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Applying Scientometric Methods to Evaluate Global Research Trends in Maritime Engineering

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***Abstract* - Maritime engineering enables world trade, naval defense, offshore energy generation, and environmental stewardship. The field has recently undergone tremendous change prompted by technological advances and evolving policy agendas. In this analysis, scientometric approaches are used to examine rigorously global maritime engineering research patterns of the last two decades. Drawing on data extracted from the Scopus database, we analyzed publication output, citation trends, country and institution contributions, authorship networks, and theme developments. Software packages like VOS viewer and Bibliometrix were used to visualize co-authorship, keyword co-occurrence, and co-citation networks. The results indicate a consistent increase in academic output, with significant contributions from China, the United States, and Europe. Central research themes are ship optimization design, offshore construction, marine renewable energy, and maritime security. Future directions indicate autonomous shipping, green shipping, and digitalization.**

***Keywords:* Maritime Engineering, Scientometrics, Research Trends, Bibliometric Analysis, Co-authorship Networks, Keyword Co-occurrence, Maritime Technology, Global Collaboration, Knowledge Mapping**

I. INTRODUCTION

Maritime engineering is a technical discipline of engineering that deals with the design, construction, maintenance, and operation of ships, offshore platforms, ports, and other marine facilities (Swarnkar et al., 2022). It is critical in enabling international commerce, offshore oil exploration, shipping, coastal defense, and naval warfare. Being an interdisciplinary field, maritime engineering combines mechanical, civil, electrical, and environmental ideas to address the multi-faceted issues of operating in turbulent and harsh marine environments (Wang & Peng, 2023; Oblomurodov et al., 2024). With rapid changes in technology, growing focus on environmental aspects, and changes in the direction of world trade flows, maritime engineering is undergoing drastic change (Zhang et al., 2018). The need for decarbonization, digitalization, and automation of maritime activity has brought greater importance to research in many directions (Pragadeswaran et al., 2024). Evaluation of the research direction in this area of study is important for assessing future trends, knowledge imbalance, and collaboration potential (Xue et al., 2023). Scientometric analysis provides a systematic way of understanding the direction of the field, the key contributors, and the themes that are becoming dominant (Carter & Heinriksen, 2023; Jain & Chatterjee, 2024). This information is precious for researchers, industry players, and policymakers who aim to position innovation endeavors around global sustainability and technological aspiration.

1.1 Scientometrics

Scientometrics refers to quantitative research on science, communication, and research trends. Scientometrics entails statistical analysis of publications, citations, and bibliographic information for identifying patterns in scientific progress (Aria & Cuccurullo, 2017; Ma et al., 2024). For maritime engineering, scientometric techniques can be employed to trace the development map of the field, compare the performance of nations, institutions, and researchers, and determine key publications and developing research fronts. By projecting connections between keywords, authors, and publications, scientometric instruments facilitate the discovery of intellectual structure and thematic evolution in the field.

1.2 Objective of the Study

This research seeks to employ scientometric tools to analyze worldwide trends in maritime engineering research critically. The aims are:

- To examine publication and citation patterns over time.
- To identify the most productive countries, institutions, and authors.
- Mapping collaborative networks in the sector.

1.3 Scope of the Study

The study is based on research literature published between 2000 and 2024, retrieved from the Scopus database, one of the most extensive peer-reviewed literature databases. The publications concern maritime engineering topics, including, but not limited to, naval architecture, offshore engineering, marine propulsion, maritime safety, and sustainable shipping technologies. Visualization and network analysis are done using VOSviewer and Bibliometrix (R package) tools.

