Analyzing Sustainability Literature in Maritime Studies with Text Mining

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Abstract: Since the world's first Earth Summit in Rio de Janeiro in 1992, sustainability has become a focal point of significant debate for industry, government, and international organizations. As a result, research on sustainability of maritime logistics is on the rise, yet fragmented in terms of conceptual development, empirical testing and validation, and theory building. The aim of this paper is therefore two-fold: the first aim is to present a literature review of key journal articles in the field of maritime studies published between 1993 and 2017 using a technique of topic modelling; and the second is to provide future research directions with respect to major topics, themes and co-authorship patterns. Mapping and consolidation of sustainability issues are achieved by conducting a generative probabilistic text-mining technique, called latent Dirichlet allocation (LDA), for latent data discovery and relationships among text document data. Moreover, bibliometric analysis is conducted to visualize the landscape of sustainability research. Based on the results, a new intellectual structure of sustainability research is created, the underlying themes are identified, key trends and patterns are extracted and future research development trajectories are mapped for the field of maritime studies.

Keywords: sustainability; maritime studies; topic modeling; Latent Dirichlet Allocation; LDA; research trend

1. Introduction

The new paradigm of development that combines growth with sustainability is theoretically challenging, yet desirable to attain a sustainable future. In September 1997, the International Maritime Organization (IMO) adopted an International Convention Protocol to achieve "sustainable maritime development" [1], which is aligned to the notion of "sustainable development" that "meets the needs of the present without compromising the ability of future generations to meet their own needs" [2]. Sustainability necessitates all three dimensions—environmental, economic, and social—to be considered in business development. The environmental dimension requires a reduction in environmental impacts, while the economic dimension concerns minimization of costs or business continuity. The social dimension relates to community well-being, including the provisions of human rights, better working conditions and improved labor regulations [3]. Sustainability has three main objectives: minimize economic costs, mitigate negative environmental impacts, including air and water pollution, and enhance social justice, protect human rights and improve working conditions for labor.

In recent decades, the issue of sustainability has been taken seriously by the maritime industry through implementing policies and strategies to reduce shipping miles, promoting

environment-friendly technology to reduce carbon emission and energy consumption, and ensuring compliance with labor laws [3]. There are now additional costs and penalties for non-compliance and unsustainable practices for companies in the shipping industry [4–7]. Environmental costs in shipping, which include damage due to vessel exhaust pollution and external air pollution, are reduced by sustainable operations and fuel-efficient management practices [7–10]. Sustainable maritime development has subsequently become a management framework for benchmarking maritime business practices, logistics operations and procedures [11]. The maritime industry, including ports, shipping and logistics, has begun to embrace environmental guidelines and regulations to reduce environmental impacts and carbon emissions. Pressures related to sustainability have also driven significant changes for markets, business practices of enterprises, and government policies and regulations. In particular, sustainability issues have become a vital element of maritime logistics; these include greening of ports [12], zero carbon shipping and reducing emissions from vessels [13,14], climate change mitigation and adaptation [15], ship speed optimization for reducing emissions [16–21], climate risk assessment [22], use of renewable/sustainable energy—including LNG—as an alternative marine fuel [23–25], and regulations including MARPOL (a treaty to prevent maritime pollution) [26–28]. However, these frameworks, methodologies and practices are not well documented in a coherent and systematic manner. The research interest in sustainability has significantly grown. Mansouri et al. [29] have conducted a comprehensive review of sustainability focusing on environmental concerns in maritime shipping, highlighting the need for real-time data monitoring of ports and vessels' conditions. Sislian et al. [30] found that most ports widely apply sustainable principles to operate maritime operations in their review of sustainability of port systems and ocean carrier networks. Davarzani et al. [31] applied bibliometric and network analysis tools to review greening ports and maritime logistics to identify key themes and research trends. Notwithstanding this work, the extant literature on maritime sustainability requires theoretical consolidation to provide clarity, and to resolve conflicting views on sustainability for maritime operations and businesses. It is therefore important to conduct a comprehensive review of previous studies, identify key topical themes, and set out new research directions. Given the limited cognitive capacity of humans to handle and process large amounts of data, there is a strong need to deploy more sophisticated computing power and algorithms to text mine large databases to extract latent thematic patterns, clustering of ideas/concepts, and trends in sustainability research over time.

Although topic modeling is widely used in many studies to analyze various types of text data and multiple fields, including for journals [32,33], newspapers [34], and reports [35], its application to maritime studies is rather limited. Typical applications of topic modeling include statistics [36], aviation [35], hydropower [37], transportation [38], personal information privacy [39], marketing [32], and health [33]. There are a few recent studies [38,39] that have employed topic modeling to analyze key characters used in academic papers and to then generate a group of words ("corpus" hereafter) that collectively represents the core subjects. An inference and parameter estimation algorithm is used to extract the latent structures and patterns in the text documents by identifying the most common topics. This technique is similar to a dimension reduction technique, such as factor or principal component analysis, that enables extracting the underlying factors from a large volume of data variables [40]. The basic concept of topic modeling is that a single document is linked to various topics, which could contain many words. Topics can be shown in many documents at the same time [35]. Hence, "documents blend multiple topics" [36].

Despite a few attempts, there is limited knowledge on the scope and scale of sustainability literature across the wider maritime industry, including shipping, port, and maritime logistics businesses. In addition, there is limited attempt to apply computational tools to data mine textual information embedded in journal databases. Furthermore, there is a lack of understanding on what sustainability means for maritime studies, with inconsistencies and conflicting views on the use of various concepts, models and measurements. Identification of key words and clusters based on a

similarity/dissimilarity matrix would help formalize a framework to reflect the meaning, scope and application of the concept of sustainability in the maritime studies.

This paper primarily aims to identify key concepts and terms applied to denote the notion of maritime sustainability. This study employs topic modeling techniques, such as latent Dirichlet allocation (LDA) and other computational approaches, to extract and visualize the underlying thematic groupings, trends and patterns in sustainability research in the field of maritime studies. We analyze 155 research papers published in peer-reviewed journals since 1993, text mining this research for relevance to maritime sustainability.

The rest of the paper is structured as follows. The next section describes the data utilized. Section 3 presents the methods employed to identify specific patterns and trends in textual data. Findings and results are presented in Section 4. Finally, Section 5 concludes this study by highlighting research limitations, implications and future research.

2. Data Sets Used

2.1. Data Collection

Maritime-related journals were first selected from the area of transportation, logistics, shipping, and port-related journals listed on the science citation index (SCI), science citation index expanded (SCIE) and social science citation index (SSCI). The search for these areas was carried out in the Web of Science and Scopus database (two databases were selected for cross-checking). Maritime related-papers which contain the word "port" or "ports" or "seaport" or "seaports" or "container terminal" or "container terminals" or "container port" or "container ports" or "shipping" or "sea transport" in the title or keywords or abstracts within "sustainability" or "sustainable" related-papers were identified. This search covered the 25-year period from 1993 until 2017, and resulted in 155 papers, which were published in 48 peer-reviewed academic journals, excluding book chapters, editorials, papers on conference proceedings, and working papers (Appendix A Table A1).

Table 1 shows the significant increase in the number of papers since 2012 on sustainability in the field of maritime studies, as illustrated in Figure 1. Our analysis shows that the term "sustainability" was first used by Brooks, (1993) in maritime studies, which was considered to be a "competitive advantage" for ocean container carriers. Most of these papers were related to seaport-related topics, followed by shipping. A small proportion of these related to maritime logistics.

Table 1. Literature survey results.

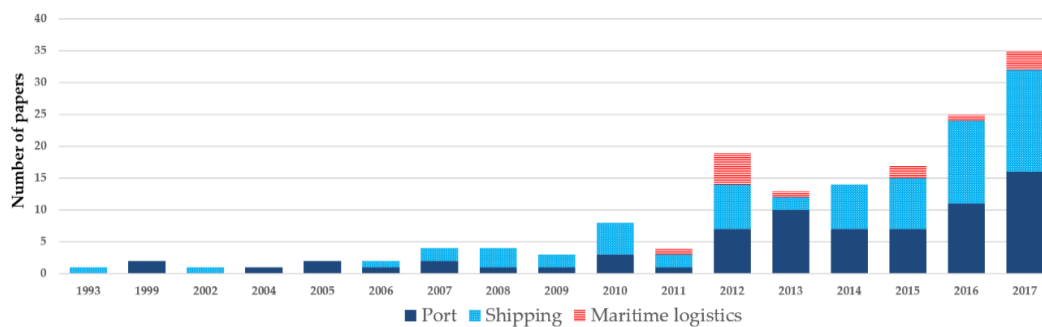|	1990s			2000s									2010s					Total
	93	99	02	04	05	06	07	08	09	10	11	12	13	14	15	16	17	
Port issue in sustainability		2		1	2	1	2	1	1	3	1	7	10	7	7	11	16	**72**
Shipping issue in sustainability	1		1			1	2	3	2	5	2	7	2	7	8	13	16	**70**
Maritime logistics issue in sustainability											1	5	1		2	1	3	**13**
Total	1	2	1	1	2	2	4	4	3	8	4	19	13	14	17	25	35	155

Figure 1. Number of papers over time.

