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ASIAN PORT PERFORMANCE DIMENSIONS AND ANALYSES: A SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

Purpose: The aim of the study was to analyze the performance dimensions and performance analysis techniques applied in studies of Asian port performance

Theoretical framework: The lack of literature in the context of port performance dimensions in Asian was the theoretical basis of the study. A related study on Asian port performance was analysed and listed in the study based on thematic approach.

Design/methodology/approach: The PRISMA Statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) was used to guide this research, based on the databases of the two most prominent sources of articles which is Web of Science and Scopus.

Findings: This review identified four main categories surrounding the dimensions of port performance, those being operational dimensions, dimensions surrounding customers' perspectives, logistical dimensions, and organizational dimensions. Furthermore, the following three performance analysis approaches were identified as being preferred by researchers of the Asian region: efficiency, productivity, and competitiveness.

Research, Practical & Social implications: The current findings of this research have shown that most studies on Asian ports focus on their efficiency and competitiveness rather than their productivity. A productivity survey might give a better overview of port performance as it concerns the actual output of the ports.

Originality/value: The systematic literature review (SLR) approach were hardly found in study of port performance. At the same time, the PRISMA method were applied to synthesized previous studies on port performance in Asian is another niche of the study.

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DIMENSÕES E ANÁLISES DE DESEMPENHO DO PORTO ASIÁTICO: UMA REVISÃO SISTEMÁTICA DA LITERATURA

RESUMO

Objetivo: O objetivo do estudo era analisar as dimensões e as técnicas de análise de desempenho aplicadas em estudos de desempenho de portos asiáticos.

Estrutura teórica: A falta de literatura no contexto das dimensões de desempenho portuário na Ásia foi a base teórica do estudo. Um estudo relacionado sobre o desempenho dos portos asiáticos foi analisado e listado no estudo com base na abordagem temática.

Design/metodologia/abordagem: A Declaração PRISMA (Preferred Reporting Items for Systematic Reviews e Meta-Analyses) foi utilizada para orientar esta pesquisa, com base nas bases de dados das duas fontes mais proeminentes de artigos que são Web of Science e Scopus.

Conclusões: Esta revisão identificou quatro categorias principais em torno das dimensões de desempenho portuário, sendo estas dimensões operacionais, dimensões em torno das perspectivas dos clientes, dimensões logísticas, e dimensões organizacionais. Além disso, as três seguintes abordagens de análise de desempenho foram identificadas como sendo preferidas pelos pesquisadores da região asiática: eficiência, produtividade e competitividade.

Pesquisa, implicações práticas e sociais: Os resultados atuais desta pesquisa mostraram que a maioria dos estudos sobre portos asiáticos se concentra em sua eficiência e competitividade, em vez de sua produtividade. Uma pesquisa de produtividade poderia dar uma melhor visão geral do desempenho dos portos, uma vez que diz respeito à produção real dos portos.

Originalidade/valor: A abordagem de revisão sistemática da literatura (SLR) dificilmente foi encontrada no estudo do desempenho dos portos. Ao mesmo tempo, o método PRISMA foi aplicado a estudos anteriores sintetizados sobre o desempenho portuário na Ásia é outro nicho do estudo**.**

Palavras-chave: Revisão Sistemática, Ásia, Porto, Eficiência Portuária, Análise de Envelopamento de Dados, Determinantes.

DIMENSIONES Y ANÁLISIS DEL RENDIMIENTO DE LOS PUERTOS ASIÁTICOS: UNA REVISIÓN SISTEMÁTICA DE LA LITERATURA

RESUMEN

Objetivo: El objetivo del estudio era analizar las dimensiones del rendimiento y las técnicas de análisis del rendimiento aplicadas en los estudios sobre el rendimiento de los puertos asiáticos.

Marco teórico: La falta de bibliografía en el contexto de las dimensiones del rendimiento portuario en Asia fue la base teórica del estudio. Se analizó un estudio relacionado sobre el rendimiento portuario en Asia y se enumeró en el estudio basado en el enfoque temático.

Diseño/metodología/enfoque: Para orientar esta investigación se utilizó la declaración PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), basada en las bases de datos de las dos fuentes de artículos más destacadas, que son Web of Science y Scopus.

Resultados: Esta revisión identificó cuatro categorías principales en torno a las dimensiones del rendimiento portuario, que son las dimensiones operativas, las dimensiones en torno a las perspectivas de los clientes, las dimensiones logísticas y las dimensiones organizativas. Además, se identificaron los tres enfoques de análisis del rendimiento preferidos por los investigadores de la región asiática: eficiencia, productividad y competitividad.

Investigación, implicaciones prácticas y sociales: Los resultados actuales de esta investigación han demostrado que la mayoría de los estudios sobre los puertos asiáticos se centran en su eficiencia y competitividad más que en su productividad. Un estudio sobre la productividad podría ofrecer una mejor visión del rendimiento portuario, ya que se refiere a la producción real de los puertos.

Originalidad/valor: El enfoque de revisión sistemática de la literatura (SLR) apenas se ha encontrado en el estudio del rendimiento portuario. Al mismo tiempo, la aplicación del método PRISMA para sintetizar estudios anteriores sobre el rendimiento portuario en Asia es otro nicho del estudio.

Palabras clave: Revisión Sistemática, Asia, Puerto, Eficiencia Portuária, Análisis Envolvente de Datos, Determinantes.

INTRODUCTION

Global seaborne trade is doing well, and with an expansion rate of four percent – the fastest growth seen in the industry in five years – international maritime trade has increased its momentum and sentiment in the shipping industry (UNCTAD, 2017). However, due to the COVID-19 pandemic, the value of international maritime trade declined to 0.5 percent in 2019, a decrease from its 2018 record of 2.8 percent (UNCTAD, 2020). A point of importance in the study of maritime trade is the fact that 80 percent of its international trade is conducted via ports. Therefore, ports play a vital role in connecting many developing countries' international trade systems through port communities (Langen, 2015). Transportation of the goods by sea are the best platform if compared to others mode such as air, railway and road (Vu Thi Hoang Yen, 2022). Ports are crucial in logistics supply chain systems and are at the forefront of the national and regional trading industries. The performance of ports in logistics systems is significant to the current trade industry. Many major port clients focus on the quality and reliability of entire logistics systems rather than just their basic sea-to-land connectivity (Notteboom, 2006). Thus, import and export activities are relying very much on the port performance of the country. Import activities for instance, is profitbale for the country compared to produce the goods locally due to the limited resources (Rahman, Muda, Caroline, Panjaitan, and Situmorang, 2022).

