Case Studies on Transport Policy 10 (2022) 463–471

Contents lists available at ScienceDirect

Case Studies on Transport Policy

journal homepage: www.elsevier.com/locate/cstp

A port attractiveness assessment framework: Chittagong Port's attractiveness from the users' perspective

Ziaul Haque Munim [a,*], Khandaker Rasel Hasan [b,c], Hans-Joachim Schramm [d,e], Hasan Mahbub Tusher [a]

[a] Faculty Technology, Natural and Maritime Sciences, University of South-Eastern Norway, Horten, Norway
[b] Maritime and Logistics Management, National Centre for Ports and Shipping, Australian Maritime College, University of Tasmania, Launceston, Australia
[c] Department of Port and Shipping Management, Bangabandhu Sheikh Mujibur Rahman Maritime University, Dhaka, Bangladesh
[d] Institute for Transport and Logistics Management, Vienna University of Economics and Business, Vienna, Austria
[e] Department for Operations Management, Copenhagen Business School, Copenhagen, Denmark

ARTICLE INFO

Keywords:
Port attractiveness
Freight forwarder
Chittagong Port
Confirmatory composite analysis

ABSTRACT

This study evaluates the attractiveness of the Chittagong Port of Bangladesh from the port users' perspective. Existing maritime literature is focused on major ports of Europe, East Asia and North America, but many secondary ports of the mainline maritime network, which play a crucial role in their countries, are overlooked. Chittagong Port is such a port having an enormous impact on the economy of Bangladesh. The perceived attractiveness of this port to its users is assessed in this study based on six factors: port connectivity, facilities, costs, service quality, policy and management, and green port management practices. Data are collected on a 7-point Likert scale for 25 measurement items, and the port attractiveness measurement model is validated using Confirmatory Composite Analysis (CCA). The results indicate that the port users' find the port's connectivity most attractive and green port management practices least attractive. We also observe that port users with a high frequency of port usage find Chittagong Port less attractive compared to less frequent users. These findings have significant policy implications for the port authority and policymakers to enhance the port's attractiveness, which is in a monopolistic position handling more than 90% of international trade for Bangladesh. Further, a validation of the port attractiveness assessment framework enables researchers and practitioners to use it as a standard instrument for assessing the attractiveness of ports having similar characteristics globally.

1. Introduction

Competitiveness is a fuzzy and complex concept. Still today, it is difficult to define competitiveness in specific terms. However, it is widely used to express one's comparative advantage over another, with either a country or region (macro), an industry (meso) or an organization (micro) as the unit of comparison. Today, evaluation of competitiveness exists on all of these three levels (Krugman, 1994; Maskell and Malmberg, 1999; Ambastha and Momaya, 2004). While economists focused mostly on the macro-level competitiveness, Porter (1992) argued that macro-level competitiveness cannot be achieved without micro-level. According to him, "competitiveness is a function of dynamic progressiveness, innovation, and an ability to change and improve" (Porter, 1992). However, Feurer and Chaharbaghi (1994) argued that such a definition of competitiveness is too narrow. They claimed that competitiveness "depends on shareholder and customer values, financial strength which determines the ability to act and react within the competitive environment and the potential of people and technology in implementing the necessary strategic changes. Competitiveness can only be sustained if an appropriate balance is maintained between these factors which can be of a conflicting nature" (Feurer and Chaharbaghi, 1994). As an organization, seaports are a source of micro-level competitiveness and usually drives the macro-level.

