RESEARCH MAPPING OF MARITIME NAVIGATIONAL TECHNOLOGY BASED ON VISUALIZATION MAPPING APPROACH

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ABSTRACT

Indonesia is a large country with many spreading archipelagos and many ocean resources. The condition makes Indonesia a potential country in many maritime sectors. The potential condition establish maritime navigational technology is one of many topic that has begun to interest many researches. The strong desire of researcher will also get support from the many sources of citations that are now appearing and can be used as references. Even though it has a wide area of expertise, the researches concerning maritime technology is very little at present. This research aims to collect the trends of maritime technology research in Indonesia by performing bibliometric analysis from scientific papers indexed by partly free scholarly database named google scholar. This research analyzes the numbers of document published, the most cited papers, and the productivity of maritime researchers in two specific area of maritime navigation and maritime navigational technology. Some keywords focused on this researched were minned by clustering using VOSviewer. As the result, this study hopefully provide an overview of current research on maritime technology in Indonesia and provide the right direction for researchers with maritime technology research interest.

Keywords: Navigational Technology; Maritime Technology; Vosviewer.

1. Introduction

Indonesia is a potential development for maritime sectors based on the large of its archipelagos country (Perumperindo, [1]). The existence of coastlines on almost every island in Indonesia (±54,720 km) which makes Indonesia rank third after Canada and Norway as a country that has the longest coastline in the world (A. Kumar, [2]). Indonesia also conceive with 514 cities spread over thousands of islands and its population is measured to reach 318.9 millions in 2045 (BPS Statistic, [3]). This strength has great potential to advance the Indonesian economy with the diversity of Indonesia's Maritime potential. It is recorded that Indonesian maritime research has been started since 1872 [4]. Meanwhile, marine research institutes have existed since 1905 under the name "Visscherij Laboratorium te Batavia" which is located in Sunda Kelapa, Jakarta. This institution later metamorphosed and became known as the LIPI Oceanographic Research Center (Kompas.com, [5]). Even though we already have special research institutes and maritime department at universities, research on maritime technology is still very uncoordinated and results in undirected development in the maritime sector (Kompas.com, [5], M. Indonesia, [6]).

There are many journal resource databases can be used now days. Some researchers usually use Scopus as their references for the research. Google Scholar provides a simple way to broadly search for scholarly literature. From one place, you can search across many disciplines and sources: articles, theses, books, abstracts and court opinions, from academic publishers, professional societies, online repositories, universities and other web sites. Google Scholar helps you find relevant work across the world of scholarly research (M. Thelwall, [7], M. E. Falagas, Et, al, [8]). Google Scholar aims to rank documents the way researchers do, weighing the full text of each document, where it was published, who it was written by, as well as how often and how recently it has been cited in other scholarly literature.
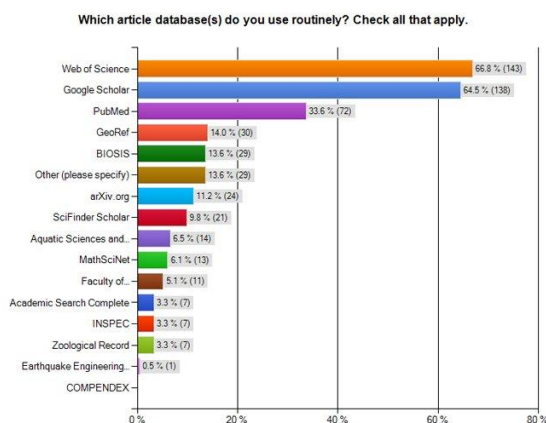
Figure 1. Databases used routinely by all researchers in the study. In this question, multiple database selections were encouraged. The "other" category contains sixteen databases each of which received five or fewer votes.