Thus, evaluating port performance is critical and essential to these sectors. Various studies have been conducted on the performances of the major ports of the world. One of the most prominent types of port performance analyses is the port characteristic performance evaluation, which studies a port's performance by analyzing its inputs and outputs. Recently, researchers have been attracted to researching port performance through different dimensions, using new approaches, such as logistics. This research into new dimensions is needed due to the increase in competition between ports, which, in turn, has been caused by the emergence of robust logistics supply chains and massive increments of goods being traded via e-commerce. The Logistics Performance Index (LPI), established by the World Bank, is the leading evaluation tool for logistics performance. It is used as an indicator and benchmark by investors when choosing locations (Lauri Ojala and Celebi, 2015).

Due to the industry's highly competitive nature, all ports must be independent and able to compete with one another in terms of performance and competitiveness. As such, it is important to ensure that port efficiency is always prioritized in a port's development planning.

Toward a systematic review framework for Asian port performance

A systematic literature review examines, analyzes, selects, and explains previous studies on specific topics based on a specific set of criteria. This method is considered rigorous in terms of its research findings, which are based on significant and prominent databases. The outcome of the review will be the identification of research gaps in the field of port performance evaluation for future studies to fill.

As of now, many scholars have reviewed various port performance studies. However, efforts to systematically review the overall performance of Asian ports have been limited, even though the Asian region is the primary contributor to the world seaborne trade. Hence, this study's primary objective is to analyze the existing literature on port performance analyses in Asian countries. It aims to identify the gaps in and cluster the patterns of performance dimensions and approaches of existing literature on Asian port performance. This study is significant given the stiff competition among Asian ports. The importance of Asian ports is evidenced by the fact that most of the highest-performing ports in the world are in Asia.

The present research was guided by the methods currently being used to measure Asian port performance. The details surrounding the dimensions and approaches utilized are critical elements that need to be evaluated to determine the best and most suitable method of analyzing port performance. Apart from studies that measured port performance, studies that researched the determinants of Asian port performance were reviewed as well to identify the various themes that have been previously researched.

The primary concerns of this research are the performance dimensions and performance analysis techniques applied in studies of Asian port performance. The 'performance dimensions' approach has been used by several researchers to study various topics, such as port performance in O'Connor, Evers, and Vega (2019); port competitiveness in Parola, Risitano, Ferretti, and Panetti (2017); and logistics supply chains in Durach, Wieland, and Machuca (2014). The adoption of different dimensions in different studies is due to several reasons: the availability of data, the approach to or focus on a particular dimension in each study, and finally, an exploration of research from different perspectives.

This section introduced the subject and purpose of this research. The second section of this study explains the methodology and the PRISMA Statement (Preferred Reporting Items Systematic Reviews and Meta-Analysis) used. The third section reviews and systematically analyzes the related research on Asian port performance, and the final section discusses recommendations for future research.

METHODOLOGY

This section explains the methods used to analyze the included articles related to Asian port performance. The researcher followed the PRISMA guideline to locate articles on Scopus and Web of Science and then systematically reviewed these articles through the following process: identification, screening, testing for eligibility and quality, and, finally, analyzing the chosen articles.

PRISMA

The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement was used to guide this study. A standard of publication is needed to guide authors and ensure that publications are of high quality. The PRISMA method is often used in medical and environmental management studies to maintain publication standards. Sierra-Correa and Cantera Kintz (2015) explains that the PRISMA statement offers unique advantages to a study. Firstly, it has a systematic approach and inclusion and exclusion criteria for the process of identification. Secondly, it explores an extensive database of scientific literature in a relatively short amount of time. It is a rigorous search method used in a variety of fields, including those related to Asian port performance. The PRISMA approach is rarely used in transportation, ports, and maritime trade studies. However, a certain standard must be applied to and upheld by systematic literature reviews. As explained by Glass (1976) in Elvik (2005), 'Meta' means above, and 'meta-analysis' can be defined as an analysis's analysis. Several recent studies on transportation have utilized the PRISMA approach in their research, including Heydari, Hickford, McIlroy, Turner, and Bachani (2019) and Kabashkin, Yatskiv, and Prentkovskis (2018).

Resources

This research analyzed articles found in two leading databases, Scopus and Web of Science (WOS). WOS was the first database searched in the review. It comprises more than 33,000 journals across over 518 disciplines, including economics and the social sciences.

The second database searched in this review was Scopus. Scopus is one of the largest databases in the world, consisting of more than 24,600 active titles from 5000 publishers, which are rigorously vetted and selected by an independent review board.

Eligibility and exclusion criteria

The eligibility and exclusion criteria for this study were determined. Firstly, only articles with empirical data were selected. Other types of research, such as reviews, book series, standalone books and chapters in text and conference proceedings, were excluded. Secondly, only articles published in English were accepted. Thirdly, to ensure the review was up-to-date, only articles published between 2007 and 2020 were selected. As this review sought to focus on port performance in Asia, articles listed in social science indexes were chosen, thus excluding articles indexed in pure science indexes (Science Citation Indexed Expanded). Lastly, in line with its objective to focus on Asian ports, only articles researching Asian territories were selected for this review (see Table 1).

Systematic review process

Identification

The process of selecting articles for the current review involved several stages. First in the selection process was the identification process, wherein keywords related to this study's research were identified and keyed into the search engines of the databases. A thesaurus was used to ensure that all essential keywords were identified. In addition, previous studies were also referred to explore the appropriate and common keywords used in port performance studies. Several keywords, such as data envelopment analysis (DEA), Malmquist, and stochastic, were applied in the search strings based on the findings from previous articles. These words were mainly found in the titles of the identified articles.

Then, these keywords were inputted as search strings in the Scopus and WOS search engines. The Scopus search engine found 160 articles, and the WOS search engine found 735 articles. Altogether, 895 articles were found at the first stage of the systematic review process.

Table 1: Keywords and search strategy

Database	Keywords used
Scopus	TITLE-ABS-KEY ((productivity OR competition OR competitive* OR efficient* OR "technical efficiency" OR performance* OR "DEA" OR "data envelopment analysis" OR stochastic OR Malmquist) AND (port* OR seaport* OR harbor OR container* OR "container AND port" OR "seaport AND container" OR "container terminal*") AND (Asia OR Asian OR ASEAN))
Web of Science	(TS= ((productivity OR competition OR competitive* OR efficient* OR "technical efficiency" OR performance* OR "DEA" OR "data envelopment analysis" OR stochastic OR Malmquist) AND (port* OR seaport* OR harbor OR container* OR "container AND port" OR "seaport AND container" OR "container terminal*") AND (Asia OR Asian OR ASEAN))) AND LANGUAGE: (English) AND DOCUMENT TYPES: (Article) Timespan: 2010-2020. Indexes: SCI-EXPANDED, SSCI, A&HCI, ESCI.

