



Literature Review: Smart Port Concept in Indonesia Using Bibliometric Analysis Methods

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Abstract

Smart Port is a trending solution to meet the challenges of the maritime industry. "Smart" ports mean more attractive and competitive for customers. Artificial intelligence such as the Internet of Things, Big Data, and other technologies allow ports to create smarter workflows, conditions, or customer management, helping to make better decisions so that they can operate more effectively. This research applies bibliometric analysis. Bibliometric analysis is a literature review method that is widely applied in the field of business review to reveal the development of a field of research. This study reviewed 87 studies related to Smart Port research in Indonesia published between 2013 and 2023. Based on this research, the Smart Port Concept developed in Indonesia in terms of technology use includes automated operations using technology systems to control equipment, thereby minimizing human error, by digitizing gateways and using the Internet of Things (IoT). In the environmental concept, an environmental management system is needed to preserve the environment by adapting the concepts of sustainability and green port. This study contributes to a better understanding of the smart Port concept, which lacks an exact definition. Furthermore, this study provides an overview of publication trends and distribution, influential publishers, as well as the Smart Port concepts that are widely adopted in Indonesia. Regarding industry contributions, the results of this study will help port stakeholders clearly understand the issues related to smart port development to make critical decisions in applying advanced technologies to enhance smart port development and high efficiency in port operations.

Keyword: Bibliometric, Smart Port, Review Literature.

1. INTRODUCTION

Rapid technological advancements and increasing demand for the transportation of ocean trade volumes amounting to 80% of global trade and a steady growth rate of 4% in international maritime trade [1] have led to significant transformations in port operations worldwide [2]. Among these transformations is the emergence of the "smart port" concept, which integrates advanced digital technologies to improve port efficiency, security, and sustainability [3]–[5]. Smart ports utilize the Internet of Things (IoT), big data analytics, artificial intelligence (AI), and other advanced technologies to streamline operations and improve port competitiveness on a global scale [3], [6]–[8]. This evolution is in line with the broader trend towards Industry 4.0, where automation and data exchange play an important role in industrial processes [2], [3], [9], [10].

Indonesia, as an archipelago with a strategic geographical position, has realized the importance of improving port infrastructure to meet international standards [11]. Indonesia has 638 large and small ports managed by the government and Port Business Entities (BUP). These ports are continuously developed, especially in terms of infrastructure and facilities, to meet the demands of a dynamic and competitive regional and global environment [6]. The implementation of smart port technology in Indonesia aims to address various



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challenges such as high logistics costs, inefficient port operations, and the need for better integration with global supply chains [3], [12]. Although initial steps have been taken towards digitalization, there is still a significant gap in technology adoption and operational efficiency compared to leading global ports. In addition, the criteria for Smart Ports have not been clearly defined, leading to diverse interpretations in the development of smart ports in Indonesia.

The development of smart ports in Indonesia involves several key components, including digital infrastructure, automated systems, and better human resources capable of managing advanced technologies [1]–[4]. Ports such as Tanjung Priok [7], [13], Makassar Container Terminal [4], and Teluk Lamong Terminal [14] have started to adopt smart port initiatives, integrating digital platforms for operations, business transactions, and communications [4], [9]. These efforts aim to create a smoother and more efficient port ecosystem that can better serve international trade demands [2], [8].

Bibliometric analysis is a method used to assess [15] developments and trends in smart port implementation. By analyzing literature from 2013 to 2023, patents, and other academic and industry publications, researchers can identify key concepts, influential development strategies, and emerging technologies in the smart port domain. This study aims to conduct a literature review on smart port development in Indonesia, using bibliometric techniques to map the research and innovation landscape in this area.

Through this research, the authors seek to highlight the current concept of smart port development in Indonesia, identify important challenges and opportunities, and provide recommendations for future research. It is important to note that this research is limited to examining the extent of smart port implementation in Indonesian ports by describing the concepts that have been implemented. By understanding bibliometric trends and patterns [15], [16] stakeholders can better strategize the implementation of smart port technologies to improve Indonesia's maritime competitiveness in the global arena [1], [3], [5], [17], [18].

2. METHOD

This research applies bibliometric analysis to provide an overview of the Smart Port study. Bibliometric analysis is a literature review method that is widely applied in the business field to reveal the evolution of a research domain [15]. Bibliometric analysis is systematic, transparent, and integrated in reading keywords in an article, making it easy to map concepts using the VoSviewer application.