The main objective of this research is to present a knowledge map of maritime navigational technology research in Indonesia. It is intended to inform researchers and decision makers to recognize knowledge areas, evaluate knowledge gaps and identify future development opportunities. This research is consist of four sections. The first section is discussed about introduction as explained. The second section is talking about methods that used. The section IV is talking about result and discussion of this research and the last section is talking about conclusion.

2. Research Methodology

To avoid confusion in the use of the terms maritime and marine, this research uses a different approach in interpreting the two terms. Maritime and marine research has different drivers (L. Hildebrand, [16], L. P. H. .J.-U. Schröder-Hinrichs, [17]). The Maritime industry works to achieve sustainable and efficient operations, and to position the maritime industry to meet challenges, such as competitiveness and cost efficiency. Marine research, on the other hand, is driven by the need to understand ecosystems, how they function and how they change, and to understand the impact of human activities on ecosystems and to develop options for sustainable use. The challenge is to convene the two communities, to address issues such as the transfer of marine invasive species through maritime transport, or the impact of ships on marine mammals.

A European association of universities in marine technology, WEGEMT, stipulated the term technology for the safe use, exploitation, protection of, and intervention in, the marine environment (WEGEMT, [19]). In this assume, according to WEGEMT, the technologies involved in marine technology are the following: naval architecture, marine engineering, ship design, ship building and ship operations; oil and gas exploration, exploitation, and production; hydrodynamics, navigation, sea surface and sub-surface support, underwater technology and engineering; marine resources (including both renewable and non-renewable marine resources); transport logistics and economics; inland, coastal, short sea and deep sea shipping; protection of the marine environment; leisure and safety (L. Hildebrand, [16]).

This bibliometric study uses quantitative study of spesific term in english language literature stored in the Dimension database containing the keyword "maritime technology", "maritime navigation" and "maritime navigation technology" in their title, abstract or keyword. This research also left out the keyword "marine" and "marine technology" to give the scope of limitation as mentioned before. The collection of data collected were analyzed and visualized using VOSViewer (N. J. van Eck and L. Waltman, [18], N. J. van Eck and L. Waltman, [20]).

3. Result and Discussion

The first Western civilization known to have developed the art of navigation at sea were the Phoenicians, about 4,000 years ago (c. 2000 B.C.E.)(Bratcher, [9]). Phoenician sailors accomplished navigation by using primitive charts and observations of the Sun and stars to determine directions. Despite these early beginnings, it would take many centuries before global navigation at sea became possible. Until the fifteenth century, mariners were essentially coastal navigators. Sailing on the open sea was limited to regions of predictable winds and currents, or where there was a wide continental shelf to follow. Farther ventures were enabled by the development of scientifically and mathematically based methods and tools(Bratcher, [9], Nair, [10]).

One of the earliest human-made navigational tools used to aid mariners was the mariner's compass, which was an early form of the magnetic compass. Early mariners thought the mariner's compass was often inaccurate and inconsistent because they did not understand the concept of magnetic variation, which is the angle between true north (geographic) and magnetic

north(Bratcher, [9], Nair, [10]). It was primarily used when the Sun was not visible to help identify the direction from which the wind was blowing. Throughout the history of navigation, latitude could be found relatively accurately using celestial navigation (Bratcher, [9], Nair, [10], Wikipedia, [11], Theqexperience, [12]). However, longitude could only be estimated, at best. This was because the measurement of longitude is made by comparing the time-of-day difference between the mariner's starting location and new location. Even some of the best clocks of the early eighteenth century could lose as much as 10 minutes per day, which translated into a computational error of 242 kilometers (150 miles) or more.