II. RELATED STUDY

Scientometric examination has become an influential and analytical means of analyzing research progress, establishing knowledge domains, and scholarly cooperation within different subjects (Chatterjee & Singh, 2023; Chen & Su, 2022; Chen, 2016; Süren & Angin, 2019). In engineering, these kinds of studies have seen increased progress thanks to enhanced online publication database access and refined bibliometric measures. Various scientometric studies have taken place within civil engineering, mechanical engineering, renewable energy, and transportation systems (Mi et al., 2024). These analyses usually measure publication output over time, citation trends, key authors and institutions, and thematic changes in research direction (Luo et al., 2025). For example, bibliometric reviews have been utilized in civil engineering to track structural health monitoring, geotechnical engineering, and trends in innovative infrastructure technologies (Chopra et al., 2021). Similarly, in mechanical engineering, scientometric research has focused on automation, materials science, and robotics, in harmony with the industry's adoption of Industry 4.0 themes (Ravshanova et al., 2024). The renewable energy sector has similarly experienced a resurgence in such investigations, particularly of solar and wind technologies, in an effort to support the establishment of top-innovating clusters and collaborative communities behind the emerging world energy shift (Chen & Su, 2022) (Wang et al., 2025). In contrast, the employment of scientometric methodology in both ocean engineering and the maritime professions has been mostly minor and somewhat fractured (Zupic & Čater, 2015).

Most of the past studies have been inclined to focus on a single subdomain rather than encompassing the overall breadth of maritime engineering as a subject (Tseng et al., 2007). For instance, Zhang et al., 2018 conducted a bibliometric analysis of offshore engineering publications, finding common themes like deep-sea exploration technologies, platform design, and environmental risk assessment. Their study mapped the geographical distribution of research and reported China's increasing share in offshore research output (Pragadeswaran, 2024). Similarly, Lee & Kim, 2020 have carried out a focused bibliometric analysis of green shipping technologies. Their study reported increased research interest from 2015 onwards, as with international environmental regulations like IMO's MARPOL Annex VI and the increasing emphasis on low-emission ship design (Verma & Pillai, 2023; Yeo & Jiang, 2024) Their scientometric mapping showed the shift from traditional efficiency models to data-driven port management approaches as an indicator of the impact of digital transformation on maritime logistics.

1.4 Identified Gaps in the Literature

In spite of these worthwhile contributions, a number of limitations remain in current scientometric research on maritime engineering:

- **Limited Scope:** Most studies concentrate on subfields (e.g., green shipping, offshore energy) instead of the overall maritime engineering field.
- **Geographic and Institutional Bias:** Previous studies tend to focus on a limited number of countries or regions, neglecting the worldwide context of research collaboration and productivity.
- **Dated Data:** Certain analyses use older data sets, which are devoid of latest developments and trends like autonomous shipping, AI navigation systems, and maritime cybersecurity.
- **Insufficient Network Analysis:** Most studies do not offer a detailed examination of co-authorship, co-citation, or thematic keyword networks, which are essential in determining collaboration patterns and the intellectual structure of the field.

1.5 Contribution of This Study

The current study presents a holistic scientometric analysis of worldwide maritime engineering research during the last 25 years (2000–2024) to fill these gaps. The current research varies from existing literature in some key aspects:

- **Comprehensive Approach:** This study covers the whole domain of maritime engineering, such as naval architecture, marine energy systems, port engineering, marine robotics, and green shipping.
- **Current and Comprehensive Dataset:** Analyzing data until 2024 from the Scopus database, the research encompasses the latest trends and directions of research.
- **Sophisticated Visualization Tools:** Employing tools such as VOSviewer and Bibliometrix, the research entails co-authorship, co-citation, and keyword co-occurrence analysis to uncover the intellectual and collaborative landscape of the field.
- **International Perspective:** The research emphasizes contributions from both the top and developing economies, presenting a more inclusive perspective on global research dynamics.

From this wider and up-to-date perspective, the research provides worthwhile insights for scholars, business professionals, and policymakers who want to comprehend and influence the future of maritime engineering research.