2.2. Pre-Processing

The input data format for building topic models is a document-terms matrix (DTM), which consists of rows corresponding to the documents (papers) and columns that correspond to the terms (words found in each paper's title, abstract, and keywords), as shown in Figure 2.
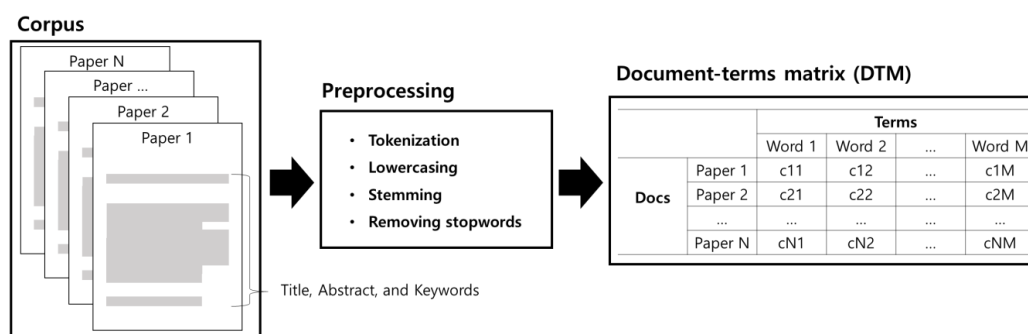

Figure 2. An example of a document-terms matrix (DTM).

To generate the document-term matrix, raw textual data need to be preprocessed [41] by following a number of preparatory steps. These include converting tokenized terms (words), lowercasing, stemming, and removing "stopwords".

First, the corpus, which is the full text of documents, represents papers. The corpus must be tokenized into a smaller bag of words (word tokenization) by splitting a text and making word tokens. The second step, lowercasing, prevents a word with different capitalization from being mistaken for two different words. Third, stemming terms is conducted to remove pluralization or other suffixes and to normalize different tenses and variations of the same word (i.e., /select-/: select, selects, selection, selecting, selected). Special terms, such as "study", "analysis", and "research", which are often used in abstracts, are also omitted. Lowercasing and stemming make words into a simpler and more uniform form for text mining. Last is removal of stop words (such as, "and", "but", and "or"); such words do not contain information that is needed for analysis. Because these unnecessary words can impair the accuracy of topic modeling calculations, a predefined "stopwords" list is created and these words are deleted [41]. Additional preprocessing steps involve removing numbers, punctuation characters, and white space. Furthermore, some terms that have limited discriminatory value in the corpus dataset are excluded; for example, terms such as "model", "management", and "strategy". These types of words make the output harder to interpret, as these terms are featured in almost all topics.

2.3. Formation of the Document Terms Matrix

The generation of the DTM is the most basic task in all forms of text mining, including topic modeling. The topic modeling approach relies on the "bag-of-words" format, which describes the text that represents the occurrence of terms (words) within a paper (document). A row in the DTM represents a document (N = 155 in Figure 2), and a column represents a term (M = 576 in Figure 2).

Before applying LDA, a document-term matrix (DTM) should be established due to the fact that the DTM format is required for the processing of topic modeling. Each cell in the DTM matrix indicates how often each term occurs in each document. The calculated DTM can be expressed via matrix algebra so that data can be analyzed by representing text as computer-readable numbers.

The DTM is not only used for generating the word cloud (Appendix A, Figure A1) that provides a graphical representation of word frequency in a source text, but also generates a dendrogram (Appendix A, Figure A2) that reflects hierarchical clustering and classification of words. However, these two figures do not provide enough information for determining the intellectual structure of sustainability literature. On the other hand, topic modeling provides a convenient way to summarize and understand large unclassified texts by discovering hidden themes and topical patterns in the archives of such texts. Moreover, the topic modeling employed in this study provides a useful tool in analyzing collections of textual information by using an algorithmic solution.

In the following sections, this paper discusses a topic modeling approach based on the DTM, using an analytical technique based on Bayesian statistics, to provide a way to categorize the corpus into a set of "topics" that contains meaningful words.

3. Method: Topic Modeling

Topic modeling belongs to the field of unsupervised machine learning [41], which uses algorithms to identify specific patterns of text, unlike supervised machine learning, which requires coding rules and data training. Topic modeling algorithms with statistical methods analyze words from documents to discover the topics contained in them.

Topic modeling automatically categorizes documents according to their underlying theme structures [42]. LDA is the most straightforward probabilistic topic approach to document modeling [36,42].

Figure 3 presents the concept behind the LDA model (Blei, [43] and Kuhn, [35]). K represents the number of topics. K can be determined by researchers based on practical experience rather than scientific evidence. However, this study uses a statistical method for determining the value of K, following the suggestions of Newton and Raftery [44] and Griffiths and Steyvers [45]. It is noted that each topic consists of specific words by Dirichlet distributions and the topic model algorithm from a DTM. The suggestion for determining K, referring to a harmonic mean, allows the discovery of the optimal number of topics, as well as measuring the goodness-of-fit in the modeling. By using the calculation of the harmonic mean, which is one of the maximal log-likelihood methods, the optimum number of topics (K) can be ascertained, as shown in the Appendix A, Figure A3. In the case of ports, the value of K was determined to be 10; for shipping and maritime logistics, values were 14 and 9, respectively. In the case of papers on ports, the optimal number of topics using the harmonic means method was 21 when the value of the maximum log-likelihoods is observed (Appendix A, Figure A3). However, too many topics generate noise from undesirable or unwanted topic groups in the text data, because similar topic groups should be separated to create a larger number of topics. Thus, we selected a value ($K = 10$) where the slope of the line in the maximum log-likelihood graph begins to flatten. Moreover, k and K represent different quantities: K stands for the specified number of topics, k indicates the auxiliary index over topics.
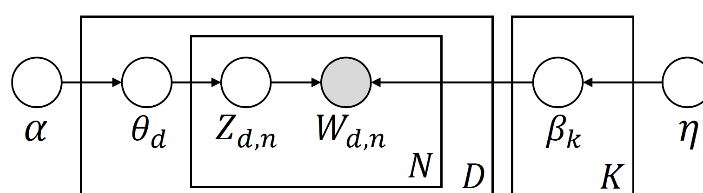

Figure 3. Latent Dirichlet allocation (LDA) model (Blei, [43] and Kuhn, [35]).

α represents the Dirichlet parameter, indicating the parameter for determining θ_d. The topic distribution per paper in topic modeling is represented by the Dirichlet distribution, which is given by the Dirichlet parameter α ($\alpha > 0$). α is generally set as $\alpha = 50/K$, as suggested by Griffiths and Steyvers [45]. Thus, the parameter α is applied with different values depending on K (i.e., in the case of ports, α should be 5, when the parameter K is 10). d represents individual documents. In the case of ports, d has 72 documents (papers) concerning sustainability. The number of shipping papers concerning sustainability is 70, and maritime logistics has 13 papers concerning sustainability. In other words, θ_d is a random variable from α, indicating the topic proportions for the individual dth document. As shown in Figure 3, the value α determines topic proportions, θ_d, as shown in Figure 3. The relationship between θ_d and α can be shown as follows:

$$\theta_d \sim \text{Dirichlet}(\alpha)$$

Then, Z_d is determined by θ_d, indicating the topic assignments for the dth document. Thus, $Z_{d,n}$ shows the topic assignment for the nth word (n depends on each document) in each document, d. η is the parameter for determining β_k. While θ_d represents topic proportions, each β_k represents the word (term) distributions. The relationship between β_k and η can also be shown as follows, in that the value η determines topic proportions β_k. The value η is assumed to be 0.1, as suggested by Griffiths and Steyvers [45].

$$\beta_k \sim \text{Dirichlet}(\eta)$$

For each topic being indexed by k, β_k is the model parameter, indicating word proportions within the topic. Therefore, $W_{d,n}$ is the observed variable in the document from the multinomial distribution ($p(W_{d,n}|Z_{d,n}, \beta_k)$), indicating the nth word of document d.

This study conducts topic modeling using R statistical software version 3.4.4 (R Development Core Team, Vienna, Austria) ("R is available as Free Software under the terms of the Free Software Foundation's GNU General Public License", R software website (www.r-project.org)), which provides attractive environments for computational methods of data science [41]. The next section presents the results from the R software using the *topicmodels* package.

4. Results and Analysis

4.1. Topics on Port Issues in Sustainability

In Table 2, 10 major topics ordered by the highly distributed terms (words) in each paper, and the corresponding top five terms for each topic, are listed and visualized.

Table 2. 10 topics in sustainability of port study.