Source: Prepared by the authors (2022)

Screening

The screening process allowed for the adoption of topics thought to be related to the study's field and the exclusion of those thought to be irrelevant to the present review. Firstly, only journal articles with empirical data were included. Other publications, such as reviews, book series, books, chapters, and conference proceedings, were excluded. Secondly, only articles published in English were accepted for review to avoid mistranslations and confusion. Thirdly, to maintain this research's contemporary relevance, only articles published within the past five years (2015 to 2020) were included. Fourthly, only articles published in the fields of social science, business management and accounting, economics, econometrics, finance, and mathematics were selected. Lastly, only studies on Asian countries were selected. In total, 435 articles were excluded during the screening process.

Table 2: The inclusion and exclusion criteria

Criterion	Eligibility	Exclusion
Literature type	Journals (research articles)	Journals (systematic reviews), book series, books, chapters of a book, conference proceedings
Language	English	Non-English
Timeline	Between 2015 to 2020	Before 2015
Indexes	Social Science Citation Index, Emerging Sources Citation Index, Art and Humanities Index (Web of Science)	Science Citation Indexed Expanded
Countries and territories	Asian countries	Non-Asian countries (Mixed geography of Asian and Non-Asian countries in one study was included)

Source: Prepared by the authors (2022)

Eligibility

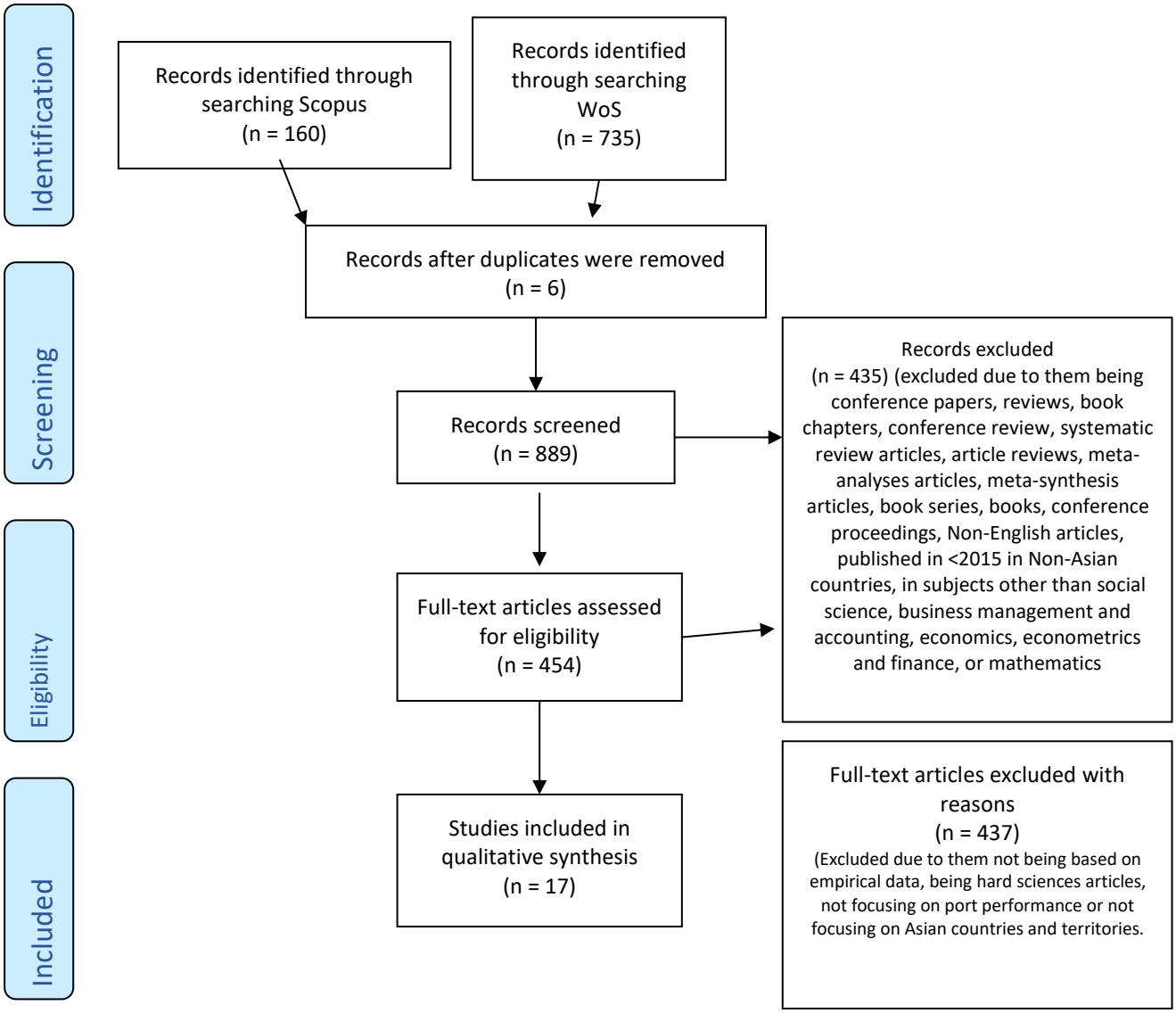
A total of 454 articles proceeded to the third stage of the screening process. A more detailed examination of the articles' titles, abstracts, and main contents was conducted to ensure they met the present study's inclusion criteria. Consequently, 437 articles were excluded from the review due to ineligibility.

Data abstraction and analysis

All related articles were analyzed and examined. The focus of this stage of the screening process was to identify the common themes found within the articles' formulated questions. First, the articles' abstracts were read, and then their full texts were studied in-depth to extract their themes. Qualitative content analysis was performed to identify the themes related to Asian

port performance and port analysis dimensions. The authors then organized the related dimensions into the themes of the topics.

Fig.1. Flow diagram of the study (adapted from Moher et al., 2009).



