robust"; Fedi, "COVID-19," 747–777.

45 Zhou, "Analytics"; Mateos, "Adapting."

where models were developed, attempts were made to prepare them based on specific examples using real data; unfortunately, in many cases verification was only possible using numerical experiments.[46] Also, for all studies using the experiences of actors during the pandemic period, specific examples were used and, interestingly, recommendations were prepared based on comparisons of the effectiveness of the solutions applied by each actor (e.g. with reference to their maintained effectiveness or the change in hierarchical position with respect to the pre-pandemic situation).[47]

Among the seven analysed articles on resilience in relation to shipping lines, networks and the maritime ecosystem, the majority of them examined their resilience to disruptions, and in one case their impact on the resilience of other entities (as was the case in the study by Fedi et al.).[48] Among the indicated disruptions, the predominant ones were those resulting from the pandemic situation, which in two studies were compared to other, earlier disruptions: the global financial crisis and a local conflict in a port.[49] Other studies either did not indicate specific disruptions or, as in the case of ports, these were climate and weather disruptions.[50] Most of the analysed studies used specific actors as examples and real data, which, especially in works published in 2024, referring to the pandemic situation, allowed for the comparison and verification of some earlier conclusions. This was the case when D'agostini et al. and Rogerson et al. confirmed the early conclusions of Notteboom et al. on the relatively high resilience of shipping lines to disruptions resulting from the COVID-19 pandemic. In general, when comparing the studies on the resilience of ports and shipping lines to disruptions resulting from the COVID-19 pandemic, one can point to a greater resilience of the latter, sometimes even at the expense of ports, which may be due to the implementation of appropriate strategies in response to previous disruptions, such as the 2007/2008 financial crisis.[51]

Among the other analysed studies, half of them concerned the resilience of seafarers and indirectly the resilience of carriers.[52] The analysed works also included a methodological approach to developing a tool to enable the measurement of the resilience of autonomous solutions for maritime transport and a proposal to use maritime

46 Li, "Enhancing," 1–23; Zhou, Analytics; Asadabadi, "Maritime," 703–714.

47 Fedi, "COVID-19," 747–777; Ayaz, "Resilience," 806–834.

48 Lee, "Optimal," 703–714.

49 Notteboom, "Disruptions," 179–210; Rogerson, "Comparing," 163–191.

50 Lee, "Optimal," 703–714; "Wan, Evaluating," 389–409.

51 Fedi, "COVID-19," 747–777; Rogerson, "Comparing," 163–191; Notteboom, "Disruptions," 179–210; D'agostini, "Chartering."

52 Joanne McVeigh., Malcolm MacLachlan, M. "A silver wave? Filipino shipmates' experience of merchant seafaring," *Marine Policy* 99 (2019): 283–297, accessed 12.11.2024, DOI: 10.1016/j.marpol.2018.10.012; Pauksztat, "The impact."

transport in planning a reverse logistics system based on the example of Japan.[53] Only one of the studies in this group concerned the impact of disruptions resulting from the COVID-19 pandemic (Pauksztat et al.).[54] All of them either used primary data or developed a model based on a specific example, indicating the need for further refinement and verification.[55]

The study by Nguyen et al., which was qualified for full-text analysis but was not described in section 3 due to its scope, is the first systematic literature review of studies on managing disruption in maritime transportation.[56] The authors used the scientific publications database Web of Science, from which they downloaded studies published in 2006–2021 on 3 June 2021. The justification for taking up the topic was similar to that adopted by the Authors – an increase in disruptions in maritime transport resulting from, among others, the COVID-19 pandemic. Nevertheless, the thematic scope, although it included "resilience" in its second research question, focused more on disruption management or mitigation strategies for disruptions. Among the identified research gaps, Nguyen et al. indicated 1) a large share of theoretical, mathematical and model solutions that can be used to improve the management of disruptions in maritime transport and the lack of empirical verification of these proposed solutions, especially those that would take into account internal and external stakeholders, 2) the need to verify solutions for different types of actors that make up the maritime transport system and 3) conducting a systematic literature review using another database of scientific publications as a basis. A systematic literature review conducted by the Authors three years later using a different database of scientific publications (Scopus) indicated that the research gaps indicated by Nguyen et al.[57] were partially filled. For example, the issue of taking into account stakeholders appears, for example, in the studies by León-Mateos et al., Fedi et al., and Ayaz et al. create recommendations based on data on the resilience strategies used by Turkish container ports, just as Fedi et al. indicate the need for changes in maritime alliances based on data on port operations.[58] The gap in the verification of the proposed solutions according to the analysis carried out by the Authors still remains in force – in most cases, the verification was based on numerical experiments and not actual implementations and their subsequent evaluation. The Authors' study works quite well to fill the last of the research gaps indicated by Nguyen et al. – the need to conduct a review using a different database of scientific publications.[59]