Topic #1	Topic #2	Topic #3	Topic #4	Topic #5
/green-/	/envirntl-/	/emiss-/	/perform-/	/process-/
/region-/	/industri-	/polici-/	/econom-/	/citi-/
/effect-/	/framework-/	/pollut-/	/evalu-/	/urban-/
/strateg-/	/environ-	/cost-/	/critic-/	/locat-/
/integr-/	/institut-/	/truck-/	/intern-/	/plan-/
Topic #6	**Topic #7**	**Topic #8**	**Topic #9**	**Topic #10**
/chain-/	/network-/	/improv-/	/activ-/	/decis-/
/suppli-/	/industri-/	/logist-/	/reduc-/	/factor-/
/compet-/	/social-/	/innov-/	/energi-/	/green-/
/collabor-/	/trade-/	/chang-/	/strateg-/	/influenc-/
/import-/	/design-/	/govern-/	/prtsystem-/	/project-/

The right panel in Table 2 presents a broader view of the topic model. The size of circles represents the distance between each topic in two-dimensional space. Based on the researchers' prior knowledge, each topic name can be defined and extracted by manual examination. Many studies related to harbors and ports deal with the following topics: green ports [46–49], green performance [50], greening of ports [31,51], green port policy [52], employees' green behaviors in the port [11], and green concerns [53]. Topic #3 deals with the issue of emission, policy, pollutants, and cost; for example, emissions in ports [10,54,55], the environmental costs of port related emissions [56], carbon emission evaluation [57], Emission Control Areas (ECA) [58,59], and emission tax policy [10]. As Sislian et al. [30] indicate, sustainable development in ports usually focuses on environmental issues. Topics #2, #5, and #7 indicate environmental issues in industry and port cities, such as the sustainable development of port cities/areas [60], environmental reform [49], environmental performance [61], environmental sustainability in seaports [46,62], environmental management systems [63], environmental risk perceptions [64], environmental management [65], and environmental efficiency [66].

4.2. Topics on Shipping Issues in Sustainability

Since the value of the harmonic mean was stable around 14, the optimal number of topics is determined to be 14 as shown in Table 3.

Table 3. 14 topics in sustainability of shipping study.

Topic #1	Topic #2	Topic #3	Topic #4	Topic #5
/green-/	/ship-/	/freight-/	/improv-/	/estim-/
/industri-/	/compet-/	/perform-/	/chain-/	/plan-/
/econom-/	/intern-/	/decis-/	/road-/	/urban-/
/collabor-/	/pollut-/	/criteria-/	/compar-/	/citi-/
/strateg-/	/factor-/	/fuzzi-/	/project-/	/state-/

Topic #6	Topic #7	Topic #8	Topic #9	Topic #10
/emiss-/	/envirntl-/	/servic-/	/energi-/	/optim-/
/reduc-/	/intermod-/	/activ-/	/compani-/	/cost-/
/benefit-/	/shipper-/	/sector-/	/resourc-/	/network-/
/csma-/	/reduc-/	/govern-/	/influenc-/	/regul-/
/air-/	/truck-/	/climat-/	/applic-/	/empti-/

Topic #11	Topic #12	Topic #13	Topic #14	
/region-/	/technolog-/	/rout-/	/corridor-/	
/cost-/	/econom-/	/effici-/	/motorway-/	
/govern-/	/control-/	/time-/	/import-/	
/process-/	/liner-/	/custom-/	/rail-/	
/environ-/	/effect-/	/polici-/	/extern-/	

Topic #1 (green, industry, economy, collaboration) related to shipping sustainability can be explained by the titles shipping industry and economy for green shipping. Many papers have the issue of "green shipping" as a topic [67–71]. Topics #6 and #7 are close to the others, which means it represents one common issue: emissions and environment issues for shipping sustainability, including ship emissions [72–76], truck and intermodal emissions [77], emission regulation and policy [1,10,78,79], and emission calculation [80]. Topics #9, #10, #11, and #13 indicate the external costs, energy, and efficiency issues in sustainability for shipping companies by optimizing their transportation routes and networks: shipping networks to minimize external cost [71], alternative sources and renewable energy [81,82], energy efficiency [83] in shipping, and fleet deployment for sustainable collaborative transportation [4]. Topics #2 and #5 are close to the others, indicating the impact of vessels' pollution on land, such as port-city [1,77] and emission of inland shipping [80].

4.3. Topics on Maritime Logistics Issue in Sustainability

Using the same method, nine was the optimal number of topics ascertained for maritime logistics issues, as shown in Table 4.

Table 4. 9 topics in sustainability of maritime logistics study.

Topic #1	Topic #2	Topic #3	Topic #4	Topic #5
/logist-/	/region-/	/cost-/	/chain-/	/green-/
/improv-/	/custom-/	/qualiti-/	/suppli-/	/integr-/
/envirntl-/	/effect-/	/distribut-/	/qualiti-/	/energi-/
/hinterland-/	/effici-/	/product-/	/perform-/	/intern-/
/econom-/	/social-/	/rout-/	/influenc-/	/program-/
Topic #6	**Topic #7**	**Topic #8**	**Topic #9**	
/extern-/	/servic-/	/design-/	/compani-/	
/polici-/	/compet-/	/chang-/	/strateg-/	
/import-/	/network-/	/structur-/	/growth-/	
/rail-/	/empti-/	/intertid-/	/framework-/	
/scale-/	/process-/	/emerg-/	/resourc-/	

Topic #1 (logistics, improvement, environmental) can be explained by the title: the logistics system and flow for improving sustainable maritime logistics [6,57,84]. Topics #3 and #4 have the same core word, "quality", indicating quality management in supply chains [85] and service quality analysis for logistics companies [86]. For the methodology, quality function deployment (QFD) was employed for analysis of sustainable maritime supply chain. Topics #8 and #9 located in quadrant IV (sustainable supply chain design and strategy) can be explained by supply chain design for the sustainability of maritime logistics [87–89].

4.4. Supportive Analysis

4.4.1. Co-Occurrence Analysis

Key hotspots of high-frequency keywords are identified by co-occurrence analysis [90]. Bibliometric methods were employed to investigate the hotspots with keywords given by the author(s). There were 18 high-frequency keywords (occurrence above 5) detected within the collected 155 papers during the period 1993–2017, which were related to maritime sustainability. The term "management" (except for "sustainability") had the highest number of occurrences, followed by "port", "emission", "impact", and "performance". "Impact", and "emission" are the most significant nodes, which form the basis for other terms to be linked to maritime sustainability, as shown in Table 5.

Table 5. Frequency of keywords (above 3 occurrences).

No.	Count	Keywords	No.	Count	Keywords
1	22	sustainability	17	5	cost
2	21	management	18	5	operation
3	18	port	19	4	indicator
4	17	emission	20	4	carbon emission
5	14	impact	21	4	city
6	14	performance	22	4	inventory
7	9	model	23	4	policy
8	9	logistics	24	4	co2 emission
9	8	system	25	4	governance
10	8	framework	26	3	harbor
11	7	environmental management	27	3	environmental sustainability
12	7	transport	28	3	dry port
13	6	seaport	29	3	container transport
14	6	shipping	30	3	corporate social responsibility
15	5	supply chain management	31	3	sea
16	5	perspective	32	3	container terminal

Figure 4 provides the network for keyword co-occurrence (above 5 times) in maritime sustainability papers with the same results as shown in Table 5. The thickness of the line surrounding the circle indicates their betweenness centrality [91] (p. 311). The term "port" shows the highest betweenness centrality among other keywords, although the number of connectivity is four. In other words, this keyword, "port", has a low degree of connection but high betweenness centrality. This result can be interpreted as meaning that the connections of "port" are linking different keywords together, having an influence across the whole network, even though "port" has fewer connections. Regarding authors' keywords, many papers regarding sustainability research in maritime topics have used such keywords, including emissions, management, impact, and performance.

Figure 4. Keyword network for co-occurrence of maritime sustainability papers.