RESULTS

The themes of these articles consisted of three areas: performance dimensions, performance analyses, and approaches to variables. There are four performance dimensions, namely operational, customers' perspective, logistical, and organizational. Performance analysis analyzes the following areas: efficiency, productivity, and competitiveness. In addition to the four performance dimensions and three performance analyses, there are two main variables studied in these articles: input/output and determinants/indicators. The present review has conducted a comprehensive analysis of the latest port performance studies conducted on

the Asian region. Five categories of research have been identified based on the countries studied in the previous studies, those being the categories of Asian ports and non-Asian ports. Thirteen of the selected articles focused solely on Asian port performance analysis (Nguyen, Woo, Beresford, and Pettit, 2020; Yang and Yip, 2019; Tsai and Tai, 2019; Sinha and Roy Chowdhury, 2018; Kavirathna, Kawasaki, and Hanaoka, 2018; Venkatasubbaiah, Rao, Rao, and Challa, 2018; Lee, Lam, Lin, Hu, and Cheong, 2018; Ren, Dong, and Sun, 2018; Akhavan, 2017; S. Kim, Kang, and Dinwoodie, 2016; Jang, Park, and Kim, 2016; Pak, Kim, Moon, and Jee-moon, 2015; T. S. Kim, 2015; Yeo, 2015), while two of them examined both Asian and non-Asian ports (Chen, Chou, and Hsieh, 2018; Jim Wu, Yuan, Goh, and Lu, 2016). Furthermore, four studies concentrated on port comparisons (Lee et al., 2018; Ren et al., 2018; Yeo, 2015; S. Kim et al., 2016), one study focused on the categories of port services (Ren et al., 2018), and five studies concentrated on a single port or country analysis (Tsai and Tai, 2019; Sinha and Roy Chowdhury, 2018; Kavirathna et al., 2018; Akhavan, 2017; and Pak et al., 2015). All the selected studies followed a quantitative approach in terms of research types. The studies were published in different years. One article was published in 2020, two were published in 2019, seven were published in 2018, one was published in 2017, three were published in 2016, and three in 2015.

Dimensions of port performance in Asian countries

This section will explain the dimensions of port performance analysis performed on Asian countries. Several dimensions were found in the review and clustered into four overarching categories: operational, customers' perspective, logistical, and organizational. The categorization of dimensions was an important process because categories provide an actual understanding of how port performance is currently being measured and evaluated.

Operational

The operational dimension typically concerns the measurement of port performance based on the characteristics or specifications of port facilities and infrastructures. Nine out of the seventeen selected studies focused on operational dimensions (Nguyen et al., 2020; Yang et al., 2019; Venkatasubbaiah et al., 2018; Chen et al., 2018; Kutin et al., 2017; Jang et al., 2016; T. S. Kim, 2015; Jim Wu et al., 2016; Lee et al., 2018). The standard approach to measuring port performance via operational dimensions is either through the parametric approach (Data Envelopment Analysis [DEA]) or the non-parametric approach (Stochastic Frontier Analysis [SFA]). Four out of nine articles on operational dimensions applied the DEA

method, two the SFA, one the Malmquist Productivity Index, one the generalized Metafrontier Malmquist Productivity Index (gMMPi), and one the AMS. Three out of the four articles that relied on DEA (Venkatasubbaiah et al., 2018, Kutin et al., 2017; Jang et al., 2016) focused on conventional DEA to measure port performance, while one article by Nguyen et al. (2020) combined DEA and market concentration analysis to find a different approach. DEA is a non-parametric approach which uses the inputs and outputs of Decision Making Unit (DMUs) to measure port performance.

The first study analyzed in this review, Venkatasubbaiah et al. (2018), studied the performance of 28 ports in Asia using DEA, Principal Component Analysis (PCA), and the hybrid method of DEA-PCA to rank the chosen ports' performances. In this study, yard area, the number of quay cranes, terminal cranes, and yard tractors used by the port, and berth length were the inputs of the DMUs, whereas terminal cargo handling capacity was the output. The ranking of the ports' performances was based on two approaches, which were DEA and PCA, and a combination of the two in the DEA-PCA hybrid method. The ranking results showed a consistency rate of about 75% in the ranking approaches of DEA, PCA, and the DEA-PCA hybrid for container terminals. A correlational analysis of the rankings of the three methods was done through the Minitab-14 and Pearson correlation coefficients test, which showed that the correlations between the ranking methods were high and positively correlated. The second study in the review, Kutin et al. (2017a), focused on the performance evaluation of 50 ports in the Asian region, applying the DEA-BCC and DEA-CCR output-oriented models. This study examined the data of the studied ports in two modes: firstly, by examining the inland seaports and seaports, and secondly, by studying the handling systems of the ports, such as their quay and yard handling systems. Six categories of ports were identified in the article, which were inland seaports and seaports with yard gantry systems; inland seaports and seaports with rubber tyred gentry cranes (RTGs) and FTs; seaports/terminals with yard gantry systems and FTs; seaports/terminals with yard gantry systems, RTGs, and FTs; inland seaports that lacked yard handling systems; and inland seaports with yard gantry systems. Another study that employed DEA for its efficiency measurement was Jang et al. (2016), which concentrated on 21 ports in Asia. This study used the DEA models of CCR-I, BCC-I, BCC-O, CRS-SBM (Slacks-Based Measure), and VRS-SBM in combination with Shannon's entropy approach. Several inputs, such as length of berth, number of gantry cranes, and terminal area, were used, while container cargo volume was employed as the output. Shannon's entropy was used in the study due to each of the DEA models providing different results. The final study, Nguyen et al. (2020), obtained an interesting finding on the port efficiency and market concentration of 50 major ports in Asia,

as explained in the discussion section of this review. DEA was conducted on the study, with berth length, number of cranes, and total area serving as its inputs and container throughput serving as its output. In the same study, Nguyen et al. (2020) employed different approaches to measure market concentration: the Hirschman-Herfindahl Index (HHI), Gini coefficient, and shift-share analysis.

For studies that utilized the parametric approach, only one study, Chen, Chou, and Hsieh (2018), was found to have utilized SFA. The study explored the technical efficiency, disaggregate input efficiency, and meta-technical efficiency of 35 ports in Asian and Non-Asian regions from 2004 to 2011. Container throughput (TEU) was employed as the output variable of the study. The input variables were the number of berths, berth length, terminal area, container storage volume, and number of ship-to-shore container cranes, trucks and vehicles, and quay cranes. Environmental variables that comprised micro-environmental variables (region, water depth, and port automation) and macro-environmental variables (economics growth rate, liner shipping connectivity indexes, and time trends) were included as well. The study's results showed that, in the context of output efficiency for throughput and ship-to-shore cranes and trucks, ports in the Asia-Pacific region were significantly superior to docks in Europe and America. However, European and American ports were significantly superior to Asian ports in the input efficiency of their container storage.