Based on my experience and researches made, there are more 50 modified types of navigational equipments which can be found onboard ocean going vessels today. Among them are: Voyage Data Recorder (VDR), Rudder Angle Indicator (RAI), Range Tracking and Identification (LRTI), Orca AI, Magnetic Compass (SMC), Gyro Compass, long active Radar, Automatic Radar Plotting Aid (ARPA), Speed & Distance Log Device (SDLD), Electronic Chart Display Information System (ECDIS), Automatic Identification system (AIS), Auto Pilot, Global Positioning System (GPS), Echo Sounder, Rate of Turn Indicator (RTI), etc.
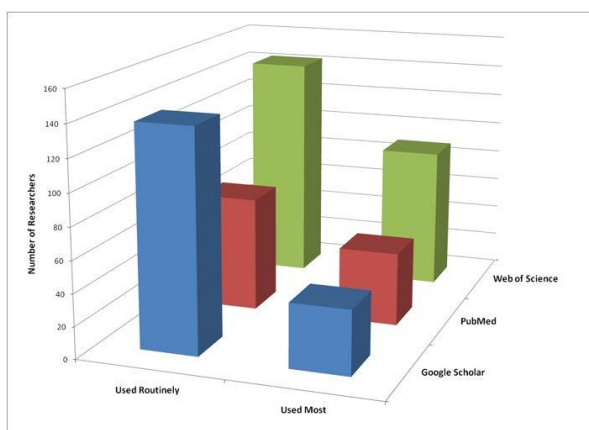

Figure 2. The top three most highly used

Databases comparing how many researchers use them routinely along with other databases, and how many researchers use them as their single most used source. There is a statistical relationship between type of use and which database is used

Google Scholar as mentioned before is a web-search engine that is free and simultaneously indexes full-text scholarly literature across many disciplines and databases. Google Scholar indexes individual academic papers from "journal and

conference papers, theses and dissertations, academic books, pre-prints, abstracts, technical reports and other scholarly literature from all broad areas of research(Martin, Et. Al [14], Singh, Et, al., [15]). Unlike many academic databases, Google Scholar couples numerous social components with its search engine capabilities, which can expand how a researcher uses this database for designing, conducting, and disseminating research.

Within Google Scholar, authors can create profiles with a range of privacy settings similar to social media outlets; affiliate with an institution's library, thereby joining and expanding a social network; allow customizable access to one's curated articles library; access other authors' public libraries; and finally, track who is citing their work. These social components, combined with the multitude of literature-specific search engine aspects, potentially can expand the outreach for individual papers through Google Scholar beyond traditional means, such as presenting or networking at academic conferences.
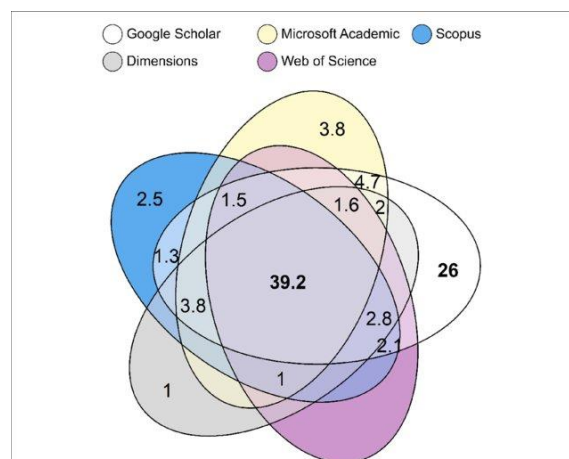

Figure 3. Overlaps between citations found by Google Scholar, Microsoft Academic, Scopus, Dimensions, and Web of Science (Martin, Et. Al [14])

Bibliometrics is a relatively important subject or branch of information science (A. Parlina, [22], T. Bertoncel, [23]. It lies between the border areas of the social science and the physical science. Its scope, includes the studying the relationship within a literature (e.g. citation studied) or describing a literature (A. Pritchard, [24], J. J. Ng and K. H. Chai, [25], P. García-Sánchez, Et. Al, [21]. Typically these descriptions focus on consistent patterns involving authors, monographs, journals or subject/ language.