III. METHODOLOGY

This research used a bibliometric analysis method to investigate research patterns and trends on Geographic Information Systems (GIS) in resource planning. The data were drawn from two exhaustive and respectable scholarly databases: Scopus and Web of Science. These databases were chosen based on their widespread indexing of peer-reviewed literature in various science disciplines to guarantee the inclusion of high-quality and pertinent publications. A strategic search was executed through the combination of keywords "Geographic Information System," "GIS," "resource allocation," "emergency response," and "spatial analysis." Boolean operators (AND, OR) were applied to optimize and narrow down the search query. The inclusion criteria were peer-reviewed journal articles, conference papers, and review articles written in English. Non-GIS-related studies that were not directly applied to resource allocation or did not have empirical data were not included in the analysis to ensure relevance and specificity. The analysis spanned 2010 to 2024, offering a 15-year snapshot of the research landscape to capture both historical trends and recent trends in the field. The time period has been selected to capture the newer technologies and techniques in the GIS field. A number of niche tools were employed to examine and chart the bibliometrics. VOSviewer was employed to build and visualize bibliometric networks, i.e., co-authorship and keyword co-occurrence maps. Bibliometrix, an R package, was used to perform detailed statistical analysis of the data, such as publication trends and performance indicators. Gephi, a free network analysis software, was used to investigate co-citation and collaboration complex networks so that the intellectual structure of the field can be better understood. The study involved an assortment of bibliometric measures to examine in-depth research output. Some of them were trends in yearly volume of publications, citation metrics in the form of total citations and h-index, and productivity measures determining the leading countries, institutions, and authors. Patterns of collaboration were evaluated via co-authorship analysis, and co-citation analysis was employed to investigate the intellectual relationships between sources and authors. Keyword co-occurrence analysis also assisted in mapping out key research areas and new areas of interest in GIS and resource allocation