In this research, bibliographic data was collected from a leading academic database, namely Publish or Perish 08 with a search method using Google Scholar. Apart from Publish or Perish, the Mendeley Desktop application is also used to re-screen articles to be reviewed before being visualized. Data was extracted by searching for keywords in 2013-2023 containing the keywords "Smart Port" and "Indonesia" in the title, abstract or keywords. This study also does not use the keywords "marine" and "marine technology" to provide previous limitations. The collected data set was analyzed and visualized using VOSViewer [16].

The flow of this research can be described as follows.



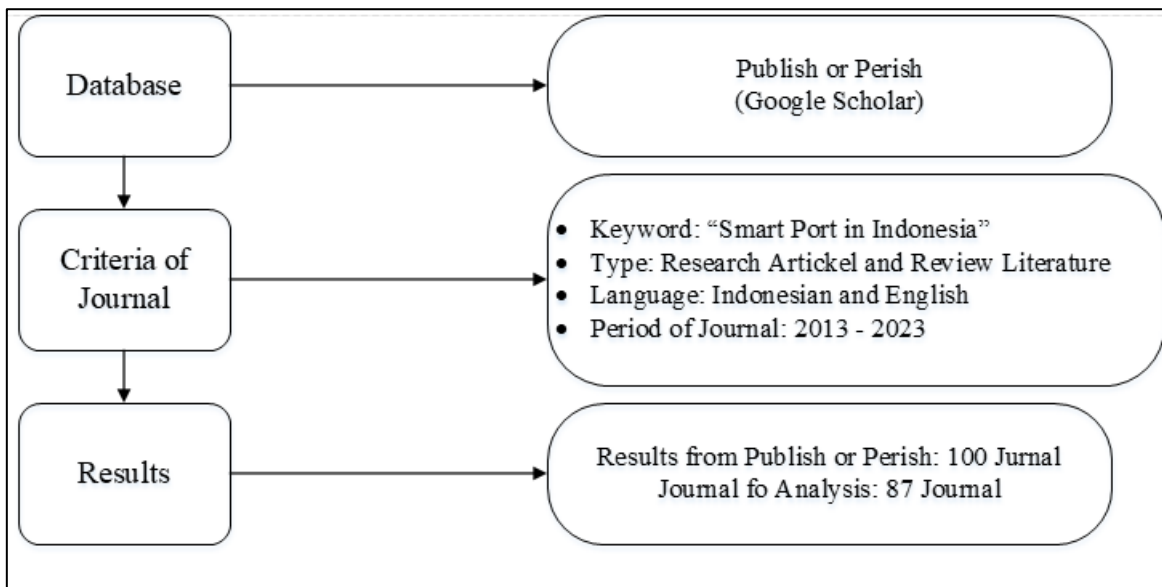


Figure 1 Research Flow

3. RESULTS AND DISCUSSION

3.1. Bibliometric Analysis and Findings

This study reviews a sample of 87 studies related to Smart Port research in Indonesia which were published in 26 publication outlets from 2013 to 2023. Based on the research conducted, it is known that the average number of citations per year since the first journal was 171.30. The journal data obtained is shown in Figure 1 below.

| Citation metrics | | Help |
|---------------------------------|----------------|----------------------|
| Publication years: | 2013-2023 | |
| Citation years: | 10 (2013-2023) | |
| Papers: | 87 | |
| Citations: | 1713 | |
| Cites/year: | 171.30 | |
| Cites/paper: | 19.69 | |
| Cites/author: | 710.79 | |
| Papers/author: | 39.30 | |
| Authors/paper: | 2.85 | |
| h-index: | 23 | |
| g-index: | 38 | |
| hI,norm: | 13 | |
| hI,annual: | 1.30 | |
| hA-index: | 13 | |
| Papers with ACC >= 1,2,5,10,20: | 80,62,35,17,9 | |

Figure 2 Detail of Analyzied Journals

Based on the results of the analysis, of the 87 journals reviewed, it is known that journals published in Elsevier have the highest citation rates compared to other publication media as shown in Figure 3 below.