Figure 5 represents a timeline view of the co-occurrence network wherein each line shows a cluster. The purple rim of the circle in Figure 5 (as in Figure 4) indicates a high degree of connectivity in the network, while the yellow rim of the circle indicates a low degree of connectivity. The size of the circles indicates the number of papers.
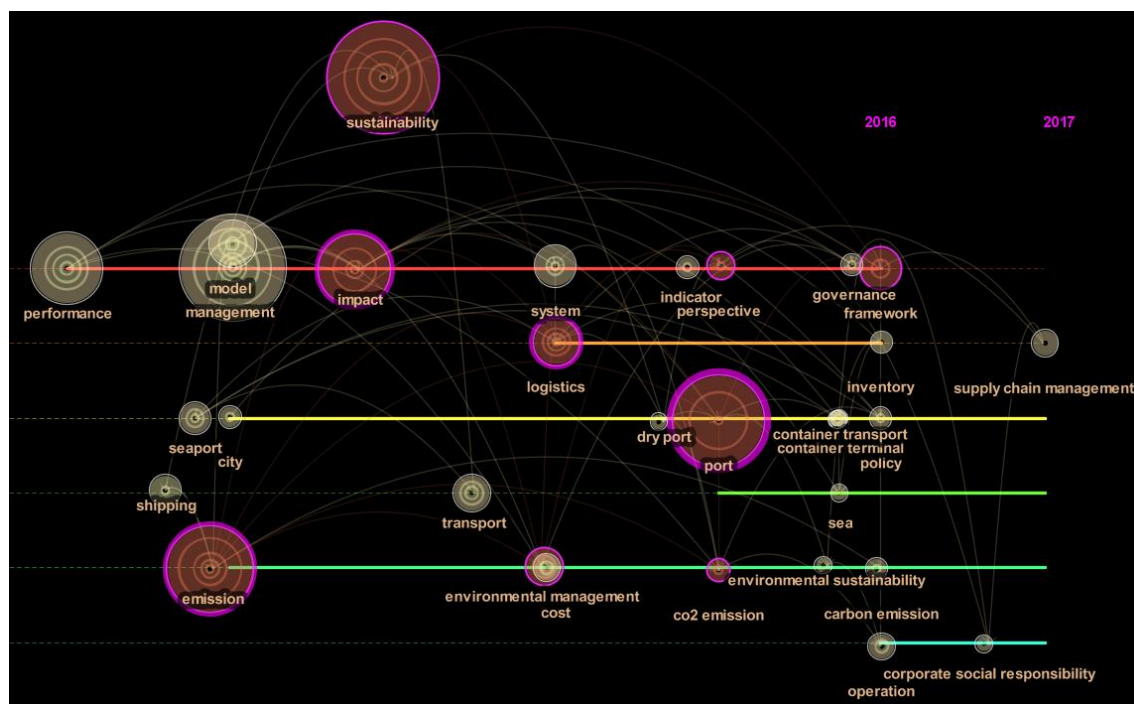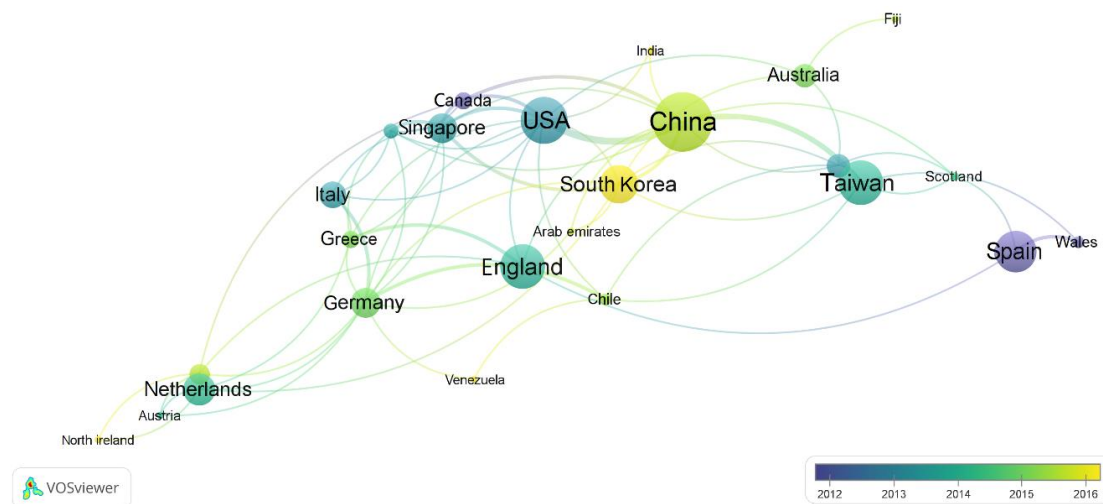
Figure 5. Network for co-occurrence of maritime sustainability papers over the time. Each line stands for clustering as follows: (i) red line: management, impact, and governance; (ii) orange line: logistics and supply chain management; (iii) yellow line: seaport and container terminal; (iv) green line: sea transportation; (v) turquoise line: emission and environmental issue; vi) blue line: operation issue including corporate social responsibility.
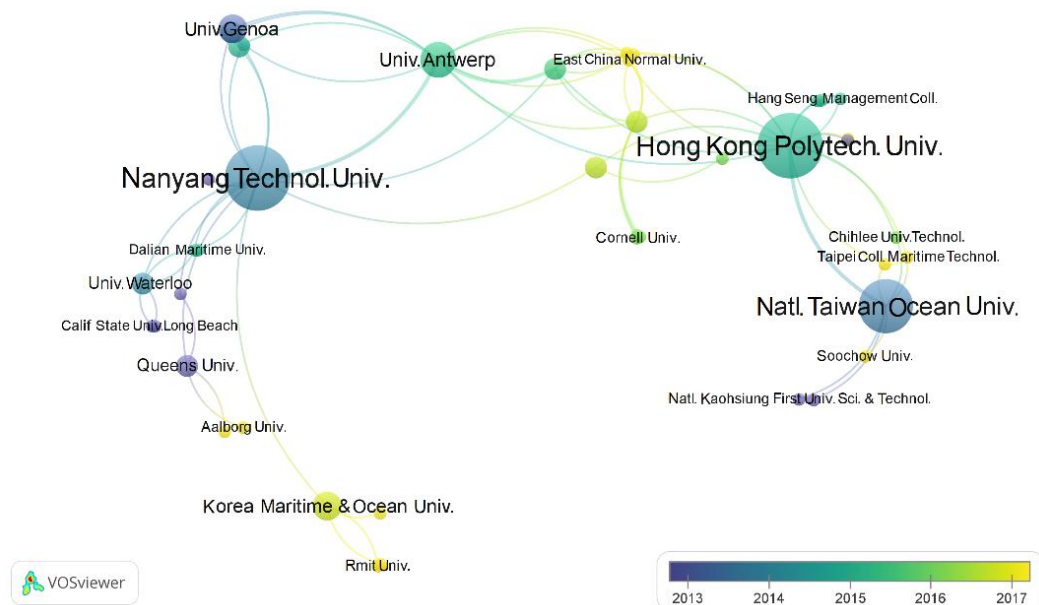
The keywords related to maritime sustainability in recent years are governance, corporate social responsibility, and supply chain management, which are different from the keywords in the earlier phase of sustainability research.

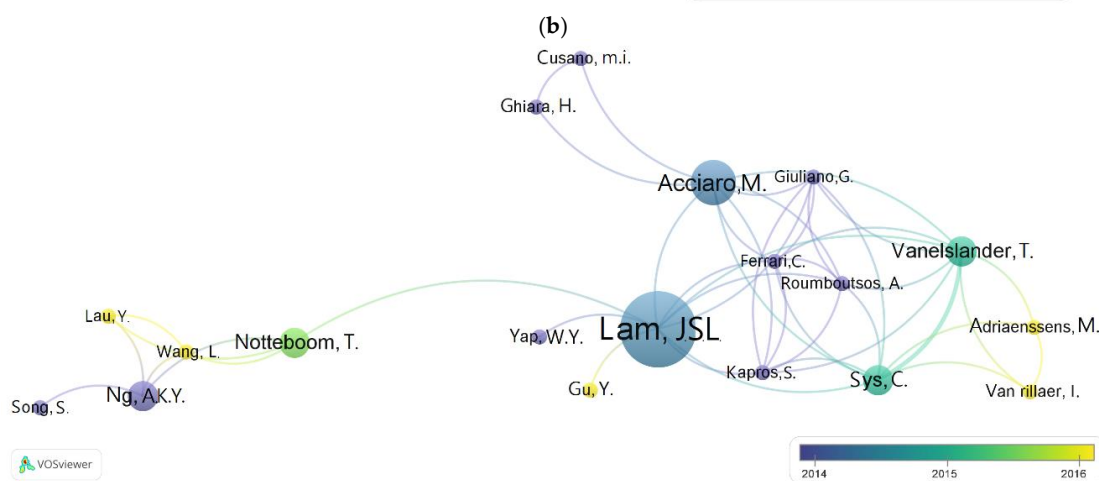### 4.4.2. Co-Authorship: Country, Affiliation, and Authors