53 Sugimura, "Designing"; Fjørtoft, "Assessing."

54 Pauksztat, et al., "The impact."

55 McVeigh, "A silver"; Pauksztat, et al., "The impact"; Sugimura, "Designing"; Fjørtoft, "Assessing."

56 Nguyen, "Managing," 170–190.

57 Ibidem.

58 León-Mateos, "Adapting"; Fedi, "COVID-19," 747–777; Ayaz, "Resilience," 806–834.

59 Nguyen, "Managing," 170–190.

Only two publications were repeated in both reviews regardless; one should bear in mind the differences in the timing of the retrieval of publications in the two cases and the different emphasis on the meaning of "resilience" in the search criteria used.[60]

The second systematic literature review considered, Lau et al., concerns publications on resilience in maritime transport published between 1997 and 2023 (publications downloaded on 20 March 2023) in the Web of Science Core Collection database.[61] This article is available in the scientific publication database Scopus but was not included in the Authors' review due to its failure to meet their accepted search criteria (including assigned disciplines and open access). In the case of this article, although the Lau et al., focused mainly on bibliometric analysis, some similarities to the results obtained by the Authors can be noted.[62] Firstly, despite the fact that due to the longer analysis period, included many more studies (735), they note, as did the Authors, a marked increase in interest in the issue of maritime transport resilience after 2019, which was attributed to the occurrence of the COVID-19 pandemic situation in 2020.[63] Also in terms of the keywords most frequently occurring among the analysed articles, there is agreement on "resilience" and "COVID-19" among those most frequently assigned to the articles. Lau et al.[64] divided the analysed studies into 6 thematic clusters, depending on the adopted point of view and research optics, and on this basis indicated the lack of studies that would comprehensively and systematically address the topic of resilience in maritime transport. The research trends identified by Lau et al.[65] included, among others, the resilience of ports and supply chains, the impact of climate change on the resilience of ports, and the resilience of port infrastructure – topics that were also present in the studies analysed by the Authors. Lau et al., among the suggestions for further research directions, indicated the use of methods other than bibliometric analysis or conducting a literature review from the point of view of specific fields, which could be useful in preparing recommendations for potential stakeholders.[66] With their study, the Authors partially filled this research gap by using a different method of analysis in their literature review and by narrowing the search criteria for scientific publications to the fields of "Economics, Econometrics and Finance" and "Business, Management and Accounting." Despite the similar scope of keywords used, only one study occurred both in the review by Lau et al. and the one conducted

60 Notteboom, "Disruptions," 179–210; Zhou et al., "Analytics."

61 Lau, "Maritime."

62 Ibidem.

63 Ibidem.

64 Ibidem.

65 Ibidem.

66 Ibidem.

by the Authors, and this is, as in the case of concurrence with the review by Nguyen et al., the study by Notteboom et al.[67] which indicates the validity of the literature review conducted by the Authors using a different database of scientific publications.

5. Conclusions

The maritime transportation is under constant pressure from internal (e.g. operational or organisational) and external (e.g. technical or legislative) conditions as well as hard-to-predict disruptive events influencing its effectiveness and overall resilience. An efficient, resilient, and more sustainable maritime sector is essential for both the smooth flow of global trade and the more local scale for the EU's commercial competitiveness.