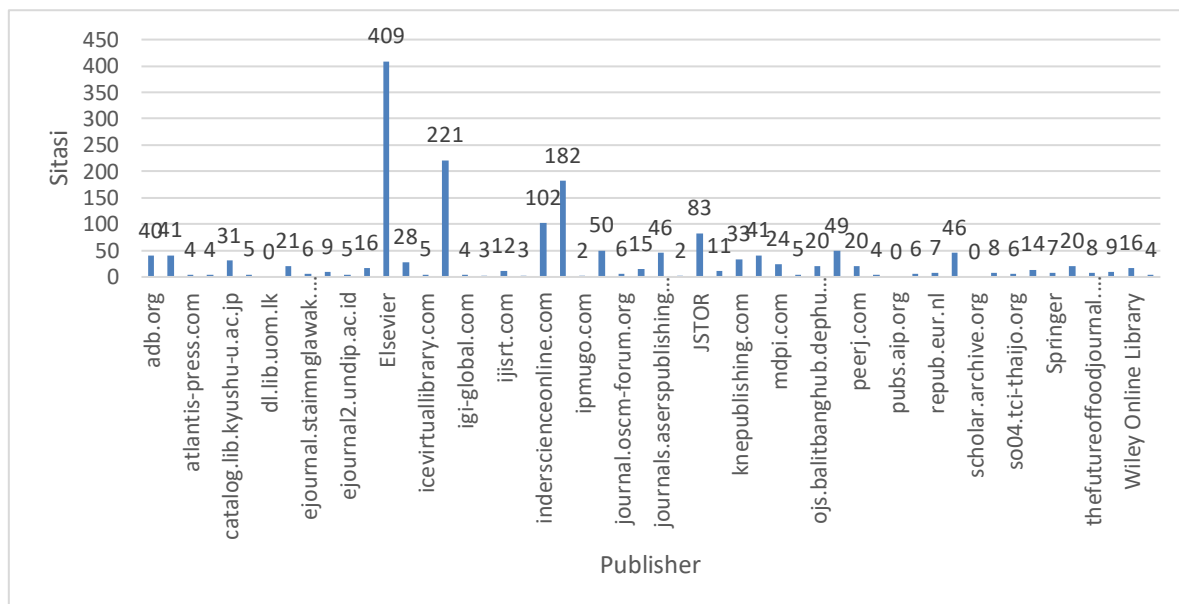


Figure 3 Comparison of Citation Numbers Based on Publication Media

3.2. Smart Port Concept Based on Research Clusters

3.2.1. Bibliometric Analysis Results in VosViewer

Mapping the application of the Smart Port concept in Indonesia using VosViewer describes that the Smart Port concept is closely related to the analysis of hierarchical processes, innovation, challenges and is widely applied to container ports in Indonesia. This is because container flows are still dominated by the four main ports in Indonesia, namely Tanjung Priok Port, Belawan Port, Tanjung Perak Port, New Makassar Port, while other container ports have not been able to compete and there is still a gap in loads in domestic container flows between regions. west and east Indonesia so it is hoped that the implementation of Smart Port can bring change and equal distribution of loads [10].

Apart from that, the Smart Port concept developed in Indonesia in terms of the use of technology is automated operational activities with the use of technological systems to control equipment thereby reducing human error [11], digitalization of ports, utilization of the Internet of Things (IoT) for expansion. broader business. In the environmental concept, an environmental management system is needed to maintain environmental sustainability by adapting the concepts of sustainability and green port [12].

The Smart Port concept mapping is described in Figure 4 below

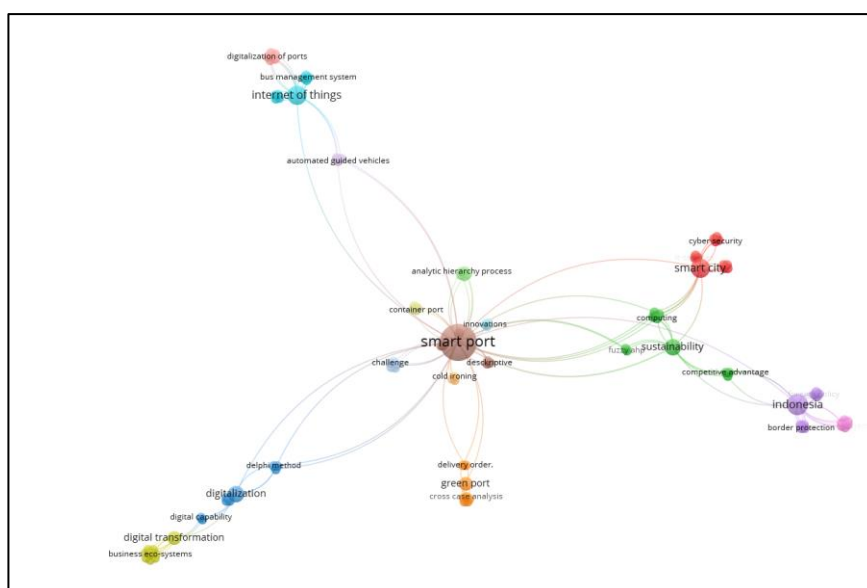


Figure 4 Mapping Konsep Smart Port in Indonesia Based on VosViewer



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Based on the results of concept mapping, it is known that the journal explaining the Smart Port concept in VosViewer starts from 2018 to 2023. This shows that the Smart Port concept in the 2013-2017 period is still not of interest in research in Indonesia. Based on the color description, it is known that the latest research on the Smart Port concept discusses the implementation of Smart Ports in container ports, analytic hierarchy processes, automation and business expansion (business eco-system) as shown in Figure 5 below.