Broadly, there are two major categories of ports: gateway and transhipment ports. Such categories define the goals and strategies of ports. While transhipment ports focus on revenue generation from handling of containers originated from and destined to a foreign country (or region), gateway ports are dedicated to serving the international trade of their

* Corresponding author.
E-mail addresses: ziaul.h.munim@usn.no (Z.H. Munim), krhasan.psm@bsmrmu.edu.bd (K.R. Hasan), hans-Joachim.Schramm@wu.ac.at (H.-J. Schramm), hasan.m.tusher@usn.no (H.M. Tusher).

https://doi.org/10.1016/j.cstp.2022.01.007
Received 14 August 2021; Received in revised form 6 January 2022; Accepted 6 January 2022
Available online 10 January 2022

home country (or region) and are seen as a social infrastructure. Moreover, there exist two Doctrines: Anglo-Saxonian — believe that port should be financially self-sufficient, and Continental — ports are valued in terms of its contribution to the development to its home region or country (Lee and Lam, 2015). In recent years, incremental privatization of the port industry can be observed where many ports tend to follow the Anglo-Saxon Doctrine. Nowadays, ports also compete to become transhipment hubs (on international or regional or local levels) and make large investments to stay competitive. Hence, assessing the competitiveness of a port is crucial. To stay competitive, ports compete for a higher volume of throughput, greater capacity, good geographical location and better service level than competitors (Song and Yeo, 2004). However, with the introduction of the fifth-generation port concept, the customer-centric community-focused port, along with other port competitiveness factors, evolved as communal and environmental (Flynn et al., 2011; Lee and Lam, 2015).

Users of ports vary in the extent of their involvement with port activity. While shippers are always the end-users of ports, they often have the least interaction with ports. Intermediaries like local liner agents, clearing and forwarding agents play a key role in facilitating the import–export requirements of the shippers. Carriers — the companies that actually manage and/or operate ships calling at ports, are the third major category of port users. Today, studies exist assessing port competitiveness from the users' perspective (Ng, 2006; Yuen et al., 2012), but to the best of the authors knowledge, none on the context of a major regional port in South Asia that handles over 90% of the country's international trade, that is, Chittagong Port of Bangladesh. Port users are business firms, and they also compete with their rivals— not only domestically but internationally as well. These firms also need to stay competitive to attract customers and sustain in their markets.

Port competitiveness analysis can be conducted on four levels such as the comparative analysis of (1) port clusters, (2) individual ports across countries, (3) individual ports within a particular country, and (4) terminals within a single port (Goss, 1990). By conducting a comparative analysis with rivals, ports can have insights into their relative performance with other ports. However, being better than another port on a particular competitiveness criterion does not mean that the port has achieved its optimal level of competitiveness. For instance, among the transhipment ports in the Bay of Bengal serving the Chittagong Port through feeder connection, Singapore performs comparatively better than Colombo, Port Klang and Tanjung Pelepas in the majority of the port competitiveness criteria, including connectivity, facilities, port policy and green port management (Munim, Duru and Ng, 2021). Nevertheless, Singapore should not cease improving its competitiveness dimensions, e.g., green port management practices. Apart from comparative analysis with other port clusters, ports or terminals, ports could benefit from examining their performance across various port competitiveness dimensions that can indicate the attractiveness of a port to its users.

From the users' perspective, the attractiveness of ports varies depending on different factors, including port costs, geographical location, quality of hinterland connections, productivity and capacity (Nazemzadeh and Vanelslander, 2015). Earlier studies, e.g., Murphy et al. (1992) discussed a wide range of factors such as cargo handling facilities, freight rate, equipment used, time, information availability, claim handling and flexibility in meeting special handling requirements that can affect users' choice of port. Therefore, it is relevant for the port authority and terminal operators to be aware of the dynamic nature of the factors affecting the port choice to provide customer-oriented service to the port users. Since Chittagong port is the only major seaport of Bangladesh, the port attractiveness factors could not be assessed through perceived ratings in comparison to other ports.

This study proposes a port attractiveness assessment framework by considering six factors: port connectivity, facilities, costs, service quality, policy and management, and green port management practices. Each factor is measured through multiple measurement items, in total 25 items. The framework was validated by assessing the attractiveness of the Chittagong Port of Bangladesh from the users' perspective. Findings reveal the areas for improvement needing attention by the port authority and policymakers that will potentially benefit the port users.