The analyses of the studies on maritime transport resilience allowed achieving the adopted goal and answering the research questions. In recent years, especially after 2019, it was possible to observe an increase; there has been a clear increase in interest in maritime transport resilience, which was also noted in the study by Lau et al.[68] The increased interest in this topic was attributed by Lau et al. to the disruption resulting from the COVID-19 pandemic situation, which can be observed from 2020 onwards.[69] This is a conclusion with which the Authors, based on their analysis, are inclined to agree – almost half of the works subjected to in-depth analysis in this study concerned the impact of the COVID-19 pandemic on maritime transport and various actors operating within its ecosystem. The COVID-19 pandemic had a strong impact on the economies of countries and the global economy as a whole, earning it the title of a "black swan," i.e. an event that is unlikely to happen but has a major impact on reality.[70] Among other causes of disruption that may affect maritime transport resilience, climate change and induced weather phenomena and energy supply disruptions emerged – but these studies accounted for 1/5 among all those analysed. The COVID-19 pandemic, as a global disruption, forcing different entities to reevaluate and revisit their previous crisis management strategies, allowed a comparison to be made of the actions taken and strategies adopted between different actors – previous studies of resilience in maritime transport as pointed out by Nguyen et al. were usually concerned with individual actors. In the case of the COVID-19 pandemic, which was a disruption affecting multiple

67 Nguyen, "Managing," 170–190; Notteboom, "Disruptions," 179–210.

68 Lau, "Maritime."

69 Lau, "Maritime."

70 Maria Nicola, et al., "The socio-economic implications of the coronavirus pandemic (COVID-19): A review," *International journal of surgery* 78 (2020): 185–193, accessed 12.11.2024, DOI: 10.1016/j.ijsu.2020.04.018.

actors at the same time with varying intensity, allows for an unprecedented learning and benchmarking opportunity.[71] The possibility to compare the effects of actions implemented by these actors has a very high application value in relation to potential future disruptions.[72] Interestingly, attempts to compare the responses of entities to disruptions caused by the COVID-19 pandemic and the earlier international financial crisis of 2007/2008 seem to confirm the transferability of experience and the effectiveness of previously developed strategies for mitigating risks caused by various disruptions, all the more indicating the application value of these studies.[73]

Among the analysed studies, two main approaches to the subject of resilience can be identified: 1) an attempt to develop ways to ensure/increase it and 2) the development of tools to measure/predict the resilience of a given actor/actors/system. It is also important to point out that the resilience of a given actor may depend on the actions taken by other entities, directly or indirectly related to it, which indicates the need for a comprehensive analysis of the resilience of maritime transport as a system, which is also in line with the suggestion of further research indicated by Lau et al.[74] The present study is not without limitations - as in the case of two other literature reviews by Nguyen et al. and Lau et al. whose results the Authors cited for the discussion - the results obtained are dependent on the adopted search criteria.[75] Changing or extending the search criteria (other databases of scientific publications, different time frames, other keywords, narrowing down to other scientific fields or a specific type of actor within the maritime transport ecosystem). Also, repeating the study based on the same assumptions at a later stage may yield interesting results regarding the further evolution of maritime transport resilience research in the context of corporate behaviour in the post-pandemic period (e.g. strategy building, inclusion of different stakeholder groups to build resilience not only of the organizations but also of supply chains). Similarly, the application of other methods of analysis (e.g. using machine learning) could be an interesting direction for further consideration.

At the same time, it is worth mentioning that some of the implemented solutions, like digitalisation and implemented remotely controlled autonomous technology in modern ships can lead to new risks and disruptions (as e.g. an exponential increase in cyber-attacks around the world). The starting discussion on the cyber resilience of ships' information systems may become an interesting future research direction.[76]

71 Nguyen, "Managing," 170–190.

72 Ayaz, "Resilience," 806-834; Gracia, "Assessing," 806-834; D'agostini, "Chartering."

73 Notteboom, "Disruptions," 179–210; D'agostini, "Chartering."

74 Asadabadi, "Maritime"; Lee, "Optimal," 703–714; Lau, "Maritime."

75 Nguyen, "Managing," 170–190; Lau, "Maritime."

76 *Communication from the Commission*.

BIBLIOGRAPHY

Asadabadi, Ali, and Elise Miller-Hooks. "Maritime port network resiliency and reliability through co-opetition." *Transportation Research Part E: Logistics and Transportation Review* 137 (2020). Accessed 11.11.2024. DOI: 10.1016/j.tre.2020.101916.