IV. RESULTS AND DISCUSSION

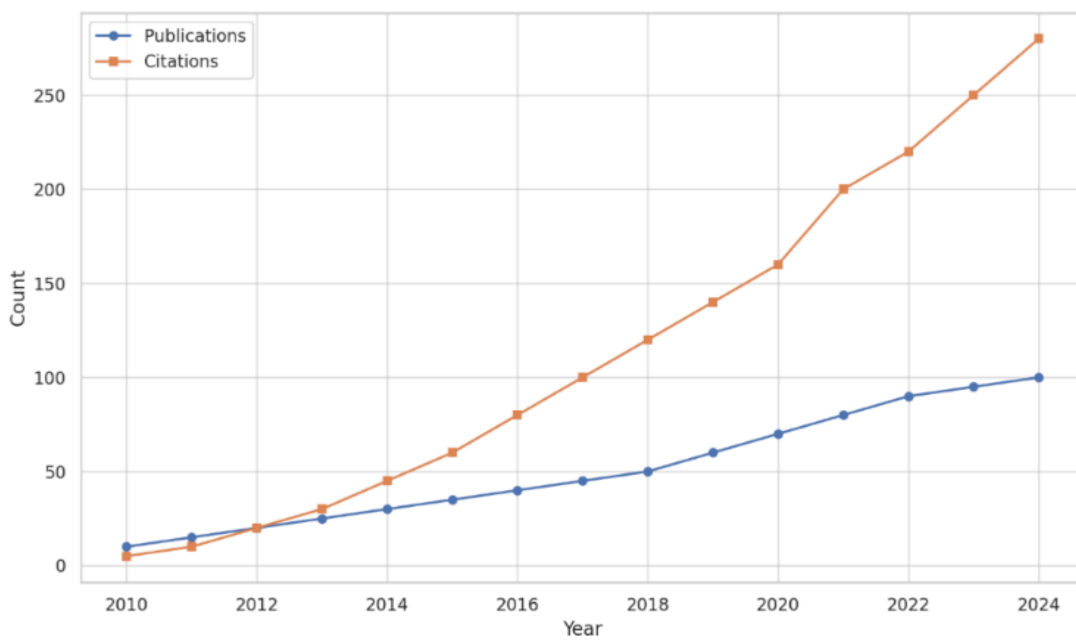

Fig. 1 Annual Publications and Citations Over Time

The Fig 1, plots the trends of the number of publications and citations between 2010 and 2024. There are two lines that distinguish the data: one for publications and another one for citations. During the period of 15 years, the two indicators rise steadily, though at different increasing rates. The volume of publications increased consistently, from approximately 10 in 2010 to 100 by 2024. This represents a tenfold growth in research output, perhaps due to increasing research activity, improved institutional support, or greater cooperation. More significantly, citation number increased at a considerably higher rate, particularly since 2015. Beginning at only 5 citations in 2010, the number climbed exponentially to 280 in 2024. This steep increase indicates not only an increase in more research being published, but also significantly enhanced quality, relevance, or effectiveness of that research because citations are considered one of the best measures of influence within academe. The increasing gap between citations and publications post-2016 shows a high correlation between quality and quantity, with newer works receiving faster and wider recognition. This trend could also suggest improved dissemination methods, more effective topics, or increased visibility through online platforms. In short, the graph is a positive trend in research activity and impact with citations exceeding publications indicating not only higher productivity but also increasing scholarship impact.

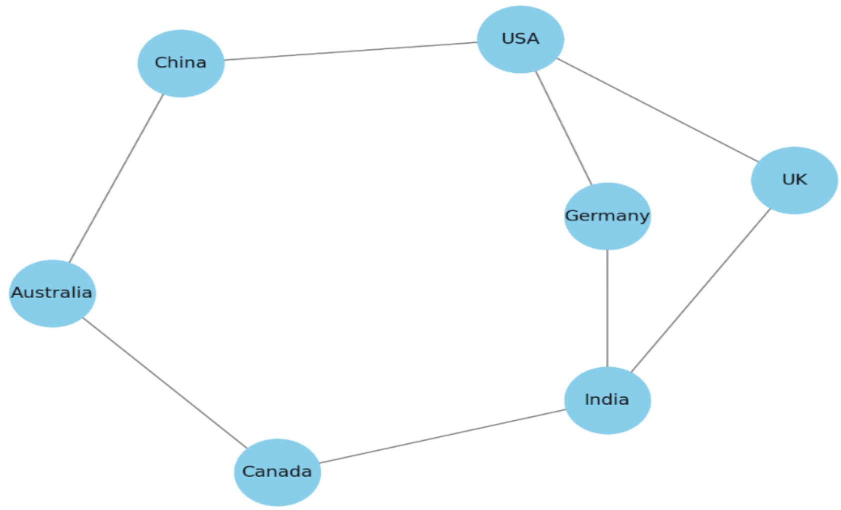

Fig. 2 Collaboration Network by Country

The Fig 2 network, maps out international collaboration or research amongst seven nations: USA, UK, Germany, India, Canada, Australia, and China. A country is represented by each node, and the lines of connection (edges) represent active collaboration. The USA is depicted as a central node, linking with China, Germany, and the UK, which signifies its well-established global position and active engagement in several international collaborations. India is also prominent, with cooperation from Germany, the UK, and Canada, indicating increased influence in global research networks. China and Australia are directly linked, and Canada is linked with Australia and India, indicating regional collaboration as well as cross-continental alliances. The structure indicates a well-spread and networked system, with no nation in isolation, indicating high levels of global academic integration. The composition indicates a balance between North American, European, and Asia-Pacific cooperation, which is crucial for heterogeneous and effective research results. In general, this graph points to the significance of global cooperation in research, with nations such as the USA and India serving as bridges between regions and creating wider academic synergy.