Figure 6 provides information on co-authorship by country, affiliation, and collaboration between authors. China has conducted the most research on maritime sustainability. In a timeline view, authors from western countries including England, Germany, the Netherlands, Spain, Italy, and USA have conducted maritime sustainability research. Authors from Asian countries, including Singapore and Taiwan, were among those who undertook research on maritime sustainability at an earlier stage. Recently, researchers from China and South Korea have produced many studies in maritime sustainability, as shown in Figure 6a. The possible explanation is that Asian researchers have started to study sustainable development in social, economic, and environmental dimensions beyond traditional economic growth in maritime industry. Regarding affiliation, three universities (i.e., Nanyang Technological University, Singapore; The Hong Kong Polytechnic University, Hong Kong; and National Taiwan University, Taiwan) are at the center of research with various connections between other academic affiliations as shown in Figure 6b. Lam and Acciaro are the authors who have the most papers published and connections established with other authors on sustainability in the field of maritime studies (Figure 6c). Figure 6c,d have been generated based on the authors' information and their citation network of 155 research papers, which contain the maritime related-keywords in the title or keywords or abstracts within "sustainability" or "sustainable". We acknowledge that the work of some other prominent scholars in the field might have been overlooked in the filtering process.
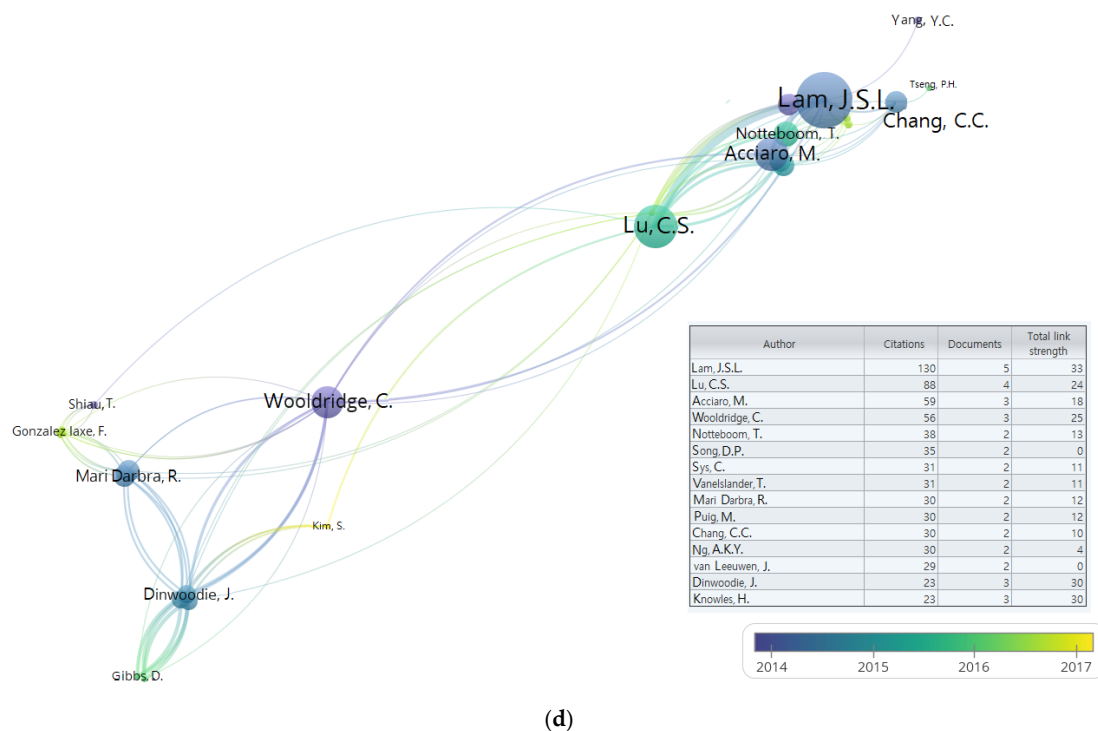
(**a**)

(**b**)

(**c**)

Figure 6. *Cont*.

Author	Citations	Documents	Total link strength
Lam, J.S.L.	130	5	33
Lu, C.S.	88	4	24
Acciaro, M.	59	3	18
Wooldridge, C.	56	3	25
Notteboom, T.	38	2	13
Song, D.P.	35	2	0
Sys, C.	31	2	11
Vanelslander, T.	31	2	11
Mari Darbra, R.	30	2	12
Puig, M.	30	2	12
Chang, C.C.	30	2	10
Ng, A.K.Y.	30	2	4
van Leeuwen, J.	29	2	0
Dinwoodie, J.	23	3	30
Knowles, H.	23	3	30

(**d**)

Figure 6. Network for co-occurrence of maritime sustainability papers over time: (**a**) co-authorship network by country; (**b**) co-authorship network by affiliation; (**c**) co-authorship network by authors; (**d**) citation network by author.

5. Discussion and Conclusions

This study conducted a comprehensive literature review on sustainability in the field of maritime studies. From SCI/SSCI journals, 155 academic papers related to port, shipping and maritime logistics were extracted. Consolidation of sustainability issues was achieved by conducting a latent Dirichlet allocation for latent data discovery and relationships among text document data. The landscape of sustainability research was illustrated using bibliometric analysis. In this study, a new intellectual structure of sustainability literature was created, current trends and key co-authorship patterns were mapped, and future research development trajectories in the field of maritime studies were projected.

The results from text mining indicate the extracted common sustainability issues for ports and shipping businesses. Broadly, these issues are related to green ports/shipping, carbon emission/climate change and region-specific environmental regulation/management. The need to optimize shipping routes/networks to reduce carbon/green house gas emission, shrink distances, and reduce logistics costs is an additional sustainability issue for shipping.

For maritime logistics, sustainability issues are generally related to achieving optimal logistics systems, sustainable supply chain design, and service quality management. The co-occurrence analysis identified high-frequency keywords, including sustainability, management, port, emission, impact, performance, model, logistics, system and framework. More recently, the keywords have shifted to include governance, corporate social responsibility, and supply chain management. A shift in publication on sustainability from OECD (Organization for Economic Co-operation and Development)-dominated countries, with the exception of Singapore and Taiwan, to China and South Korea is noted in the visual illustration of mapped data.

A notable finding in this study shows that most of the sustainability issues related to ports, shipping and maritime logistics were related to economic and environmental dimensions of sustainability. However, social aspects, such as labor laws and standards, working conditions, maritime employment, regional growth and development, and the livability of communities within port regions,

have attracted relatively less academic investigation within the field of maritime studies. Arguably, sustainability of the maritime industry requires that all dimensions are equally addressed.

There are theoretical and policy implications of these findings. From a theoretical perspective, this study has developed a broader understanding of the major themes and conceptual models to help theorize the notion of sustainability in the context of maritime studies. It enables researchers to: see the value of text-mining tools to help synthesize diverse results; understand the inconsistencies in the extant body of literature; and, develop new theories and models of maritime sustainability. From a policy perspective, this study has created a grounded platform to help researchers to develop maritime sustainability assessments and improvement frameworks to identify and evaluate key sustainability principles, guidelines and measurements employed in the field of maritime studies.

Future research could pay equal attention to researching social aspects of maritime management, including the effectiveness of community planning, labor laws and regulations, and strategic policy-making. From a supply chain perspective, single port-to-port chains is an issue that has received limited attention that requires further investigation. Competitive port supply chains therefore could be incorporated in the future research agenda. Sustainability of the broader region within which a port operates needs to be integrated in the evaluation of sustainability measures on port functions, shipping services and maritime logistics operations. In addition, new case studies from developing countries and emerging economies could be encouraged to provide wider insights into sustainability issues in a globalized marketplace. Furthermore, interdisciplinary research across institutions and nations could be better promoted by journals to enhance cross-cultural learning across different business settings and industry practices to help preserve the natural environment and mitigate deleterious impacts of maritime operations on the natural habitat, while generating growth and employment opportunities for local port communities.

Conflicts of Interest: The authors declare no conflict of interest.
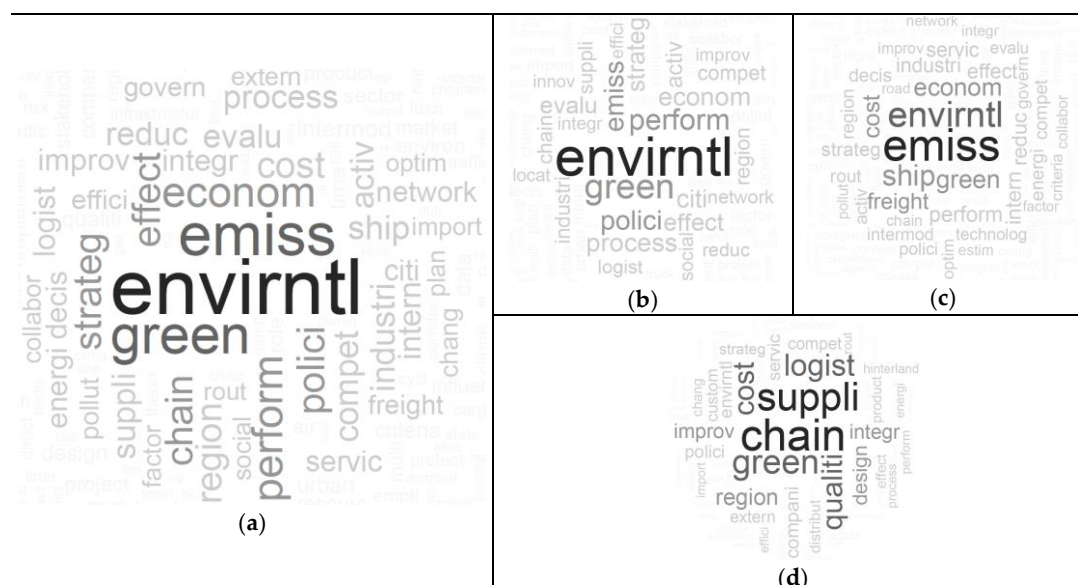
Appendix A