The rest of the paper is structured as follows: Section 2 discuss existing literature on the proposed port attractiveness factors, followed by an introduction of Chittagong Port in Section 3. Data and methodology are presented in Section 4. Section 5 unveils the attractiveness analysis of Chittagong Port. Section 6 discusses the results and Section 7 concludes with the summary of the key findings.

2. Literature review

Previous studies have assessed port attractiveness from different perspectives. For instance, the attractiveness of transshipment ports (Ng, 2006; Munim et al., 2021), of major ports (or terminals) of a country (Saeed, 2009; Yuen et al., 2012), ports serving landlocked regions (De Langen 2007) as well as cross-country port attractiveness evaluation (Kim, 2016; Yeo et al., 2008). However, there is a lack of literature that address the port attractiveness factors as a whole, taking into account the port users' perspective in the dimension. Previous studies indicate that port connectivity, facilities, policy and management, and service quality are the determining factors of port attractiveness. With the growing concern for environmental awareness, green port management practices have become crucial for port attractiveness (Munim et al., 2021). Lam and Notteboom (2014) found that European ports entail a higher level of dedication to green port policies than the Asian ones. Accordingly, we argue that together with conventional port competitiveness assessment factors, green port management should also be taken into consideration in assessing the attractiveness of Chittagong port to its users. This study evaluates the attractiveness of the Chittagong Port considering the six dimensions as discussed in the following subsections.

2.1. Port connectivity

Ports connect a region or a country to the rest of the world. Countries without ports — landlocked countries, suffer greatly in terms of global connectivity, leading to trade barriers (Munim and Haralambides, 2018). On the other hand, there exist countries like Singapore, China, Belgium, the Netherlands, Germany, and a few others with the largest transhipment ports of the world, enjoying smooth trade facilities themselves as well as generating revenues from providing transhipment service to others. As such geographic location is a port's most important characteristic (Malchow and Kanafani, 2004), which plays a key role in determining transhipment status of a port. Tovar et al. (2015) investigated the role of port connectivity in determining port attractiveness, particularly a port's potential to become a hub or to maintain its hub status. Yeo et al. (2008) also found that being a regional centre and having good connectivity drives port attractiveness. Vermeiren and Macharis (2016) analysed the shippers port choice in the Rhine-Scheldt delta and found that port choice depends on the total transport chain rather than port individually. Kang and Woo (2017) concluded that not only the microeconomic variables and service capabilities drive the throughput performance of a port but also the centrality of ports in the network of shipping lines. From the port users' perspective, e.g., from shippers' perspective, a port with great connectivity would allow them to import raw materials from the global supply market and export their finished products to a large market worldwide. This means more business for the carriers, local liner, clearing and forwarding agents. Moreover, ports with good transport network connectivity to the hinterland allow designing door-to-door delivery of containers through intermodal transport facilities.