Customers' perspective

The perspective of customers is another dimension evaluated in port performance analysis. In this field, customers generally refer to professionals or experts in the port industry who are asked to evaluate port performance in this dimension. Two out of the seventeen selected articles were found to fall under this category. The first study was a survey done by Lee et al. (2018) on the performance of fifth-generation ports (5GPs), which utilized the Multiple Criteria Decision Making (MCDM) methodology, wherein the Visekriterijumska Optimizacija I Kompromisno Resenje (VIKOR) method was applied to obtain the integrated scores of the evaluated ports and the preference ranking organization method for the study's enrichment evaluations (PROMETHEE). This method was employed to measure the performances of the ports, while consistent fuzzy preference relation (CFPR) was used to measure the relative weights of the ports' features. This study was conducted on four ports in the Asian region, namely the ports of Busan, Hong Kong, Singapore, and Shanghai. Five aspects (service, technology, sustainable development, clusters, and hubs) were tested in this survey, in addition to twelve different criteria (reliability, resilient systems, SWS, RFID,

coordination, integrated development, green port development, port cluster management, maritime cluster management, port infrastructure, port connections, inland connections, and value-added functions). The study found that the Port of Singapore was the highest-performing port based on the average performance of the 5GP criteria of the four ports. The second study to fall under this dimension was Ren et al. (2018), which applied Multi-Attribute Decision Analysis (MADA) to evaluate the ports of Singapore, Hong Kong, and Shanghai from the professionals' and experts' perspectives of the port industry. Three indicators, natural conditions (geographical position superiority, deep-water berth, and berth length), shipping conditions (container handling capacity, route accessibility, the concentration of vessels, registered shipping capacity), and external conditions (tax, market freedom, and political factors) were used to measure the performances of ports that were under the Belt and Roads Initiatives. The study's outcome showed that Singapore was the most competitive port, followed by Hong Kong and then Shanghai. Both customer perspective dimensions showed that opinions from stakeholders are essential in evaluating port performance in the context of satisfaction and opinions on the quality of port services, standards, and other criteria related to port performance.

Logistics

Logistics is the third category of the dimensions of port performance studies conducted in Asia. Logistics has become a critical area of research recently due to the importance of supply chain systems to economics and businesses. Five articles were found to fall under the logistics dimension in the selected Asian port performance studies. The first article is by Tsai and Tai (2019), which studied the competitiveness of the Kaohsiung port in terms of its shipping carrier operating cost. Most ports in East Asia face various pressures and threats, such as changes in shipping line structures, ships upsizing, and pressure from the alliance. This critical study found that the port of Kaohsiung was able to prevent these threats and pressures from affecting its efficiency and maintain its performance by introducing new measures related to alleviating cost-related burdens. The port of Kaohsiung was found to need to build a new deep-water terminal and obtain larger cargo-handling equipment to attract more ships. The second article under this category is Kavirathna et al. (2018), which studied the competitiveness of the port of Colombo and its competitors in the transshipment industry: Singapore, Klang, and Tanjung Pelepas. The study applied a generalized cost approach to measuring performance and chose the discrete choice model to investigate port choice by exploring the ports' transshipment market shares. An integration of quantitative criteria and non-quantitative criteria was the

approach utilized in this study. The model of generalized cost employed in this study measured monetary cost (port charges), journey cost, time cost, and other non-quantitative criteria.

The third article under the logistics analysis category, Akhavan (2017), conducted a comparative analysis of the competitiveness of the port of Dubai relative to the port of Singapore. The study, in essence, denied the idea that Dubai's port is far behind Singapore's port in terms of logistics performance. Akhavan (2017) indicated that, based on the Logistics Performance Index (LPI), Dubai's port has enhanced its logistical competitiveness and shows an improving trend compared to Singapore. The fourth article is S. Kim et al. (2016), which studied port competitiveness based on the ports' regional gateway statuses. The ports of Shanghai, Hong Kong, and Busan were studied as important ports in the North Sea Asia (NSA) region to measure the competitiveness of that region. This study also explored the determinants of port competitiveness and grouped them into four sub-dimensions: availability, operational efficiency, port costs, and service quality. The available components comprised local cargo volume, infrastructure, facility utilization, market niche, preference of shipping liners, and the port's physical capacity. For operational efficiency, the five components identified were terminal productivity, hinterland development, simplification of procedures, cargo handling speed, and supply chain cooperation. Two other sub-dimensions identified were port costs (transport cost per container, transshipment cost, port charges, and port service costs) and service quality (reliability of service performance, safety and security, application of IT, quick response to port user's needs, and low congestion in port). The fifth article under the logistics dimension is Pak et al. (2015), which investigated the influence of liner connectivity, traffic volume, and trade environment on the performance of Korea's ports. The result of the research identified that connectivity and traffic volume per connection enhanced port performance.

Organizational

Although only two articles were found to use the organizational dimension, it is still a critical component in these studies. The organizational dimension covers the structure of a port's stakeholders, be they individuals, corporations, or companies. Under this dimension, the performance of a port was evaluated based on any of its organizational variables. The first study falling under this category is Yeo (2015), which evaluated port performance based on two critical organizational components: a global terminal operator (GTO) and port ownership. Data for this study was collected from 260 container terminals in China, Korea, and Japan. Overall, this study highlighted the importance of GTOs in influencing port performance. Unfortunately, no significant relationship was found between port ownership and port performance. The

second article, Sinha and Roy Chowdhury (2018), explored suitable models for port privatization (berth) in India to maximize port efficiency. The results suggested that an optimal mix of private and self-governed ports was the best model for enhancing efficiency, as opposed to complete privatization.

All of the above dimensions, which were employed by previous studies, are summarized in Table 3.

Table 3: The dimensions of port studies in Asian

No	Authors	Operational	Customers'Perspective	Logistical	Organizational
1.	Nguyen P. N. et al. (2020)	x			
2.	Yang X. et al. (2019)	x			
3.	Venkatasubbaiah K. et al. (2018)	x			
4.	Chen H. et al. (2018)	x			
5.	Kutin N. et al. (2018)	x			
6.	Jang H. M. et al. (2016)	x			
7.	Kim T. S. (2015)	x			
8.	Jim Wu et al. (2016)	x			
9.	Lee P. T. et al. (2018)		x		
10.	Ren J. et al. (2018)		x		
11.	Yeo H. (2015)				x
12.	Sinha (2018)				x
13.	Kavirathna (2018)			x	
14.	Kim et al. (2016)			x	
15.	Cho et al. (2016)			x	
16.	Akhavan M (2017)			x	
17.	T. Tsai et al. (2019)			x	

Source: Prepared by the authors (2022)

Input/Output and determinants of port performance

In measuring port performance, various variables were used as inputs and outputs. Since all the chosen studies utilized quantitative methods, the present study has categorized these variables into two approaches: input/output variables and determinants. Input/output-based variables are commonly used in parametric and non-parametric analyses, such as DEA and SFA, and are used to measure performance. Determinants, contrastingly, are variables that explain port performance. As shown in Table 4, eight articles utilized the input/output approach to variables.