Bibliometric analysis may be classified under two broad groups (N. J. van Eck and L. Waltman, [14]). One describing the characteristics of a literature (descriptive studies), and the other examining the relationships formed between components of a literature (behavioral studies) (A. Pritchard, [24], J. J. Ng and K. H. Chai, [25]). The literature description is mainly based on the following characteristics of documents.

VOSviewer is a software tool for creating maps based on network data for visualizing and exploring these maps. The functionality of VOSviewer can be summarized as creating maps based on network data and can be used to construct networks of scientific publications, scientific journals, researchers, research organizations, countries, keywords, or terms. A map can be created based on a network that is already available, but it is also possible to first construct a network. VOSviewer provides three visualizations of a map: The network visualization, the overlay visualization, and the density visualization. Zooming and scrolling functionality allows a map to be explored in full detail, which is essential when working with large maps containing thousands of items.

The author is an important aspect to analyze for detecting research gap in maritime technology. Based on data retrieved, the visualization of distribution researchers with the most articles published or indexed can be seen in figure 3 below,
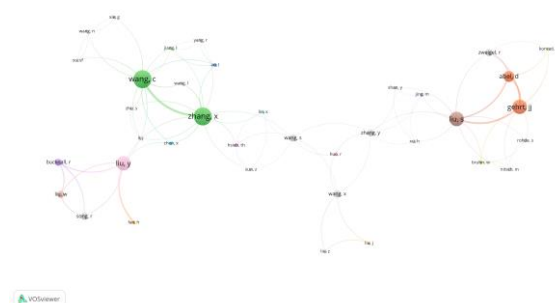

Figure 4. Author Clustering

From the figure 4, this research find that the most contributions for maritime researches in aspect of navigational technology come from Agustan and Oni Bibin Bintoro. Both researcher are affiliated to Agency for Assessment and Implementation Technology, Indonesia as known as Balai Pengkajian dan Penerapan Teknologi And They also published three papers related to the topic.

Author	Affiliation	Number of papers
Agustan	Agency for Assessment and Implementation Technology, Indonesia	3
Oni Bibin Bintoro	Agency for Assessment and Implementation Technology, Indonesia	3
Deny Nusyirwan	Universitas Maritim Raja Ali Haji, Indonesia	2
Muhamad Sadly	Meteorological, Climatological, And Geophysical Agency, Indonesia	2
Julien Louys	Griffith University, Australia	2
Sue O'Connor	Australian National University, Australia	2

Similiat with other indexed database, Google Scholar indexes the citation using some methods. There are Publication citations, Recent citations, The Relative Citation Ratio (RCR), Field Citation Ratio (FCR) and Patent citations. The publication citations value is the number of times that a publication has been cited by other publications in the database. Citing publications can be of any publication type, such as articles, chapters, preprints, or monographs. The recent citations value is the number of citations that were received in the last two years. It is currently reset at the beginning of each calendar year.. RCR indicates the relative citation performance of an article when comparing its citation rate to that of other articles in its area of research. A value of more than 1.0 shows a citation rate above average. The article's area of research is defined by the articles that have been cited alongside it. The Field Citation Ratio FCR is an article-level metric that indicates the relative citation performance of an article, when compared to similarly-aged articles in its subject area. A value of more than 1.0 indicates higher than average citation, when defined by Field of Research Subject Code, publishing year and age. Patent citations is the number of times that this record has been cited by other published patents. Patents may be registered

in several offices, and this may effect patent citation data.
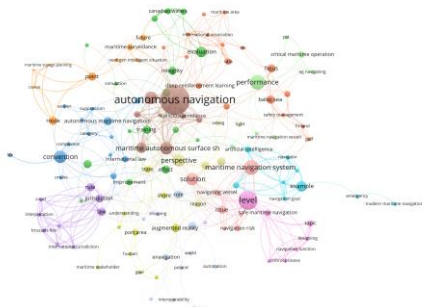
Figure 5: The visualization of co-words analysis results. The font and circle size of the keywords indicate the number of documents in which the keywords appear, while the color of a keyword′s circle displays the cluster to which this keyword belongs

The clustering process produced 8 clusters containing 161 keywords. from the clustered data, there are some research focus can be generated as shown in table below.