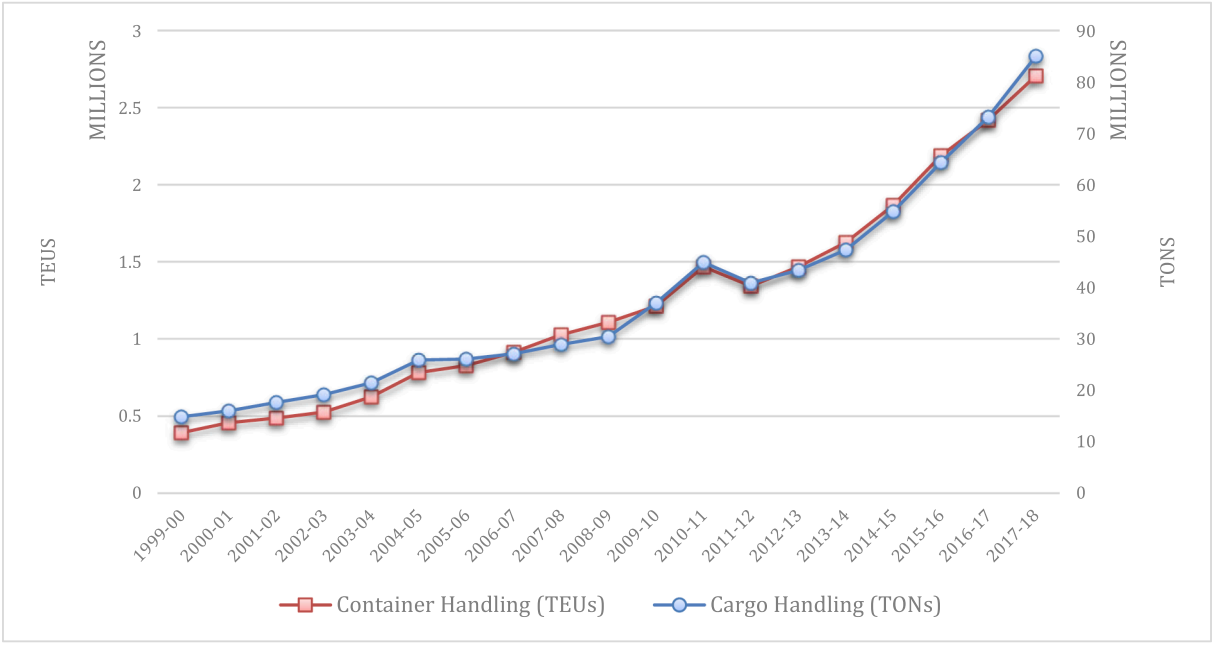

Fig. 1. Throughput growth at Chittagong Port. Source: (CPA, 2018).

2.2. Port facilities

Superstructures of a port — gantry cranes, straddle carriers, ship-to-shore gantry etc. are crucial for competitive status. The quality of the port infrastructure of a country has a significant impact on its logistics performance (Munim and Schramm, 2018). While Murphy et al. (1992) emphasised the availability of equipment at the port, Starr (1994) mentioned investment into port facilities as vital. Among others, investment in fixed capital is considered an important item for measuring the port attractiveness of the Spanish ports by Castillo-Manzano et al. (2009). Tiwari et al. (2003) stated that the number of ships call, number of berths, number of cranes, water depth, routes offered, and usage factors have a positive impact on shippers reactions. According to Ugboma et al. (2006), adequate infrastructure is one of the main preference criteria for port choice. Tongzon (2009) also found that adequate infrastructure is a key port choice factor. Analysing the Nordic and UK ports, Schøyen and Odeck (2013) found that berth length, quay cranes, terminal areas, number of yards, gantry cranes, straddle carriers, and container handling truck are essential port attractiveness criteria. Therefore, users of ports with adequate facilities enjoy timely and uninterrupted service and can serve their customers smoothly.

2.3. Port costs

Port costs have been discussed as a vital port attractiveness factor in extant literature. As Saeed (2009) indicates that Terminal Handling charge (THC) is among the most important port attractiveness factors. THC is significantly factored into the decision of port choices by the freight forwarders (Slack and Gouvernal, 2011). Handling costs and storage costs have also been indicated as important port attractiveness criteria by Wiegmans et al. (2008). In addition to the handling and storage costs, port duties, specialized cargo handling charges, and other service charges have been discussed as port attractiveness factors by Hales et al. (2016).

On the other hand, the interaction between different factors also influence the pricing strategy of port; for example, higher land fees from port authority could force the port operators to charge more in cargo handling fees which ultimately affect the overall attractiveness of the port (Notteboom and Pallis, 2020). Based on a systematic literature review, the hierarchy of port attractiveness drivers by Parola et al. (2017), rank port costs at the top position. According to them, all the direct costs are relevant such as port charges, storage and stevedoring as well as the indirect cost of time.