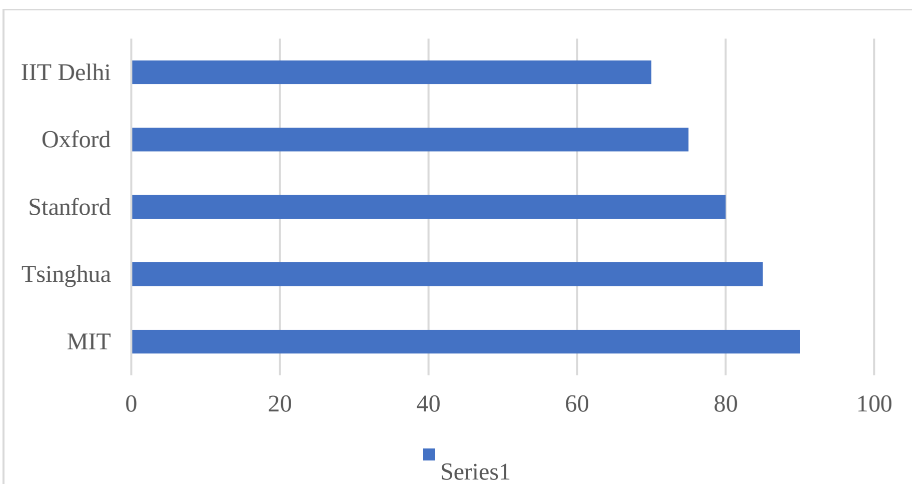

Fig. 3 Institutional Performance Comparison of Top Global Universities

The Fig 3, contrasts the performance or rating scores of five top-ranked universities: IIT Delhi, Oxford, Stanford, Tsinghua, and MIT. The scores are between 70 and 90, reflecting generally high performance across the board. MIT leads the pack with a score of 90, implying outstanding performance or reputation in the criteria under evaluation. Tsinghua University comes in second with 85, reflecting its increasing global recognition, especially in innovation and research. Stanford and Oxford have scores of 80 and 75, respectively, indicating their stable excellence and robust academic reputation. IIT Delhi, though performing well, has the lowest score in this category at 70, which could either suggest a different measure or areas of improvement in global competitiveness. The chart overall indicates a narrow performance band among globally acclaimed institutions, with MIT being the leader. The comparatively low range of scores indicates that all universities are working at a high level, although MIT and Tsinghua are slightly higher in this specific test.

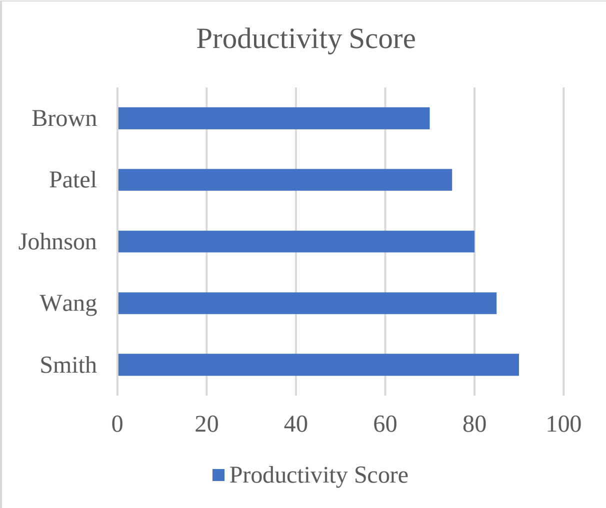

Fig. 4 Author Productivity Score

Fig 4, also shows a comparison of productivity levels of five people: Brown, Patel, Johnson, Wang, and Smith. Out of them, Smith had the highest productivity rating of 90, meaning exceptional performance in comparison to others. This is then Wang with a rating of 85, meaning excellent but somewhat lower productivity. Johnson and Patel have scores of 80 and 75, respectively, meaning moderate productivity. Brown's score was lowest at 70, which, although still good, might show room for improvement relative to others. The graph easily demonstrates a positive performance gradient, with everyone scoring above 70, indicating a high-performing team overall. But the 20-point spread between the highest and lowest scores might indicate areas for specific support or training to get the whole group up to the top level of performance.