Research Focus	Affiliation
Improvement in Strategic Aspect	Agency for Assessment and Implementation Technology, IndonesiaStrategy, Strategic Alliance, Government Support, Technological Innovation, Smart Port, Opportunity
Maritime Affairs	Agency for Assessment and Implementation Technology, IndonesiaMaritime Affairs, National Interest, Ministry, Operation, Production, limitation, maritime aspect, marine environment
Big Data and Internet of Things (IoT)	Analytical System, Simulation Program, Real Time, aviation Technology, Combination, Object
Smart System Approach	Mangrove Ecosystem, Case Study, Marine Technology, Natural Resources, Remote Sensing Technology, Smart Method, Stakeholder, national Shipping

4. Conclussion

Article databases remain important to science researchers. Not all traditional fee-based databases (e.g., Web of Science) and not all subject-specific article databases (e.g., PubMed), are in a "death spiral." While it is not necessary for an academic library to subscribe to 20-30 science article databases when money is scarce, it is also not yet the case that a single multidisciplinary database (e.g., Google Scholar or Web of Science) will suffice. Since only three databases accounted for nearly all of the databases used most in this study, and since a majority of the researchers surveyed supported paying for journal subscriptions over paying for article database access, the number of databases that are absolutely necessary if catastrophic budget conditions force librarians to cut deeply appears to be smaller than librarians once thought.

Google Scholar as free used scholar database deliver a lot of data and information for researcher to help their research. In this bibliometric research, Dimension has answered several desired aspects of this research related to author, citation, keywords that are widely used and even determine the research focus that can be used to solve problems related to the lack of research in the maritime field in terms of technology. Some of the advantages possessed by Dimension are the added value shown in this study.

Furthermore, this research is still far from perfect. Similar bibliometric research using different database sources will produce better supporting data and can reduce the shortcomings of this study. In addition, different keyword approaches can also be used for further research than what has been done at this time.

References

Perumperindo, "Indonesia's Potential Maritime Sector," 2020. Accessed online: http://www.perumperindo.co.id/publikasi/artikel/21-potensi-indonesia-sebagai-negara-maritim, last access November 18, 2021.

Kumar, "List of Countries and Islands with Longest Coastline - NCERT Notes," 2019. Accessed online: https://military-choice.blogspot.com/2019/06/countries-islands-with-longest-coastline-and-interesting-facts-about-indias-coastline.html#gsc.tab=0. Last Accessed July 7, 2021.

BPS Statistics Indonesia, Proyeksi Penduduk Indonesia 2015-2045 Hasil SUPAS 2015. BPS RI/BPS-Statistics Indonesia, 2018.

A. Nontji, "Ekspedisi challenger (1872-1876): peletak fondasi oseanografi modern," Lipi, pp. 1–8, 2017.

Kompas.com, "Riset Kelautan di Indonesia, Maju Tapi Tertinggal," 2020. Accessed online: https://www.kompas.com/sains/read/2020/08/29/173400523/riset-kelautan-di-indonesia-maju-tapi-tertinggal?page=all. Last accessed November 18, 2022.

M. Indonesia, "Riset Maritim Kurang Diperhatikan," 2020. Accessed online: https://mediaindonesia.com/read/detail/80735-riset-maritim-kurang-diperhatikan. Last accessed November 18, 2021.

M. Thelwall, "Dimensions: A competitor to Scopus and the Web of Science?," Journal of Informetrics, vol. 12, no. 2, pp. 430–435, 2018.

M. E. Falagas, E. I. Pitsouni, G. A. Malietzis, and G. Pappas, "Comparison of PubMed, Scopus, Web of Science, and Google Scholar: strengths and weaknesses," The FASEB Journal, vol. 22, no. 2, pp. 338–342, 2008.