Figure A1. Word cloud of each subject: (**a**) total papers in sustainability (n = 155); (**b**) port issue papers in sustainability (n = 72); (**c**) shipping issue papers in sustainability (n = 70); and, (**d**) maritime logistics issue papers in sustainability (n = 13). By using a DTM, a word cloud which indicates the most frequently used terms (words) in the collected documents can be generated. The size of words corresponds to the frequency of the terms in the 155 documents. As illustrated, the terms "/envirntl-/", "green", "/emiss-/", "/economy-/", "/perform-/", "/polici-/", "/strategy-/", and "/effect-/" are the top eight most important words that predict some research topics in the field of maritime studies.
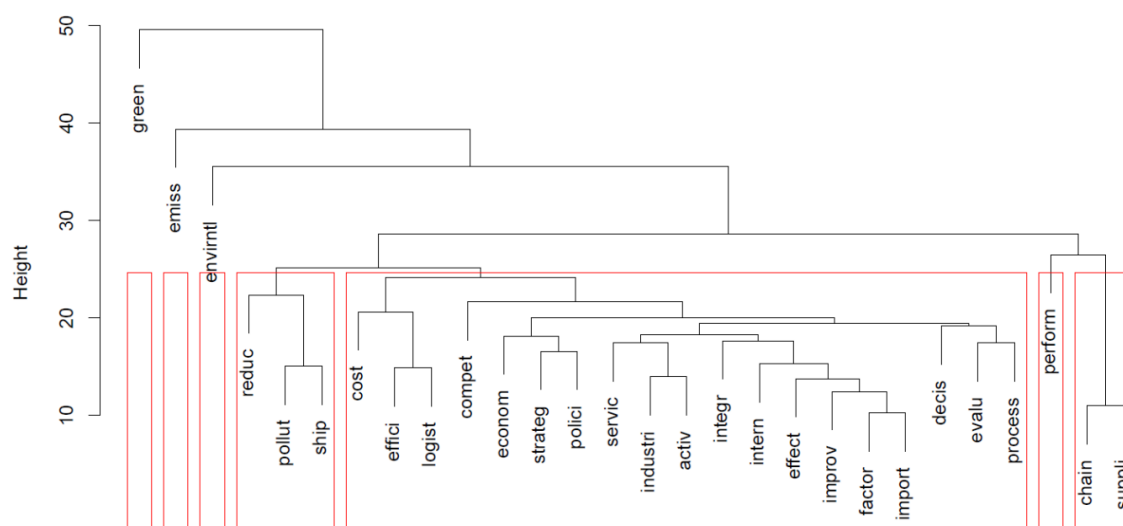

Figure A2. Cluster dendrogram. The cluster tree is generated by evaluating each word's similarity to other words from 155 documents relating to maritime studies. The Y-axis of the dendrogram represents the distance between clusters; the greater the height, the greater the difference between clusters.
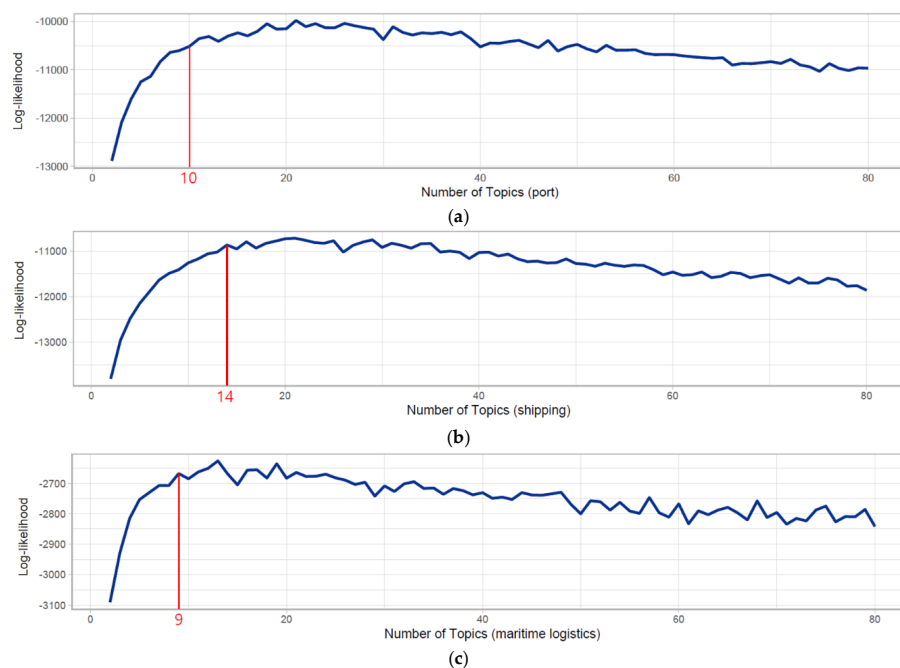
Figure A3. Determining the number of optimal topics: (**a**) port issue papers in sustainability (n = 72); (**b**) shipping issue papers in sustainability (n = 70); and, (**c**) maritime logistics issue papers in sustainability (n = 13).

Table A1. The most popular host journals and quantity of articles.

Journal	No. of Papers	SCI/SSCI/SCIE	Publication Cycle	Publish Company
Maritime Policy & Management	17	SSCI	Bimonthly	Taylor & Francis
Transportation Research Part D-Transport and Environment	16	SSCI, SCIE	Bimonthly	Elsevier
Sustainability	14	SSCI, SCIE	Monthly	MDPI
Marine Policy	11	SSCI	Monthly	Elsevier
International Journal of Shipping and Transport Logistics	10	SSCI	Quarterly	Inderscience Publishers
International Journal of Sustainable Transportation	10	SSCI	Bimonthly	Taylor & Francis
Transportation Research Part E-Logistics and Transportation Review	8	SSCI, SCIE	Monthly	Elsevier
Ocean & Coastal Management	7	SCIE	Semimonthly	Elsevier
Journal of Transport Geography	6	SSCI	Bimonthly	Elsevier
Marine Pollution Bulletin	4	SCI, SCIE	Monthly	Elsevier
Energy Policy	3	SSCI, SCIE	Monthly	Elsevier
Transport	3	SCIE	Quarterly	Taylor & Francis
Transportation Research Part A-Policy and Practice	3	SCI, SSCI, SCIE	Monthly	Elsevier
Transportation Research Record	3	SCI	Irregular	National Academy of Sciences
Business Strategy and The Environment	2	SSCI	Bimonthly	US National Research Council
Computers & Industrial Engineering	2	SCIE	Monthly	Elsevier
International Journal of Logistics-Research and Applications	2	SSCI	Bimonthly	Taylor & Francis
Promet-Traffic & Transportation	2	SCIE	Bimonthly	Sveuciliste u Zagrebu
Transport Reviews	2	SSCI	Bimonthly	Taylor & Francis
Transportation Planning and Technology	2	SCIE	Bimonthly	Taylor & Francis
Other 28 journals	28	-	-	-
Total	**155**	-	-	-

References

1. Lin, B.; Lin, C.Y. Compliance with international emission regulations: Reducing the air pollution from merchant vessels. *Mar. Policy* **2006**, *30*, 220–225. [CrossRef]
2. United Nations General Assembly. *Report of the World Commission on Environment and Development: Our Common Future: Report of the World Commission on Environment and Development*; United Nations: New York, NY, USA, 1987.
3. Asgari, N.; Hassani, A.; Jones, D.; Nguye, H.H. Sustainability ranking of the UK major ports: Methodology and case study. *Transp. Res. Part E Logist. Transp. Rev.* **2015**, *78*, 19–39. [CrossRef]
4. Du, G.; Sun, C.; Weng, J. Liner shipping fleet deployment with sustainable collaborative transportation. *Sustainability* **2016**, *8*, 165. [CrossRef]
5. Hjortnaes, T.; Wiegmans, B.; Negenborn, R.R.; Zuidwijk, R.A.; Klijnhout, R. Minimizing cost of empty container repositioning in port hinterlands, while taking repair operations into account. *J. Transp. Geogr.* **2017**, *58*, 209–219. [CrossRef]
6. Iannone, F. The private and social cost efficiency of port hinterland container distribution through a regional logistics system. *Transp. Res. Part A Policy Pract.* **2012**, *46*, 1424–1448. [CrossRef]
7. Searcy, T. Bridging islands and calming seas: A material flow management approach to sustainable sea transportation for Fiji's lower southern Lau islands. *Mar. Policy* **2017**, *83*, 221–229. [CrossRef]
8. López-Navarro, M.Á. Environmental factors and intermodal freight transportation: Analysis of the decision bases in the case of Spanish motorways of the Sea. *Sustainability* **2014**, *6*, 1544–1566. [CrossRef]
9. Tzannatos, E.; Papadimitriou, S.; Koliousis, I. A Techno-Economic Analysis of Oil vs. Natural Gas Operation for Greek Island Ferries. *Int. J. Sustain. Transp.* **2015**, *9*, 272–281. [CrossRef]
10. Tseng, P.; Pilcher, N. Exploring the viability of an emission tax policy for ships at berth in Taiwanese ports. *Int. J. Shipp.* **2016**, *8*, 705–722. [CrossRef]
11. Tsai, H.-L.; Lu, C.; Chang, C.-C. The influence of organisational green climate on employees' green behaviours: Evidence from the Eco Port of Kaohsiung. *Int. J. Shipp. Transp. Logist.* **2017**, *9*, 696–723. [CrossRef]
12. Gordon, J.R.M.; Lee, P.M.; Lucas, H.C. A resource-based view of competitive advantage at the Port of Singapore. *J. Strateg. Inf. Syst.* **2005**, *14*, 69–86. [CrossRef]
13. Winebrake, J.J.; Corbett, J.J.; Meyer, P.E. Energy use and emissions from marine vessels: A total fuel life cycle approach. *J. Air Waste Manag. Assoc.* **2007**, *57*, 102–110. [CrossRef] [PubMed]
14. Winebrake, J.J.; Corbett, J.J.; Wang, C.; Farrell, A.E.; Woods, P. Optimal fleetwide emissions reductions for passenger ferries: An application of a mixed-integer nonlinear programming model for the new york–new jersey harbor. *J. Air Waste Manag. Assoc.* **2005**, *55*, 458–466. [CrossRef] [PubMed]
15. Becker, A.; Ng, A.K.Y.; McEvoy, D.; Mullett, J. Implications of climate change for shipping: Ports and supply chains. *Wiley Interdiscip. Rev. Clim. Chang.* **2018**, *9*, e508. [CrossRef]
16. Norlund, E.K.; Gribkovskaia, I. Reducing emissions through speed optimization in supply vessel operations. *Transp. Res. Part D Transp. Environ.* **2013**, *23*, 105–113. [CrossRef]
17. Psaraftis, H.N.; Kontovas, C.A. Ship speed optimization: Concepts, models and combined speed-routing scenarios. *Transp. Res. Part C Emerg. Technol.* **2014**, *44*, 52–69. [CrossRef]
18. Wang, K.; Yan, X.; Yuan, Y.; Jiang, X.; Lin, X.; Negenborn, R.R. Dynamic optimization of ship energy efficiency considering time-varying environmental factors. *Transp. Res. Part D Transp. Environ.* **2018**, *62*, 685–698. [CrossRef]
19. Wen, M.; Pacino, D.; Kontovas, C.A.; Psaraftis, H.N. A multiple ship routing and speed optimization problem under time, cost and environmental objectives. *Transp. Res. Part D Transp. Environ.* **2017**, *52*, 303–321. [CrossRef]
20. Corbett, J.J.; Wang, H.; Winebrake, J.J. The effectiveness and costs of speed reductions on emissions from international shipping. *Transp. Res. Part D Transp. Environ.* **2009**, *14*, 593–598. [CrossRef]
21. Corbett, J.J.; Wang, H.; Winebrake, J.J. Impacts of speed reductions on vessel-based emissions for international shipping. In Proceedings of the Transportation Research Board 88th Annual Meeting, Washington, DC, USA, 11–15 January 2009.
22. Yang, Z.; Lun, V.; Lagoudis, I.N.; Lee, P.T.W. Container transportation: Resilience and sustainability. *Transp. Res. Part D Transp. Environ.* **2018**, *61*, 420–422. [CrossRef]