Table 4: The inputs and outputs

No	Authors	Input/output
1.	Nguyen P. N. et al. (2020)	Input: Berth length, number of cranes, total area. Output: Container throughput
2.	Yang X. et al. (2019)	Input: Berth length in meters, terminal areas in square meters, crane capacity in tons. Output: Container throughput
3.	Venkatasubbaiah K. et al. (2018)	Input: Yard area, number of quay cranes, number of terminal cranes, number of yard tractors, berth length Output: Cargo terminals' handling capacity
4.	Chen H. et al. (2018)	Input: Capacity of container storage, number of ship-to-shore container cranes, trucks and vehicles, and mobile/quay cranes Output: Container throughput
5.	Kutin N. et al. (2018)	Input: Dependent on the categories, which Kutin created, which were based on inland and seaports and the types of equipment used in each category Output: TEUs
6.	Jang H. M. et al. (2016)	Input: Length of berth, number of gantry cranes (G/C), terminal areas Output: Container cargo volume
7.	Kim T. S. (2015)	Output: TEUs
8.	Jim Wu et al. (2016)	Input: Quay length, terminal area, terminal capacity Output: TEUs

Source: Prepared by the authors (2022)

Discussion on the input/output of port performance

This work involves the measurement of port performance. The present researchers found nine articles that studied port performance in Asia. Several inputs and outputs were used as the primary variables to measure performance. Eight of these inputs were identified in the selected articles, and those inputs are under port characteristics, which generally consist of port facilities and equipment. These inputs are berth length, number of cranes, size or area of the port, yard and storage, number of tractors, and number of trucks. Only one output type was found in all the selected articles, and that is port throughput, usually measured in TEUs. As a result, all the studies' inputs and outputs focused on each port's internal factors in measuring port performance.

Discussion on determinants of port performance

As for the determinants of port performance, five main determinants were identified: economic, logistics and connectivity, technological, institutional, and natural or external factors. First, the economy cluster deals with macroeconomic factors, such as GDP growth, trade, and traffic volume, which have been proven to affect port performance. The economy cluster includes microeconomic factors as well, such as port charges, handling charges, and fuel cost. These determinants directly influence the decision of many port communities in entire

port systems. Thus, both macroeconomic and microeconomic variables affect the results of the determinants in various formats and findings. Secondly, the logistics cluster focuses on logistics as a determinant of port performance, including factors concerning supply chains, simplification of procedures, deviation time, vessel turnaround time, waiting time, and the logistics performance index. Thirdly, technology plays a significant role in ports due to the importance of new technology in enhancing the production rate of port throughput, which in turn increases port performance. The fourth cluster revolves around institutional aspects, which comprise matters related to the organizational structures of port communities. For instance, the factors regarding port operations and human resources are essential in determining port performance. Finally, these articles also found natural causes and external factors to be determinants of port performance. Table 5 depicts the variables applied in these nine articles.

Table 5: The determinants

No	Authors	Determinant
1.	Lee P. T. et al. (2018)	Reliability, resilient systems, SWS, RFID or IT, coordination, integrated development, green port development, port cluster management, maritime cluster management, port infrastructure, port connections, and inland connections and value-added
2.	Ren J. et al. (2018)	Natural conditions, shipping conditions, and external conditions*
3.	Yeo H. (2015)	Global terminal operators, ownership of containers, terminal infrastructure, direct calls, and hinterland connections
4.	Sinha (2018)	Revenue earned per ton by port, net earnings from cargo, net earnings from vessels, revenue earned per berth, cost per berth, total cargo handling capacity, total number of berths in port, number of days a port operates per annum, parcel load per ship, annual vessel capacity, productivity per day at berths operated by different berth operators, and desired productivity
5.	Kavirathna (2018)	Port charges, deviation cost, feeder link cost, deviation time, vessel turnaround time, waiting time, feeder link time, location with other hubs, hub port accessibility, location with feeder market, port capacity, berth availability, frequency of delays, records of damages, regulations, port infrastructure, IT, logistics facilities, navigational services, husbandry services, professional employees, marketing efforts, port flexibility, financial clearance, frequency of ship visits, number of services calling, availability of dedicated terminals, personal contacts, special preferences, availability of captive cargo, availability of feeder services, preferences of forwarders, locations of hubs
6.	Kim et al. (2016)	Local cargo volume, port facility utilization, proximity, shipping liners, physical ports, hinterland, terminal productivity, cargo handling

		management, supply chain management, simplification of procedures, total transport cost per container, transshipment costs, port charges, cargo handling charges, port service cost, reliability of service performance, safety, application of IT, quick response rates, low congestion, and service differentiation
7.	Cho et al. (2016)	Container port performance, GDP growth, number of container ships, trade cost, quality of trade infrastructure, liner shipping connectivity, and traffic volume per connection
8.	Akhavan M. (2017)	Logistics performance index
9.	T. Tsai et al. (2019)	Fuel costs, port expenses, stevedoring and handling expenses, and canal tolls with fuel costs

Source: Prepared by the authors (2022)

Categories of port performance analysis

A review of the studies of the performance of Asian ports showed three types of performance analyses adopted by researchers. The types of performance analyses found to be the preferred analyses of researchers are efficiency, competitiveness, and productivity analyses. When studying performance, efficiency, competitiveness, and productivity are usually found in the same context and circle. The productivity of a port refers to the measurement of its basic inputs and outputs. The efficiency of a firm or port refers to how effective it is in utilizing its inputs to produce the maximum output. Thus, the efficiency of a port is an essential indicator of its competitiveness. Eight of the seventeen selected articles focused on competitiveness. Six focused on efficiency, two on productivity, and one on efficiency and competitiveness.

The category of competitiveness was the most preferred topic of study by researchers of the Asian region, with nine articles employing this approach. Studies on competitiveness are critical, especially to port stakeholders, such as investors, port operators, port authorities, and shipping liners. A port's competitiveness is an indicator of its performance. Thus, a highly competitive port will gain more recognition from traders, shipping liners and investors. The nine articles that studied competitiveness in this review are Kutin et al. (2017a), T. S. Kim (2015), Lee et al. (2018), Ren et al. (2018), Kavirathna et al. (2018), S. Kim et al. (2016), Pak et al. (2015), Akhavan (2017), and Tsai and Tai (2019).