Bratcher, Amy J. History of Navigation at Sea. Accessed online at: http://www.waterencyclopedia.com/Mi-Oc/Navigation-at-Sea-History-of.html. Last accessed November 3, 2022.

Nair, Sid. History of Sea Navigation Before the GPS. Accessed online at: https://www.teletracnavman.com/gps-fleet-tracking-education/history-of-sea-navigation-before-the-gps. Last accessed November 3, 2022.

Wikipedia. History of Navigation. Accessed online at: https://en.wikipedia.org/wiki/History_of_navigation. Last accessed November 3, 2022.

Theqexperience. History of Navigation. Accessed online at: https://theqexperience.com/2022/01/04/history-of-navigation/. Last accessed November 3, 2022.

Marine Insight. New Modern Technology for Ship Navigation. Accessed online at: https://marineandoffshoreinsight.com/new-modern-technology-for-ship-navigation/. Last accessed November 3, 2022.

Martin-Martin, Alberto., Thelwall, Mike, Et. Al,. Google Scholar, Microsoft Academic, Scopus, Dimensions, Web of Science, and OpenCitations' COCI: a multidisciplinary comparison of coverage via citations. Available online at: https://www.researchgate.net/publication/341039900_Google_Scholar_Microsoft_Academic_Scopus_Dimensions_Web_of_Science_and_OpenCitations'_COCI_a_multidisciplinary_comparison_of_coverage_via_citations. Last accessed November 3, 2022.

Singh, V.K., Singh, P., Karmakar, M. *et al.* The journal coverage of Web of Science, Scopus and Dimensions: A comparative analysis. *Scientometrics* **126**, 5113–5142 (2021). https://doi.org/10.1007/s11192-021-03948-5

L. Hildebrand and J. Schröder-Hinrichs, "Maritime and marine: Synonyms, solitudes or schizophrenia?," WMU Journal of Maritime Affairs. Springer Verlag, vol. 13, pp. 173–6, 2014.

L. P. H. . J.-U. Schröder-Hinrichs, "Maritime and marine: synonyms, solitudes or schizophrenia? ". SpringerLink, 2014.Url: https://link.springer.com/article/10.1007/s13437-014-0072-y

N. J. van Eck and L. Waltman, "Software survey: VOSviewer, a computer program for bibliometric mapping," Scientometrics, vol. 84, no. 2, pp. 523–538, 2010.

WEGEMT, "History of WEGEMT (Marine Association University)," 2021. Accessed online: http://www.wegemt.com/about/history/. Last Accessed November 18, 2021.

N. J. van Eck and L. Waltman, "VOSviewer Manual version 1.6.16," Univeristeit Leiden, no. November, pp. 1–52, 2020.

García-Sánchez, A. M. Mora, P. A. Castillo, and I. J. Pérez, "A bibliometric study of the research area of videogames using Dimensions.ai database," Procedia Computer Science, vol. 162, pp. 737–744, 2019.

A. Parlina, H. Murfi, and K. Ramli, "Smart city research in Indonesia: A bibliometric analysis,". 16th International Conference on Quality in Research, QIR 2019 - International Symposium on Electrical and Computer Engineering, pp. 1–5, 2019.

T. Bertoncel, M. Meško, and M. Peji Bach, "Big data for smart factories: A bibliometric analysis,". 42nd International Convention on Information and Communication Technology, Electronics and Microelectronics, MIPRO 2019 - Proceedings, pp. 1261–1265, 2019.

A. Pritchard, "CHAPTER FIVE: The Concept of Bibliometrics," pp. 84–122, 1969.

J. J. Ng and K. H. Chai, "A bibliometric analysis of Project Management research," IEEE International Conference on Industrial Engineering and Engineering Management, vol. 2016-Janua, no. 2002, pp. 976–980, 2016.