23. Acciaro, M. Real option analysis for environmental compliance: LNG and emission control areas. *Transp. Res. Part D Transp. Environ.* **2014**, *28*, 41–50. [CrossRef]

24. Eise Fokkema, J.; Buijs, P.; Vis, I.F.A. An investment appraisal method to compare LNG-fueled and conventional vessels. *Transp. Res. Part D Transp. Environ.* **2017**, *56*, 229–240. [CrossRef]

25. Corbett, J.J.; Winebrake, J.J. Emissions Tradeoffs among Alternative Marine Fuels: Total Fuel Cycle Analysis of Residual Oil, Marine Gas Oil, and Marine Diesel Oil. *J. Air Waste Manag. Assoc.* **2008**, *58*, 538–542. [CrossRef] [PubMed]

26. Schinas, O.; Stefanakos, C.N. Cost assessment of environmental regulation and options for marine operators. *Transp. Res. Part C Emerg. Technol.* **2012**, *25*, 81–99. [CrossRef]

27. Schinas, O.; Stefanakos, C.N. Selecting technologies towards compliance with MARPOL Annex VI: The perspective of operators. *Transp. Res. Part D Transp. Environ.* **2014**, *28*, 28–40. [CrossRef]

28. Animah, I.; Addy-Lamptey, A.; Korsah, F.; Sackey, J.S. Compliance with MARPOL Annex VI regulation 14 by ships in the Gulf of Guinea sub-region: Issues, challenges and opportunities. *Transp. Res. Part D Transp. Environ.* **2018**, *62*, 441–455. [CrossRef]

29. Mansouri, S.A.; Lee, H.; Aluko, O. Multi-objective decision support to enhance environmental sustainability in maritime shipping: A review and future directions. *Transp. Res. Part E Logist. Transp. Rev.* **2015**, *78*, 3–18. [CrossRef]

30. Sislian, L.; Jaegler, A.; Cariou, P. A literature review on port sustainability and ocean's carrier network problem. *Res. Transp. Bus. Manag.* **2016**, *19*, 19–26. [CrossRef]

31. Davarzani, H.; Fahimnia, B.; Bell, M.; Sarkis, J. Greening ports and maritime logistics: A review. *Transp. Res. Part D Transp. Environ.* **2016**, *48*, 473–487. [CrossRef]

32. Cho, Y.J.; Fu, P.W.; Wu, C.C. Popular Research Topics in Marketing Journals, 1995–2014. *J. Interact. Mark.* **2017**, *40*, 52–72. [CrossRef]

33. Giaquinto, R.; Banerjee, A. Topic Modeling on Health Journals with Regularized Variational Inference. In Proceedings of the Thirty-Second AAAI Conference on Artificial Intelligence, New Orleans, LA, USA, 2–7 February 2018; pp. 20–22.

34. Torget, A.J.; Yang, T.; Mihalcea, R. Topic modeling on historical newspapers. In *Proceedings of the 5th ACL-HLT Work. Lang. Technol. Cult. Herit. Soc. Sci. Humanit*; Association for Computational Linguistics: Stroudsburg, PA, USA, 2011; pp. 96–104.

35. Kuhn, K.D. Using structural topic modeling to identify latent topics and trends in aviation incident reports. *Transp. Res. Part C Emerg. Technol.* **2018**, *87*, 105–122. [CrossRef]

36. De Battisti, F.; Ferrara, A.; Salini, S. A decade of research in statistics: A topic model approach. *Scientometrics* **2015**, *103*, 413–433. [CrossRef]

37. Jiang, H.; Qiang, M.; Lin, P. A topic modeling based bibliometric exploration of hydropower research. *Renew. Sustain. Energy Rev.* **2016**, *57*, 226–237. [CrossRef]

38. Sun, L.; Yin, Y. Discovering themes and trends in transportation research using topic modeling. *Transp. Res. Part C* **2017**, *77*, 49–66. [CrossRef]

39. Choi, H.S.; Lee, W.S.; Sohn, S.Y. Analyzing research trends in personal information privacy using topic modeling. *Comput. Secur.* **2017**, *67*, 244–253. [CrossRef]

40. Mortenson, M.J.; Vidgen, R. A computational literature review of the technology acceptance model. *Int. J. Inf. Manag.* **2016**, *36*, 1248–1259. [CrossRef]

41. Welbers, K.; Van Atteveldt, W.; Benoit, K. Text Analysis in R. *Commun. Methods Meas.* **2017**, *11*, 245–265. [CrossRef]

42. Blei, D.M.; Jordan, M.I.; Ng, A.Y. Latent dirichlet allocation. *J. Mach. Learn. Res.* **2003**, *3*, 993–1022.

43. Blei, D. Probabilistic topic models. *Commun. ACM* **2012**, *55*, 77–84. [CrossRef]

44. Newton Michael, A.; Raftery, A.E. Approximate Bayesian Inference with the Weighted Likelihood Bootstrap. *J. R. Stat. Soc. Ser. B* **1994**, *56*, 3–48.

45. Griffiths, T.L.; Steyvers, M. Finding scientific topics. *Proc. Natl. Acad. Sci. USA* **2004**, *101*, 5228–5235. [CrossRef] [PubMed]

46. Di Vaio, A.; Varriale, L. Management innovation for environmental sustainability in seaports: Managerial accounting instruments and training for competitive green ports beyond the regulations. *Sustainability* **2018**, *10*, 783. [CrossRef]

47. Chengpeng, W.; Di, Z.; Xinping, Y.; Zaili, Y. A novel model for the quantitative evaluation of green port development: A case study of major ports in China. *Transp. Res. Part D J.* **2017**, *61*, 431–443. [CrossRef]

48. Bergqvist, R.; Egels-Zandén, N. Green port dues—The case of hinterland transport. *Res. Transp. Bus. Manag.* **2012**, *5*, 85–91. [CrossRef]

49. Barnes-Dabban, H.; van Tatenhove, J.P.M.; van Koppen, K.C.S.A.; Termeer, K.J.A.M. Institutionalizing environmental reform with sense-making: West and Central Africa ports and the 'green port' phenomenon. *Mar. Policy* **2017**, *86*, 111–120. [CrossRef]

50. Lirn, T.; Jim Wu, Y.; Chen, Y.J. Green performance criteria for sustainable ports in Asia. *Int. J. Phys. Distrib. Logist. Manag.* **2013**, *43*, 427–451. [CrossRef]

51. Lam, J.S.L.; Notteboom, T. The Greening of Ports: A Comparison of Port Management Tools Used by Leading Ports in Asia and Europe. *Transp. Rev.* **2014**, *34*, 169–189. [CrossRef]

52. Shiau, T.A.; Chuang, C.C. Social construction of port sustainability indicators: A case study of Keelung Port. *Marit. Policy Manag.* **2015**, *42*, 26–42. [CrossRef]

53. Lam, J.S.L.; Gu, Y. Port hinterland intermodal container flow optimisation with green concerns: A literature review and research agenda. *Int. J. Shipp. Transp. Logist.* **2013**, *5*, 257–281. [CrossRef]