Efficiency analysis refers to direct research on the efficiency of a port’s operations, using its inputs and outputs as variables to measure the port’s performance. Efficiency analysis comprises several dimensions, including technical efficiency, allocative efficiency, and average efficiency. All methods of efficiency analysis explore the operational aspects of port infrastructure. Therefore, the inputs typically consist of port facilities and their infrastructures, such as berth length, number of quay cranes, number of rubber tyre gantries, and storage area,

while the output is typically the port throughput. The efficiency result is measured, and the ports are ranked accordingly. The eight articles that adopted efficiency performance analyses in this research are Nguyen et al. (2020), Yang and Yip (2019), Venkatasubbaiah et al. (2018), Chen et al. (2018), Kutin et al.(2017b), Jang et al. (2016), Yeo (2015), and Sinha and Roy Chowdhury (2018).

Productivity analysis is the third category of performance analysis found in Asian port performance studies. It focuses on the measurement of and changes in the productivity aspect of ports. Data from various ports and years were analyzed via the Malmquist Productivity Index (MPI) to measure changes in their productivity levels. One of the studies that utilized productivity analysis is Jim Wu et al. (2016), which evaluated the productivity of ports in the Asia-Pacific Economic Cooperation (APEC). The study categorized the locations of ports into two types of countries: developed countries (DCs) and developing countries (LDCs).

Table 5: Categories of performance analyses

No	Authors	Efficiency	Productivity	Competitiveness
1.	Nguyen P.N et al. (2020)	x		x
2.	Yang X. et al. (2019)		x	
3.	Venkatasubbaiah K. et al. (2018)	x		
4.	Chen H. et al. (2018)	x		
5.	Kutin N. et al. (2018)	x		
6.	Jang H. M. et al. (2016)	x		
7.	Kim T. S. (2015)			x
8.	Jim Wu et al. (2016)		x	
9.	Lee P. T. et al. (2018)			x
10.	Ren J. et al. (2018)			x
11.	Yeo H. (2015)	x		
12.	Sinha (2018)	x		
13.	Kavirathna (2018)			x
14.	Kim et al. (2016)			x
15.	Cho et al. (2016)			x
16.	Akhavan M (2017)			x
17.	T. Tsai et al. (2019)			x

Source: Prepared by the authors (2022)

Discussion on the categories of port performance analysis

Studies surrounding Asia's port performance are minimal, even though the Asian region is the most progressive and active in seaborne trade. The present study is the only research that systematically analyzes the study of port performance in the Asian region. Port performance is an essential indicator of seaborne trade, as it ensures the efficiency of port services. The two databases of Scopus and WOS have been reviewed and were found to contain 17 articles related to the study of Asian port performance. These 17 articles revealed that various approaches have been used by researchers in the past to measure port performance in Asia. The present analysis

found four categories of port performance dimensions: operational, customers' perspective, logistical, and organizational. There are two approaches to selecting the variables for port performance measurement, those being inputs/outputs and indicators/determinants, but they will not be discussed in depth in this study. Furthermore, this study found three types of port performance analyses preferred by researchers of the Asian region: efficiency, productivity, and competitiveness. Two main aspects will be discussed in this study: first, the dimensions of port performance, and second, the types of performance analyses.

The operational dimension is the most preferred category of dimensions studied by researchers in Asian port performance studies. This might be due to the availability of data related to port facilities. Eight out of the seventeen articles focused on operational dimensions. As stipulated in Table 3, the eight researches under the operational dimension are Nguyen P. N. et al. (2020), Yang X. et al. (2019), Venkatasubbaiah K. et al. (2018), Chen H. et al. (2018), Kutin N. et al. (2018), Jang H. M. et al. (2016), Kim T. S. (2015), and Jim Wu et al. (2016). Studies on operational dimensions evaluated the performance of a port based on its inputs and outputs. Port inputs are generally derived from port infrastructures and facilities, such as the number of quay cranes, RTG, length of berth, size of container yards, and other related factors. As for outputs, container throughput was the prominent variable selected in these studies. This variable measures the capacity and characteristics of a port in producing a selected number of containers. It measures the operational aspects of a port and is not strictly related to the port's service delivery systems. In this case, a port's capacity to produce more output than the expected number is not included. The concern of the operational dimension is the actual result generated by a given number of inputs. Thus, the efficiency results obtained from this dimension are a relative comparison of the performances of the different ports. A port with higher capacity facilities and greater container throughput than others might be the most efficient port. However, container throughput is dependent on maritime traffic and the preferences of shipping liners, which could affect a port's actual efficiency.

Efficiency analysis based on customers' perspectives is an approach that seeks opinions from port stakeholders about the performance of a port. In most cases, a survey, an interview, or a focus group is conducted among the stakeholders to obtain data on port performance. Only two articles in this review employed this approach: Lee P. T. et al. (2018) and Ren J. et al. (2018). One of the advantages of this approach is that data collection is vast and unlimited since it can explore any information stakeholders might have regarding the performance of a port. However, conducting surveys, interviews, or focus groups require additional effort and incur cost. Thus, it is not a popular approach among scholars.

The logistical dimension might be one of the best categories through which port performance can be analyzed in the service context. As mentioned earlier, the operational dimension is very much concerned with port infrastructures' operational and technical aspects. While it is indubitable that functionality is essential to port efficiency, port performance is also dependent on the port's ability to deliver containers in a timely manner. In this era of globalization and e-commerce, all goods must be handled carefully and promptly delivered. The primary measurement of port performance is how quickly containers are shipped from one port to another. Previous studies have focused much of their research on port performance measurement, but integrative approaches, such as supply chain management (SCM), are seldom utilized in port performance studies (Bichou, 2006). In this current era, port performance is influenced by various logistical indicators, such as customs clearance efficiency and the frequency of shipments within expected times. Therefore, measuring port performance from the logistical perspective might be the most accurate way to evaluate port performance. In studies on Asian port performance, only five of the selected articles were found to focus on logistics: Kavirathna (2018), Kim et al. (2016), Cho et al. (2016), Akhavan M (2017), and T. Tsai et al. (2019).