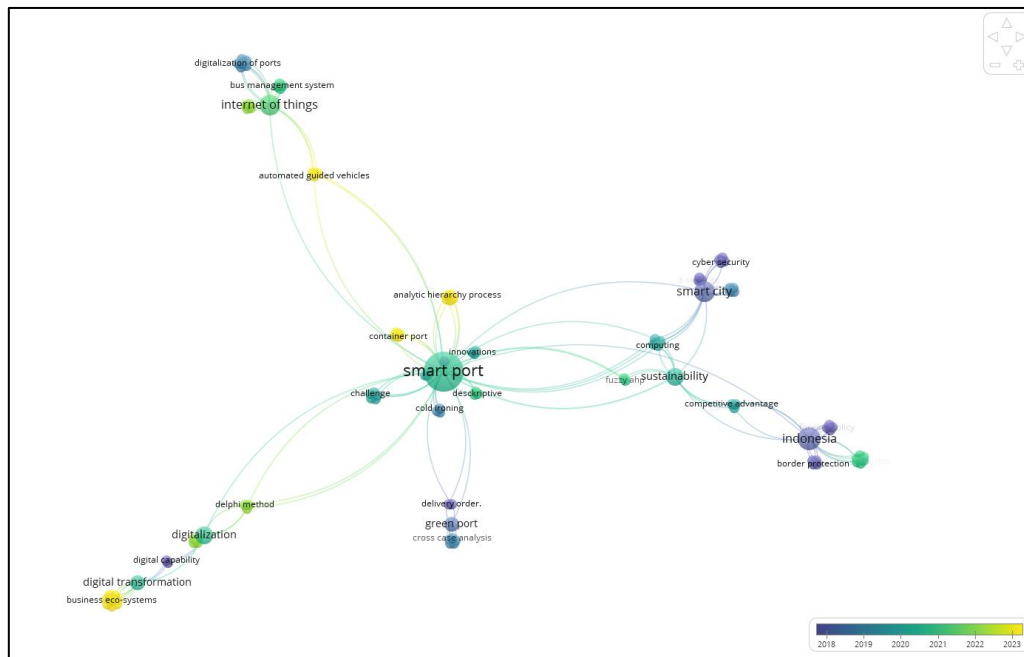


Figure 5 Smart Port Concept Mapping Based on Publication Year

3.3. Concept of Implementing Smart Port in Indonesia

The Smart Port concept in this research involves the use of information and communication technology (ICT) to improve port activities. This research covers several research themes, including the development of Internet of Things (IoT) platforms to connect disparate equipment and infrastructure within ports, reduction of greenhouse gas emissions and carbon footprint to reduce environmental impact, increased energy efficiency in port operations, and the use of smart applications to optimize port management. This aims to ensure customer satisfaction, environmental protection and a better quality of life for the community. Smart ports are characterized by the adoption of innovative technologies, such as information and communications technology (ICT), artificial intelligence, and automation, to enable effective decision making and the concept involves real-time data collection, data analysis, visualization of ship movements, and prediction of resource availability. power to optimize schedules and terminal operations. It also emphasizes collaboration and cooperation among stakeholders, environmental protection, and cybersecurity-based port security protection. In this research, optimizing renewable energy resources is a point of the smart port concept that has not been widely studied in Indonesia

4. CONCLUSION

This research outlines academic and industrial implications. This study contributes to a better understanding of the Smart Port concept which does not yet have a precise definition. Based on the results of the analysis, it is known that the urgency of discussion regarding smart ports in Indonesia has only developed from 2018 until now with a focus of study on port digitalization, automation and handling port environmental pollution problems. In addition, this study provides a general overview of publication trends and distribution, influential publishers, and the Smart Port concept which is widely applied in Indonesia.

The findings of this research will support port stakeholders in understanding issues related to smart port development to make important decisions about the application of advanced technology to improve port performance.



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This research has several limitations. Firstly, although the research is extracted from a prestigious database i.e. this study has investigated articles in indexed journals, thus, gray literature, proceeding papers and non-English publications would be questionable. In addition, the evaluation of this study is only based on 87 publications due to the scarcity of literature covering smart ports in Indonesia. This may limit the assessment for bibliometric analysis because Smart Port development is still in its early stages.

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