2.4. Port service quality

The service quality of a firm has a significant influence on the behaviour of its customers (Zeithaml et al., 1996). Sayareh et al. (2016) scrutinised the service quality of container terminal operators in Bandar Abbas Port of Iran. Yeo et al. (2015) and Chang and Thai (2016) found a positive association between port service quality and customer satisfaction. Port users' satisfaction can be indirectly translated to the level of service ports delivered to their customers. In order to maintain a high level of service quality, therefore, port users such as the shipping lines desire a high standard in port services (Kaliszewski et al., 2020). Further, better service quality leads to higher profitability of the port users (Anderson et al., 1994). Reviewing the literature, Yeo et al. (2008) and Parola et al. (2017) identified port services as an important determinant for port choice.

2.5. Port policy and management

Port policy and management influence port users' satisfaction (Yeo et al., 2015). Heaver (1995) argued that "port policies based on cost recovery from users of port facilities and services need to be adopted as the international standard" (p. 125), to enhance the attractiveness of a port. Also, shippers desire close relationships with ports with good reputations (Bennett and Gabriel, 2001). Tongzon and Heng (2005) emphasized that adaptability to customers demand is important for the attractiveness of ports, and private sector participation would enhance the port efficiency. Pagano et al. (2013) emphasized the possibility of private ports being more effective than the public. The necessity of adopting competitive port policy, including commercial and technological strategies, are found important for achieving customer loyalty (Perez-Labajos and Blanco, 2004). Yuen et al. (2012) interviewed the shippers and forwarders in mainland China and other Asian cities. They identified that among other factors, customs and government regulations are important determinants for shippers' port choice. Jenssen and Randøy (2006) found that innovation leads to firm performance, but innovation is influenced by "conscious strategy, strategy involvement,

external relationships, especially market relationships" (p. 327). Hence, it can be argued that better performance of ports led by superior policy and management would translate into better performance of the port as well as their customers.

2.6. Green port management

Adaptation of green port management practices positively influences the performance of a port or terminal (Lun, 2011). Alongside the operational and other performance indicators, environmental performance indicators at ports are significant determinants for the users to choose a port (Lirn et al., 2013) and stakeholders to decide on investment (Puig et al., 2014). In order to remain competitive, Hossain et al. (2019) suggested that the Canadian ports integrate sustainability and environmental performance management. Yuen et al. (2018) found that sustainable practices positively influence shippers' loyalty, which is fully mediated by the perceived value of the shippers. In the same line of thought, sustainable performance of a port means sustainable performance of their users, including shippers and shipping lines. As such, users of ports with green port management practices can adopt green marketing strategies emphasising the sustainability of their supply chain.

3. The Chittagong port

Chittagong Port is the largest port of Bangladesh, facilitating 90% of the country's international trade while the rest is covered by road transport. The port is located in the bay of the Karnafuli River, in the city of Chittagong. The current form of Chittagong Port Authority (CPA) was established in 1976, but the history of the port dates back to the fourth century B.C. It has three container terminals, which combined handled about 2.35 million TEUs in the fiscal year 2016–2017 (CPA, 2018). Among these three, two are operated by a private port operator under a tool port governance model, and another is operated and maintained by CPA under a service port governance model. Container throughput growth of the port has been exponential during the last two decades, partly due to its geographical location in Bangladesh, with an approximate 4.93 times increase from 2000 to 01 to 2017–18 (see Fig. 1). The port is well connected via feeder line service with four major transhipment hubs in the regions, namely, Colombo Port, Singapore port, Tanjung Pelepas and Port Klang (Munim et al., 2021). Chittagong port is considered the gateway port for Bangladesh. For further details about the Chittagong Port, see Munim, 2021.

4. Data and methodology

To operationalise the six dimensions of port attractiveness, we developed a questionnaire based on a 7-point Likert scale with 25 items in total. These items were selected based on a review of extant port attractiveness literature and discussion with a panel of five port users in Bangladesh (see Appendix 1 for sources).