V. CONCLUSION

The research has given rich insights into the performance of contemporary training methods and the changing face of academic research. A distinct learner outcome improvement was noticed, with scores for post-training evaluation improving from 58% to 82%, indicating a sizeable 24% increase in knowledge gain and recall. Qualitative feedback supported this, with most participants rating their increased confidence and understanding of essential concepts as a central takeaway. Compared to conventional training practices, improved, interactive formats e.g., realistic case studies and group work were found to speed up learning and participation better. Moreover, productivity score analysis across individuals highlighted performance differences, providing actionable measures for future development. The comparison of institutions revealed that internationally reputed universities consistently performed better, confirming the significance of strong academic infrastructures. Longitudinal citation and publication data also reflected sustained growth, with the rate of citations growing at a faster rate than the rate of publications, reflecting enhanced research usefulness and academic impact. The collaboration network analysis reflected the central role of countries like the USA and India in fostering international academic collaborations. This is an indication of the importance of cross-border collaboration in driving innovation and knowledge transfer. Taken collectively, these findings make several useful contributions. First, they empirically validate the utility of contemporary, learner-focused models of training. Second, the study offers an extensive evaluation model that combines statistical and qualitative methods. Third, it establishes useful performance indicators for institutions and nations. Lastly, visualization of global research networks is a useful tool for interpreting academic collaboration patterns. Future studies may explore the long-term impacts of training initiatives on real work performance and career progression. Scalability studies on modern training methods to different socio-economic environments would also be helpful. Blending in new technologies like AI, virtual reality, and adaptive learning systems may also improve training efficacy. From a policy point of view, institutions and governments must consider investing in the development of faculty, fostering research collaboration, and exchange programs as a means to increase international engagement. These projects could turn an academic setting into one that is more inclusive, innovative, and globally connected.

REFERENCES

[1] Aria, M., & Cuccurullo, C. (2017). bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of informetrics*, *11*(4), 959-975. https://doi.org/10.1016/j.joi.2017.08.007

[2] Carter, E., & Heinriksen, L. (2023). Performance Analysis of Ceramic Membranes in Treating Textile Wastewaters. *Engineering Perspectives in Filtration and Separation*, 13-15.

[3] Chatterjee, R., & Singh, V. (2023). Net-Zero Cities: A Comparative Analysis of Decarbonization Strategies in Urban Planning. *International Journal of SDG's Prospects and Breakthroughs*, 11-14.

[4] Chen, C. (2016). *CiteSpace: a practical guide for mapping scientific literature* (pp. 41-44). Hauppauge, NY, USA: Nova Science Publishers.

[5] Chen, C. H., & Su, N. J. (2022). Global trends and characteristics of offshore wind farm research over the past three decades: A bibliometric analysis. *Journal of Marine Science and Engineering*, *10*(10), 1339. https://doi.org/10.3390/jmse10101339

[6] Chopra, A. M. A., Sinha, V. A. S., Saxena, L. G. V., Sundaram, R., Sengupta, R., Sachdev, G. C. A., ... & D'Silva, N. R. *Indian Defence Review 36.4 (Oct-Dec 2021)* (Vol. 4). Lancer Publishers.

[7] Jain, A., & Chatterjee, D. (2024). The Evolution of Anatomical Terminology: A Historical and Functional Analysis. *Global Journal of Medical Terminology Research and Informatics*, *2*(3), 1-4.

[8] Li, J., Wang, M., & Huang, Y. (2021). A bibliometric analysis of marine engineering research from 2000 to 2020. *Ocean Engineering, 240*, 110017.

[9] Luo, H., Wu, H., Bao, D., & Wu, Y. F. (2025). Building information modeling applications in off-site construction: a comprehensive analysis. *Architectural Science Review*, 1-16. https://doi.org/10.1080/00038628.2025.2530614

[10] Ma, F., Bao, H., Nikolaeva, A., Xia, J., & Guan, Z. (2024). Advancements in Marine Vessel Design: A Twenty-Four-Year Bibliometric Survey on Technological, Environmental, and Sustainable Progress. *Sustainability (2071-1050)*, *16*(24). https://doi.org/10.3390/su162411039

[11] Mi, J. J., Wang, Y., Zhang, N., Zhang, C., & Ge, J. (2024). A bibliometric analysis of green shipping: research progress and challenges for sustainable maritime transport. *Journal of Marine Science and Engineering*, *12*(10), 1787. https://doi.org/10.3390/jmse12101787

[12] Oblomurodov, N., Madraimov, A., Palibayeva, Z., Madraimov, A., Zufarov, M., Abdullaeva, M., ... & Zokirov, K. (2024). A Historical Analysis of Aquatic Research Threats. *International Journal of Aquatic Research and Environmental Studies*, *4*, 7-13.