Ayaz, İlke Sezin, Umur Bucak, Mahmut Mollaoğlu, and Soner Esmera. "Resilience Strategies of Ports against Covid-19 in Terms of Chaos Theory." *Marine Policy* 146 (2022). Accessed 11.11.2024. DOI: 10.1016/j.marpol.2022.105323.

Chrysafis, Konstantinos A., Georgia C. Papadopoulou, and Ioannis N. Theotokas. "Measuring financial performance through operating business efficiency in the global cruise industry: A fuzzy benchmarking study on the «big three»." *Tourism Management* 100 (2024). Accessed 11.11. 2024. DOI: 10.1016/j.tourman.2023.104830.

Communication from the Commission to the European Parliament, the Council, The European Economic and Social Committee and the Committee of the Regions: Maritime safety: at the heart of clean and modern shipping, 01.06.2023 (report No. COM/2023/268 final, prepared for the European Commission, Brussels: European Commission, 2023). Accessed 01.10.2024. https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=COM:2023:268:FIN.

Czakon, Wojciech, ed. *Podstawy metodologii badań w naukach o zarządzaniu.* Warszawa: Wolters Kluwer Polska: 2015.

D'agostini, Enrico, Sohyun Jo, and Maria Attard. "Chartering policies and operational efficiency of shipping lines: exploring strategic changes in response to the COVID-19 pandemic." *Journal of Shipping and Trade* 9 (2024), 1: 1–21. Accessed 11.11.2024. DOI: 10.1186/s41072-024-00169-w.

Druzhinin, Alexander G. "The geopolitical effect of the maritime factor on the spatial development of post-soviet Russia: the Baltic case." *Baltic Region* 15 (2023), 4: 6–2. Accessed 11.11.2024. DOI: 10.5922/2079-8555-2023-4-1c.

Fedi, Laurent, Oliver Faury, Patrick Rigot-Muller, and Nicolas Montier. "COVID-19 as a catalyst of a new container port hierarchy in Mediterranean Sea and Northern Range." *Maritime Economics and Logistics* 24 (2022), 4: 747–777. Accessed 11.11.2024. DOI: 10.1057/s41278-022-00223-z.

Fisher, Len. "More than 70 ways to show resilience." *Nature* 518 (2015): 35. Accessed 11.11.2024. DOI: 10.1038/518035a.

Fjørtoft, Kay, Seyed Parsa Parvasi, Dag Atle Nesheim, Lars Andreas Lien Wennerberg, Odd Erik Mørkrid, and Harilaos N. Psaraftis. "Assessing the resilience of sustainable autonomous shipping: New methodology, challenges, opportunities." *Cleaner Logistics and Supply Chain* 9 (2023), 1–15. Accessed 12.11.2024. DOI: 10.1016/j.clscn.2023.100126.

Gracia, Maria D., Rosa G. González-Ramírez, Luis M. Ascencio and Julio Mar-Ortiz. "Assessing the implementation of governance best practices by Latin American ports." *Maritime Economics and Logistics* 24 (2022), 4: 806–834. Accessed 11.11. 2024. DOI: 10.1057/s41278-022-00224-y.

Kuhla, Kilian, Sven Willner, Christian Otto, and Anders Levermann. "Resilience of international trade to typhoon-related supply disruptions." *Journal of Economic Dynamics and Control* 151 (2023). Accessed 11.11.2024. DOI: 10.1016/j.jedc.2023.104663.

Lau, Yui-Yip, Qiong Chen, Ching Pong Poo, Adolf K. Y. Ng, and Chung ChuiYing. "Maritime transport resilience: A systematic literature review on the current state of the art, research agenda and future research directions." *Ocean & Coastal Management* 251 (2024): 107086. Accessed 11.11.2024. DOI: 10.1016/j.ocecoaman.2024.107086

Lee, Chung-Yee, Shengnan Shu, and Shengnan ShuZhou Xu. "Optimal Global Liner Service Procurement by Utilizing Liner Service Schedules." *Production and Operations Management* 30 (2020) 3: 703–714. Accessed 11.11.2024. DOI: 10.1111/poms.13311.

León-Mateos, Fernando, Antonio Sartal, Lucas López-Manuel, and María A. Quintás. "Adapting our sea ports to the challenges of climate change: Development and validation of a Port Resilience Index." *Marine Policy* 30 (2021) 4. Accessed 11.11.2024. DOI: 10.1016/j.marpol.2021.104573.