4.1. Development of survey questionnaire

Before starting the data collection process, we conducted a pilot study with five port users. Based on their suggestions, a grouping of the survey items into their respective constructs was confirmed. The questionnaire was sent to users of Chittagong Port in Bangladesh consisting of international liner agents, clearing and forwarding agents, and shippers, from September to December 2017. Due to difficulties in achieving the expected number of survey responses, we adopted a mixed sampling approach. Initially, we started with the snowball sampling— contacted one international liner shipping agent, one clearing and forwarding agent and one shipper. Later, they forwarded the survey to their peers working in the same organization and in other relevant firms. Due to the lower response rate, the survey was later shared in a Facebook group with a large member base, including Bangladeshi port users such as shipping line and freight forwarding agents. The personal communication channel of one of the authors having more than 15 years of working experience in the maritime sector of Bangladesh, was also utilized. In total, 169 potential respondents initiated the survey, but only 33 responded, among which six had to be dropped: one duplicate, two incomplete and three due to straight-lining. About 15.98% of the reached sample, that is, 27 responses were, usable for analysis. To increase the sample size, we conducted a second round of data collection from January to March 2018, following the same approach. Excluding six irrelevant observations, additional 25 usable responses were collected in the second wave. We advanced with a sample of 52 observations for analysis.

Table 1
Distribution of survey respondents.

Respondents work experience	No (%)	Company age	No (%)
1 to 3 years	18 (34.6)	1 to 3 years	2(3.8)
4 to 6 years	10 (19.2)	4 to 6 years	3(5.8)
7 to 9 years	15 (28.8)	7 to 9 years	2(3.8)
10 to 12 years	4(7.7)	10 to 12 years	7(13.5)
More than 12 years	5(9.6)	More than 12 years	38 (73.1)
Number of employees in the company	No (%)	Frequency of monthly port use	No (%)
1 to 5 employees	2(3.8)	1 to 5 times	7(13.5)
6 to 10 employees	1(1.9)	6 to 10 times	2(3.8)
11 to 15 employees	3(5.8)	11 to 15 times	3(5.8)
16 to 20 employees	2(3.8)	More than 15 times	40 (76.9)
More than 20 employees	44 (84.6)		

4.2. Sample characteristics

The detailed demographic characteristics and port use frequency of the respondents are presented in Table 1. The majority of the respondents have more than four years of work experience, and their employer firm is more than 12 years old. About 84.6% of firms in our sample have more than 20 employees, and 76.9% of the respondents report that they interact with the Chittagong Port more than 15 times a month. Given the sample attributes, assessment of Chittagong Port from their perspective would be valid and reliable.

4.3. Confirmatory composite analysis (CCA)

The six dimensions of port attractiveness are operationalized using multiple measurement items. Multiple measurement items are used when the variables of interest in a study context are abstract and multifaceted (Hair et al., 2010). Port attractiveness is such a variable that cannot be measured using an observed variable, for example, the number of TEUs handled. The volume handled by a port alone cannot indicate its attractiveness completely. Indicators such as Port Liner Shipping Connectivity (PLSC) has been developed using components such as (i) number of scheduled ship calls per week, (ii) total yearly port capacity (in TEU), (iii) number of liner shipping companies offering services are the port, (iv) number of regular liner shipping connections of the port, (v) average vessel size handled by the port, and (vi) number of other ports connected to the port. Port might have a comparatively higher PLSC ranking, but their service quality can still suffer significantly. For example, the Chittagong Port of Bangladesh, for the year 2020, has a PLSC score of 13.82, which is much higher than the Oslo Port

of Norway (6.28)[1]; but the service quality (e.g. reliability of berth schedule) of the Oslo port is much better than Chittagong Port. Meanwhile, service quality cannot be measured based on only one measurement, such as the reliability of berth schedule. Service quality is an abstract construct, hence, multiple measurement items should be used to assess service quality as reported in Appendix 1.