In the organizational category, Sinha and Roy Chowdhury (2018) studied port performance in India and explored the roles privatization played in port-on-port performance. The study developed a computational framework to identify the optimal operation of a berth by port authorities, private operators, and outsourcing agencies. This article concluded that the privatization and outsourcing of ports alone were not essential to port performance; instead, an exploration of various models of berths must be imposed by port authorities to find the most optimal model for port performance. Yeo (2015) is the second article under the organizational dimension. Hypotheses were constructed to evaluate the related factors of GTOs and port ownership in determining the efficiency of a port. The study involved 260 container terminals in China, Korea, and Japan. The results showed that GTOs have a positive relationship with port performance, but no statistically significant relationship was found between port ownership and port performance.

The three types of port performance analyses preferred by researchers are analyses of efficiency, productivity, and competitiveness. Competitiveness analysis was the most selected form of analysis for port performance studies in Asian countries, followed by efficiency and productivity. These approaches are not equally applicable in all cases. For example, a survey of ports in developing countries sometimes led to erroneous results due to the overinvestment of port facilities in specific ports caused by fierce competition among the ports (Nguyen et al.,

2020). Thus, a port which has gained a significant share of the market is not necessarily the most efficient, as was the case for Singapore, an efficient port which unfortunately lost a portion of the market. Contrastingly, Laem Chabang is a highly efficient port which has gained market shares.

Therefore, a combination of efficiency and competitiveness analysis is required to generate reliable findings on port performance. Other methods of port performance analysis were also utilized, such as in Venkatasubbaiah et al. (2018), where a combination of both DEA and Principal Component Analysis (PCA) was employed to generate a hybrid form of DEA-PCA analysis to measure the performance of 28 terminal containers in Southeast Asia.

Under efficiency analysis, DEA is one of the most preferred methods used by researchers. An issue frequently encountered in DEA is the standardization of data among the DMUs, most notably for input specification. Different ports have different types of facilities, sizes of equipment, and technologies; thus, obtaining the same standard of data for all the ports is crucial. To counter this issue, Kutin et al.(2017b) analyzed the performance of 50 container ports in Asia by categorizing the ports into two categories. The first category is inland or seaports, and the second category is based on port handling systems. The study's findings revealed that most of the ports in Asia operated under increasing return to scale, which means that ports in Asia should increase their inputs to be more efficient. Researchers might face difficulties in determining which model of DEA to apply to their research. To resolve this problem, Jang et al. (2016) employed Shannon's Entropy approach, whereby the efficiency results from each DEA model (CCR-I, BCC-I, BCC-O, CRS-SBM, and VRS-SBM) were integrated to rank the efficiency of 21 ports in Asia.

Productivity analysis is the least applied method in Asian port studies. Jim Wu, Yuan, Goh, and Lu (2016b) is one of the two articles reviewed that conducted productivity analysis on Asian ports. Their article combined a study on ports in developed and developing countries. The second article in the same category was by Yang and Yip (2019), which applied the Malmquist Productivity Index (MPI) to measure the efficiency changes of 23 major ports in Asia from 2000 to 2007. The study found a 41 percent increase in pure technical efficiency changes (PTEC), a 47.5 percent increase in scale efficiency (SC) changes, and a 30.5 percent decrease in technological changes (TC) for the whole period. These results imply that most Asian ports were facing technological deterioration and a lack of innovation during this period. In terms of the effect of PTEC, SC, and TC on the overall improvement of efficiency, PTEC was found to have the most substantial impact (correlations=0.85) on efficiency, while SC and TC had only minor effects (0.21 and 0.24, respectively).

FUTURE DIRECTION

This study has revealed that the number of studies on Asian port performance following the logistics approach is relatively limited. Only five articles focused on logistics, while eight studied operational factors, two studied customer's perspective, and two observed organizational dimensions. This might be due to the underlying theoretical basis for conventional performance analysis, which is the production theory, leading researchers to focus on operational dimensions. Nevertheless, the logistics dimensions of a port might be the most suitable indicator of its performance since logistics is the only dimension that allows for the complete analysis of a port's functionality in one analysis. As current studies focus on port throughput as the primary port performance indicator, future research can focus on new segments, such as port logistics chains, to obtain a deeper understanding of ports (Langen, Nijdam, and Horst, 2007). Ports are part of the logistics chain, and everything on goods or containers, including transportation from one country to another, is managed by ports. The efficiency of the operation of port facilities and infrastructures is essential, but other elements of the logistics supply chain are crucial, too. Thus, more studies should focus on the logistics dimension of ports, as it provides an actual understanding of container management at ports. Research into logistics will expand the current research on both the supply and demand sides of ports, such as on shippers and port service providers. These findings further support the idea in recent studies that port choice analysis should be measured simultaneously from the sides of both shippers and port service providers (Talley and Ng, 2021).

Furthermore, the future focus of port performance analysis should be reconsidered. The current findings of this research have shown that most studies on Asian ports focus on their efficiency and competitiveness rather than their productivity. A productivity survey might give a better overview of port performance as it concerns the actual output of the ports (throughput of containers). These findings highlight the importance of the productivity dimension, which shows that, on a relative basis, Asian ports are lagging behind European and American ports in terms of technology and innovation. As competitiveness is related to marketing and geography, researchers have neglected the performance aspects of ports and focused more on their networking and shipping connectivity.

Past systematic literature reviews of port performance utilized approaches such as the three-stage procedure – planning, execution, and reporting – established by Tranfield, Denyer, and Smart (2003). Systematic literature reviews (SLRs) of ports performance studies is a new approach. SLRs are commonly performed in the health sciences. However, it has been proposed that their use be extended to the field of management (Tranfield et al., 2003; Vieira, Kliemann

Neto, and Amaral, 2014). In the future, there should be more studies on SLR and the application of PRISMA on the broad dimensions of port performance scenarios and trends.

CONCLUSION

This systematic review analyzed studies on Asian port performance. The authors of these studies have identified four dimensions in their performance evaluation: operational, customers' perspective, logistics, and organizational dimensions. This review has found that, rather than performance, researchers commonly practice three types of performance analysis: efficiency, productivity, and competitiveness. This review has proposed several recommendations for future studies, such as increasing the study of logistics' dimensional aspects to evaluate port performance. Logistics can offer a broader perspective on the actual performance of ports due to the importance of ports in supply chain systems. Another recommendation proposed by this review was to have more studies on SLRs and the application of PRISMA methods on port performance analysis. This study is the only one currently applied SLR and PRISMA based on two central databases (SCOPUS and WOS) to review port performance analyses. The third recommendation suggested by this study was to explore performance analysis in the context of productivity instead of efficiency and competitiveness, which researchers currently prefer.

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