Li, Wenjie, Ali Asadabadi, and Elise Miller-Hooks. "Enhancing resilience through port coalitions in maritime freight networks." *Transportation Research Part A: Policy and Practice* 157 (2023): 1–23. Accessed 11.11.2024, DOI: 10.1016/j.tra.2022.01.015.

McVeigh, Joanne, and Malcolm MacLachlan. "A silver wave? Filipino shipmates' experience of merchant seafaring." *Marine Policy* 99 (2019): 283–297. Accessed 12.11.2024. DOI: 10.1016/j.marpol.2018.10.012.

Nguyen Thanh-Thuy, Dung Tran, Truong Ton Hien Duc, and Vinh V Thai. "Managing disruptions in the maritime industry–a systematic literature review." *Maritime business review* 8 (2023), 2: 170–190. Accessed 10.112024. DOI: 10.1108/MABR-09-2021-0072.

Nicola, Maria, Zaid Alsafi, Catrin Sohrabi, Ahmed Kerwan, Ahmed Al-Jabir, Christos Iosifidis, Maliha Agha, and Riaz Agha. "The socio-economic implications of the coronavirus pandemic (COVID-19) A review." *International journal of surgery* 78 (2020): 185–193. Accessed 11.11.2024. DOI: 10.1016/j.ijsu.2020.04.018.

Notteboom, Theo, Athanasios A. Pallis, and Jean-Paul Rodrigue. "Disruptions and resilience in global container shipping and ports: the COVID-19 pandemic versus the 2008–2009 financial crisis." *Maritime Economics and Logistics* 23 (2021), 22: 179–210. Accessed 11.11.2024. DOI: 10.1057/s41278-020-00180-5.

Nsikan, John, Rawlings Micheal, Mercy Ejovwokeoghene isiavwe- Ogbari, Ariyo Adebukola, Ine Fubara Briggs, and Daniel Osemudiamen Inegbedion. "Robust practices for managing maritime supply chain risks: A survey of Nigeria's seaports." *Asian Journal of Shipping and Logistics* 39 (2023), 4: 1–7. Accessed 11.11.2024. DOI: 10.1016/j.ajsl.2023.09.001.

Nuttall, Peter, Alison Newell, Isabelle Rojon, B. Milligan, and Andrew Irvin. "Pacific Island domestic shipping emissions abatement measures and technology transition pathways for selected ship types." *Marine Policy* 132 (2021). Accessed 11.11.2024. DOI: 10.1016/j.marpol.2021.104704.

Papadakis, Manos – Nikolaos, Evangelia Kopanaki. "Innovative Maritime Operations Management Using Blockchain Technology & Standardization." *Journal of ICT Standardization* 10 (2022) 4: 469–508. Accessed 11.11.2024. DOI: 10.13052/jicts2245-800X.1041.

Pauksztat, Birgit, Michelle R Grech, and Momoko Kitada. "The impact of the COVID-19 pandemic on seafarers' mental health and chronic fatigue: Beneficial effects of onboard peer support, external support and Internet access." *Marine Policy* 137 (2022). Accessed 11.11.2024. DOI: 10.1016/j.marpol.2021.104942.

Rethinking development in the age of discontent. Trade and Development Report. Geneva: United Nations, 2024. Accessed 10.11.2024. https://unctad.org/system/files/official-document/tdr2024_en.pdf.

Review of maritime transport 2024: Navigating maritime chokepoints. Overview. Geneva: United Nations, 2024. Accessed 25.04.2025. https://unctad.org/system/files/official-document/rmt2024overview_en.pdf.

Rogerson, Sara. "Comparing flexibility-based measures during different disruptions: evidence from maritime supply chains." *International Journal of Physical Distribution and Logistics Management* 54 (2024), 2: 163–191. Accessed 11.11.2024. DOI: 10.1108/IJPDLM-02-2023-0075.

Sugimura, Yoshihisa, and Shinsuke Murakami. "Designing a resilient international reverse logistics network for material cycles: a Japanese case study." *Resources, Conservation and Recycling* 170. Accessed 12.11.2024. DOI: 10.1016/j.resconrec.2021.105603.