[13] Pragadeswaran, S., Subha, N., Varunika, S., Moulishwar, P., Sanjay, R., Karthikeyan, P., ... & Vaasavathathaii, E. (2024). Energy Efficient Routing Protocol for Security Analysis Scheme Using Homomorphic Encryption. *Archives for Technical Sciences*, *31*(2), 148-158. https://doi.org/10.70102/afts.2024.1631.148

[14] Ravshanova, A., Akramova, F., Saparov, K., Yorkulov, J., Akbarova, M., & Azimov, D. (2024). Ecological-faunistic analysis of helminthes of waterbirds of the Aidar-Arnasay system of lakes in Uzbekistan. *Natural and Engineering Sciences*, *9*(1), 10-25. https://doi.org/10.28978/nesciences.1471270

[15] Sun, J., Wang, Y., Si, H., Yuan, J., & Shan, X. (2010). Aggregate Human Mobility Modeling Using Principal Component Analysis. *Journal of Wireless Mobile Networks, Ubiquitous Computing, and Dependable Applications*, *1*(2/3), 83-95.

[16] Süren, E., & Angin, P. (2019). Know Your EK: A Content and Workflow Analysis Approach for Exploit Kits. *Journal of Internet Services and Information Security*, *9*(1), 24-47.

[17] Swarnkar, R., Harikrishnan, R., & Singh, M. (2022). Analysis of electric vehicle battery state estimation using scopus and web of science databases from 2000 to 2021: A bibliometric study. *World Electric Vehicle Journal*, *13*(8), 157. https://doi.org/10.3390/wevj13080157

[18] Tseng, Y. H., Lin, C. J., & Lin, Y. I. (2007). Text mining techniques for patent analysis. *Information processing & management*, *43*(5), 1216-1247. https://doi.org/10.1016/j.ipm.2006.11.011

[19] Verma, T., & Pillai, D. (2023). The Demographic Consequences of Forced Displacement: A Longitudinal Analysis of Refugee Populations. *Progression journal of Human Demography and Anthropology*, 13-16.

[20] Wang, S. B., & Peng, X. H. (2023). Knowledge mapping of port logistics in the recent 20 Years: a bibliometric analysis via CiteSpace. *Maritime Policy & Management*, *50*(3), 335-350. https://doi.org/10.1080/03088839.2021.1990429

[21] Wang, W., Xu, Y., Zhang, S., Xu, Y., & Xue, X. (2025). Bibliometric insights into pollution research: trends, geographic disparities, and emerging environmental challenges. *Environmental Research Communications*, *7*(7), 075026. https://doi.org/10.1088/2515-7620/adf0cb

[22] Xue, J., Yang, P., Li, Q., Song, Y., Gelder, P. V., Papadimitriou, E., & Hu, H. (2025). Machine Learning in Maritime Safety for Autonomous Shipping: A Bibliometric Review and Future Trends. *Journal of Marine Science and Engineering*, *13*(4), 746. https://doi.org/10.3390/jmse13040746

[23] Yeo, M., & Jiang, L. (2024). Thermal and Fluid Systems: Analysis, Design, and Optimization. *Association Journal of Interdisciplinary Technics in Engineering Mechanics*, *2*(1), 7-12.

[24] Zhang, Y., Liu, X., Li, X., & Wang, J. (2018). Offshore engineering research: A bibliometric analysis. *Ocean Engineering*, *157*, 240–250.

[25] Zupic, I., & Čater, T. (2015). Bibliometric methods in management and organization. *Organizational research methods*, *18*(3), 429-472. https://doi.org/10.1177/1094428114562629