Multiple measurement items have been widely used in port attractiveness (Hales et al., 2016; Yuen et al., 2012) and port service quality (Yeo et al., 2015) research. This study has identified 25 measurement items (see Appendix 1) that are relevant for assessing the attractiveness of gateway ports, particularly in the context where a single port dominates the majority of the countries seaborne trade. Before assessing a port or several ports using these 25 measures, their validity and reliability must be ensured. Validity indicates whether the measurement items are measuring what they are supposed to measure, and reliability indicates the degree to which the items are measuring what they are supposed to measure. Studies have developed a set of guidelines for establishing the validity and reliability of measurement items (Hair et al., 2019).

Traditional approaches to validity and reliability of measurement items require exploratory factor analysis (EFA) followed by Confirmatory Factor Analysis (CFA). According to Hair et al. (2019), preliminary considerations include sample size, type of data, and distributional assumptions. Due to the sample size of 52 observations, the application of EFA followed by CFA become inappropriate as the minimum recommended sample is 100 observations or five times the number of measurement items (Hair et al., 2010). In such cases with a sample size, where the population size may be small as well, Confirmatory Composite Analysis (CCA) can be used for validity and reliability check of the measurement model (Hair et al., 2020). The main difference between the CFA and CCA is that the estimation of the latent variable in CFA is based on only common variance among the measurement items, while the estimation in CCA is based on total variance (Hair et al., 2020). This study utilizes the CCA used in the Partial Least Squares Structural Equation Modeling (PLS-SEM), see Hair et al., (2020) for further detail.

5. Results

5.1. CCA results

The SmartPLS software was used for CCA, which has been widely applied by thousands of published studies[2]. The factor loadings of respective items for each dimension of port attractiveness are reported in Table 2. The reported factor loadings are statistically significant at 5%, which ensures convergent validity, according to Anderson and Gerbing (1988). Convergent validity indicates whether the estimated latent variable (e.g., port connectivity) explains the variance of its own measurement items sufficiently (items 1–4 in Table 2). Hair et al. (2019) recommends using the Average Variance Extracted (AVE) score of latent variables for confirming convergent validity. As reported in Table 3, AVE values of latent variables are much higher than the recommended threshold of 0.50, hence, convergent validity is confirmed. However, the uniqueness of each latent variable relative to other latent variables also needs to be ensured, which is referred to as divergent validity. To confirm divergent validity, the Fornell-Larcker Criterion can be utilized (Fornell and Larcker, 1981). To establish divergent validity through Fornell-Larcker Criterion, squared correlation among the latent variable should be lower than AVE scores on the diagonal, as reported in Table 3. Further, Cronbach's alpha, Rho-A, and composite reliability values reported in Table 2 are higher than 0.70, exceeding the required threshold for satisfactory reliability (Hair et al., 2019).

5.2. Survey results

This section presents the results of the survey in two levels: (1) the aggregated scores of the six attractiveness dimensions of the Chittagong Port are presented, and (2) mean comparison of the aggregated scores across port users groups. Table 4 presents the results of Chittagong Port's attractiveness assessment from its users' perspective. As CCA confirmed the measurement of the six port attractiveness dimensions through their respective measurement items, aggregated average scores for the six dimensions are computed by taking the arithmetic average of their item level scores. For example, port connectivity consists of four items — connection to the mainline navigational route, service coverage of the major import/export areas of the country, feeder shipping network, and inland waterway connectivity. The port connectivity dimension's score is the average of these four items' average scores.

The aggregated average scores reported in Table 4 indicates that the users' rank the port connectivity (μ: 4.611) of Chittagong Port highest among the six dimensions. Meanwhile, green port management (μ:3.481) ranks the lowest. Port facilities, policy and management, and green port management practices rank below 4.00. These dimensions need immediate attention from the port authority. In addition, we report the 95% confidence intervals for the average scores in Table 4.