The Britannica Dictionary. *Resilience*. Britannica.com. Accessed 10.11.2024. https://Www.Britannica.Com/Dictionary/Resilience.

Wan, Chengpeng. "Evaluating recovery strategies for the disruptions in liner shipping networks: a resilience approach." *International Journal of Logistics Management* 33 (2022) 2: 389–409. Accessed 11.11.2024. DOI: 10.1108/IJLM-05-2021-0263.

Yue, Zhongyun, and John Mangan. "A framework for understanding reliability in container shipping networks: *Maritime Economics and Logistics* 26 (2024), 3: 523–544. Accessed 11.11.2024. DOI: 10.1057/s41278-023-00269-7.

Zhou, Chenhao, Jie Xu, Elise Miller-Hooks, Weiwen Zhou, Chun-Hung Chen, Loo Hay Lee, Ek Peng Chew, and Haobin Li. "Analytics with digital-twinning: A decision support system for maintaining a resilient port." *Decision Support Systems* 143 (2021): 7. Accessed 11.11.2024. DOI: 10.1016/j.dss.2021.113496.

English Version: Mark Atkinson

SUMMARY

In recent years, especially after 2019, there has been a clear increase in interest in maritime transport resilience, so the main objective of this article is to examine and add to the state of the art of research on the maritime transport resilience in an increasingly uncertain

environment. Through a systematic literature review (SLR), this study comprehensively examines the relevant literature on resilience and maritime transport resilience. For bibliometric analysis, 327 articles from the 2019-2024 period on the topic of resilience in the maritime transport were selected from the Scopus database. Selected texts were subjected to full-text analysis, for which the Authors used the narrative review method and the meta-analysis method. Analysed texts were divided into three subgroups based on the dominant subject of the study i.e.: (1) ports, (2) issues related to shipping lines, shipping network and their impact on other maritime actors, and (3) those dealing with various issues related to the resilience of maritime transport, such as employees or the implementation of modern technologies. The Authors have indicated causes of disruption that may affect maritime transport resilience i.e.: COVID-19, climate change and induced weather phenomena, and energy supply disruptions. The Authors indicated the need for a comprehensive analysis of the resilience of the maritime transport as a system.

Odporność transportu morskiego – zmapowane morza czy nieznane terytorium?

Słowa kluczowe: odporność, transport morski, systematyczny przegląd literatury, COVID-19

STRESZCZENIE

W ostatnich latach, zwłaszcza po 2019 r., nastąpił wyraźny wzrost zainteresowania odpornością transportu morskiego, dlatego głównym celem tego artykułu jest zbadanie i uzupełnienie stanu wiedzy na temat odporności transportu morskiego w coraz bardziej niepewnym otoczeniu. Poprzez systematyczny przegląd literatury (SLR) niniejsze badanie kompleksowo analizuje odpowiednią literaturę na temat odporności i odporności transportu morskiego. Do analizy bibliometrycznej wybrano 327 artykułów z okresu 2019-2024 na temat odporności w transporcie morskim z bazy danych Scopus. Wybrane teksty poddano analizie pełnotekstowej, w której Autorzy zastosowali metodę przeglądu narracyjnego i metodę metaanalizy. Analizowane teksty podzielono na trzy podgrupy w oparciu o dominujący przedmiot badania, tj.: (1) porty, (2) kwestie związane z liniami żeglugowymi, siecią żeglugową i ich wpływem na innych aktorów morskich oraz (3) te, które zajmują się różnymi kwestiami związanymi z odpornością transportu morskiego, takimi jak pracownicy lub wdrażanie nowoczesnych technologii. Autorzy wskazali przyczyny zakłóceń, które mogą mieć wpływ na odporność transportu morskiego, tj.: COVID-19, zmiany klimatu i wywołane nimi zjawiska pogodowe oraz zakłócenia w dostawach energii. Autorzy wskazali potrzebę kompleksowej analizy odporności transportu morskiego jako systemu.

Citation

Kos-Łabędowicz, Joanna, Zwolińska, Danuta, Drab-Kurowska, Anna. "Maritime Transport Resilience – Charted Seas or Unknown Territory?." *Studia Maritima* 38 (2025): 235–261. DOI: 10.18276/sm.2025.38-10.