54. Rødseth, K.L.; Wangsness, P.B.; Schøyen, H. How do economies of density in container handling operations affect ships' time and emissions in port? Evidence from Norwegian container terminals. *Transp. Res. Part D Transp. Environ.* **2018**, *59*, 385–399. [CrossRef]

55. Tang, J.; McNabola, A.; Misstear, B.; Caulfield, B. An evaluation of the impact of the Dublin Port Tunnel and HGV management strategy on air pollution emissions. *Transp. Res. Part D Transp. Environ.* **2017**, *52*, 1–14. [CrossRef]

56. Berechman, J.; Tseng, P.H. Estimating the environmental costs of port related emissions: The case of Kaohsiung. *Transp. Res. Part D Transp. Environ.* **2012**, *17*, 35–38. [CrossRef]

57. Yang, L.; Cai, Y.; Zhong, X.; Shi, Y.; Zhang, Z. A carbon emission evaluation for an integrated logistics system-a case study of the port of shenzhen. *Sustainability* **2017**, *9*, 462. [CrossRef]

58. Chang, Y.T.; Park, H.K.; Lee, S.; Kim, E. Have Emission Control Areas (ECAs) harmed port efficiency in Europe? *Transp. Res. Part D Transp. Environ.* **2018**, *58*, 39–53. [CrossRef]

59. Gu, Y.; Wallace, S.W. Scrubber: A potentially overestimated compliance method for the Emission Control Areas: The importance of involving a ship's sailing pattern in the evaluation. *Transp. Res. Part D Transp. Environ.* **2017**, *55*, 51–66. [CrossRef]

60. Girard, L.F. Toward a smart sustainable development of port cities/areas: The role of the "Historic Urban Landscape" approach. *Sustainability* **2013**, *5*, 4329–4348. [CrossRef]

61. Cheon, S.H.; Maltz, A.; Dooley, K. The link between economic and environmental performance of the top 10 U.S. ports. *Marit. Policy Manag.* **2017**, *44*, 227–247. [CrossRef]

62. Acciaro, M.; Vanelslander, T.; Sys, C.; Ferrari, C.; Roumboutsos, A.; Giuliano, G.; Lam, J.S.L.; Kapros, S. Environmental sustainability in seaports: A framework for successful innovation. *Marit. Policy Manag.* **2014**, *41*, 480–500. [CrossRef]

63. López-Navarro, M.Á.; Tortosa-Edo, V.; Llorens-Monzonís, J. Environmental management systems and local community perceptions: The case of petrochemical complexes located in ports. *Bus. Strateg. Environ.* **2015**, *24*, 236–251. [CrossRef]

64. Yang, Y.L.; Shyu, W.H.; Li, C.H.; Ding, J.F. Environmental risk perceptions of port residents: An empirical study on east side of Keelung Port. *J. Mar. Sci. Technol.* **2016**, *24*, 669–681. [CrossRef]

65. Wooldridge, C.F.; McMullen, C.; Howe, V. Environmental management of ports and harbours— Implementation of policy through scientific monitoring. *Mar. Policy* **1999**, *23*, 413–425. [CrossRef]

66. Na, J.H.; Choi, A.Y.; Ji, J.; Zhang, D. Environmental efficiency analysis of Chinese container ports with CO2emissions: An inseparable input-output SBM model. *J. Transp. Geogr.* **2017**, *65*, 13–24. [CrossRef]

67. Lee, T.; Nam, H. A Study on Green Shipping in Major Countries: In the View of Shipyards, Shipping Companies, Ports, and Policies. *Asian J. Shipp. Logist.* **2017**, *33*, 253–262. [CrossRef]

68. Cheng, T.C.E.; Lai, K.H.; Venus Lun, Y.H.; Wong, C.W.Y. Green shipping management. *Transp. Res. Part E Logist. Transp. Rev.* **2013**, *55*, 1–2. [CrossRef]

69. Chang, Y.T.; Danao, D. Green shipping practices of shipping firms. *Sustainability* **2017**, *9*, 829. [CrossRef]

70. Wuisan, L.; van Leeuwen, J.; van Koppen, C.S.A. Greening international shipping through private governance: A case study of the Clean Shipping Project. *Mar. Policy* **2012**, *36*, 165–173. [CrossRef]

71.   Lun, Y.H.V.; Lai, K.H.; Cheng, T.C.E. An evaluation of green shipping networks to minimize external cost in the Pearl River Delta region. *Technol. Forecast. Soc. Chang.* **2013**, *80*, 320–328. [CrossRef]

72.   Papaefthimiou, S.; Maragkogianni, A.; Andriosopoulos, K. Evaluation of cruise ships emissions in the Mediterranean basin: The case of Greek ports. *Int. J. Sustain. Transp.* **2016**, *10*, 985–994. [CrossRef]

73.   George, M.; Osman, A.S.S.; Hussin, H.; George, A.R. Protecting the Malacca and Singapore Straits from Ships' Atmospheric Emissions through the Implementation of MARPOL Annex VI. *Int. J. Mar. Coast. Law* **2017**, *32*, 95–137. [CrossRef]

74.   Cullinane, K.; Tseng, P.H.; Wilmsmeier, G. Estimation of container ship emissions at berth in Taiwan. *Int. J. Sustain. Transp.* **2016**, *10*, 466–474. [CrossRef]

75.   Dolphin, M.J.; Melcer, M. Estimation of ship dry air emissions. *Nav. Eng. J.* **2008**, *120*, 27–36. [CrossRef]

76.   Ren, J.; Lützen, M. Fuzzy multi-criteria decision-making method for technology selection for emissions reduction from shipping under uncertainties. *Transp. Res. Part D Transp. Environ.* **2015**, *40*, 43–60. [CrossRef]

77.   Kim, N.S.; Van Wee, B. Toward a Better Methodology for Assessing CO_2 Emissions for Intermodal and Truck-only Freight Systems: A European Case Study. *Int. J. Sustain. Transp.* **2014**, *8*, 177–201. [CrossRef]

78.   Sys, C.; Vanelslander, T.; Adriaenssens, M.; Van Rillaer, I. International emission regulation in sea transport: Economic feasibility and impact. *Transp. Res. Part D Transp. Environ.* **2014**, *45*, 139–151. [CrossRef]

79.   Clott, C.B.; Hartman, B.C. Clean trucks in California ports: Modelling emissions policy. *Int. J. Shipp. Transp. Logist.* **2013**, *5*, 449–462. [CrossRef]

80.   Šimenc, M. Overview and comparative analysis of emission calculators for inland shipping. *Int. J. Sustain. Transp.* **2016**, *10*, 627–637. [CrossRef]

81.   Fernndez Soto, J.L.; Garay Seijo, R.; Fraguela Formoso, J.A.; Gregorio Iglesias, G.; Carral Couce, L. Alternative sources of energy in shipping. *J. Navig.* **2010**, *63*, 435–448. [CrossRef]

82.   Nuttall, P.; Newell, A.; Prasad, B.; Veitayaki, J.; Holland, E. A review of sustainable sea-transport for Oceania: Providing context for renewable energy shipping for the Pacific. *Mar. Policy* **2014**, *43*, 283–287. [CrossRef]

83.   Rehmatulla, N.; Smith, T. Barriers to energy efficiency in shipping: A triangulated approach to investigate the principal agent problem. *Energy Policy* **2015**, *84*, 44–57. [CrossRef]

84.   Hilmola, O.P. North European companies and major Eurasian countries–future outlook on logistics flows and their sustainability. *Int. J. Shipp. Transp. Logist.* **2011**, *3*, 100–121. [CrossRef]

85.   Tran, H.; Cahoon, S.; Chen, S.L. Quality management for seaports integrated in supply chains. *Int. J. Shipp. Transp. Logist.* **2012**, *4*, 376–392. [CrossRef]

86.   Yang, Y.C.; Sung, C.Y. Service quality improvement strategies for liner-carrier-based global logistics companies. *Int. J. Shipp. Transp. Logist.* **2016**, *8*, 456–487. [CrossRef]

87.   Mallidis, I.; Dekker, R.; Vlachos, D. The impact of greening on supply chain design and cost: A case for a developing region. *J. Transp. Geogr.* **2012**, *22*, 118–128. [CrossRef]

88.   Lam, J.S.L. Designing a sustainable maritime supply chain: A hybrid QFD-ANP approach. *Transp. Res. Part E Logist. Transp. Rev.* **2015**, *78*, 70–81. [CrossRef]

89.   Gallo, A.; Accorsi, R.; Baruffaldi, G.; Manzini, R. Designing sustainable cold chains for long-range food distribution: Energy-effective corridors on the Silk Road Belt. *Sustainability* **2017**, *9*, 2044. [CrossRef]

90.   Guo, D.; Chen, H.; Long, R.; Lu, H.; Long, Q. A Co-Word Analysis of Organizational Constraints for Maintaining Sustainability. *Sustainability* **2017**, *9*, 1928. [CrossRef]

91.   Chen, C.; Song, M. *Representing Scientific Knowledge: The Role of Uncertainty*; Springer, 2017; Available online: https://www.springer.com/la/book/9783319625416 (accessed on 29 September 2018).