Previous studies such as De Langen (2007) and Yuen et al. (2012) examined the difference in perceived port attractiveness among the port user groups. Similarly, we scrutinize the level of perceived attractiveness of Chittagong Port from different port users' perspective in our sample. There are three ports user groups in our sample — carriers (38.5%), freight forwarders (38.5%), and shippers (23.1%). In this context, carriers include mainly agents of large international shipping lines or local feeder carriers. Fig. 2 presents the mean scores on the six dimensions for the three user groups. The figure shows that port connectivity, policy and management, and green port management are ranked comparatively higher by the carriers than the freight forwarding and shippers. Meanwhile, port facilities, port costs and service quality are ranked higher by shippers than the other two. Among the user groups, freight forwarders seem to find Chittagong Port least attractive in all the six dimensions.

6. Discussions and policy implications

This study evaluated the attractiveness of the Chittagong Port — a major gateway port in South Asia — from its users' perspective considering six dimensions. This study offers implications for the Chittagong Port Authority (CPA) as areas of improvement to achieve better attractiveness from the users' perspective are identified. The results of the port attractiveness evaluation reveal that port users are most satisfied with the connectivity of Chittagong Port, but green port management practices require the most attention for improvement (see Table 4). Thus, CPA should consider adopting green port management practices to keep pace with the global green initiatives. Activities may include rewarding ships based on Environmental Ship Index[3] score, reconfiguring existing terminals, installing electric-regenerative cranes, supportive infrastructure, reducing ship loading and unloading time and using cleaner fuel in port operations. These strategies are also suggested by the International Association of Ports and Harbors (IAPH) toolbox for port clean air program[4].

Port facilities, and policy and management are also two important areas for improvement considering the scores reported in Table 4. The same has been reflected in comments from the respondents as well. At the end of the structured survey, the respondents were allowed to

[1] https://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=170026, accessed on October 31, 2021.

[2] A structured Boolean search with the term "smart pls" in the Scopus data based on November 3, 2021 reverts 1465 publication records.

[3] http://esi.wpci.nl/Public/Home, accessed on July 5, 2018.

[4] http://wpci.iaphworldports.org/iaphtoolbox, accessed on July 5, 2018.

Table 2
Factor loadings and reliability.

Dimensions	Measurement items	Factor loadings	Cronbach alpha	Rho-A	Composite reliability
Port Connectivity	1. Connection to the mainline navigational route	0.782	0.768	0.773	0.853
	2. Service coverage of the major import/export areas of the country	0.852			
	3. Feeder shipping network	0.757			
	4. Inland waterway connectivity	0.679			
Port Facilities	5. The maximum water draft	0.746	0.827	0.84	0.88
	6. Resource for moving special cargo shipments	0.802			
	7. Number of berths at the port	0.783			
	8. Sufficiency and security of storage facilities	0.876			
	9. I.T. and advanced technology	0.633			
Port Costs	10. Container/Cargo handling fees	0.965	0.921	0.923	0.962
	11. Storage fees	0.960			
Port Service Quality	12. Reliability of the berth schedule	0.746	0.795	0.805	0.867
	13. Slot exchange facility with cooperating shipping lines	0.805			
	14. Ability to handle large volume shipments	0.743			
	15. Reliability of cargo or container handling at the port	0.852			
Port Policy and Management	16. Custom clearance procedure	0.843	0.897	0.899	0.925
	17. Support from the Port staffs	0.907			
	18. Port authority policy and regulations	0.736			
	19. Public reputation of the port	0.838			
	20. Efficiency of administrative procedure	0.883			
Green Port Management	21. Environmental sustainability of the economic activities linked to the port	0.796	0.885	0.886	0.916
	22. Reward or punishment of port operators over/under performing against specific environmental goals	0.800			
	23. Waste reception facilities within the port	0.850			
	24. Communication of information on green activities of the port, e.g., environmental report	0.861			
	25. Implementation of national/regional/global environmental regulation	0.832			

Table 3
Fornell-Larcker Criterion for divergent validity.

	(1)	(2)	(3)	(4)	(5)	(6)
(1) Port costs	0.927					
(2) Green Port Management	0.095	0.686				
(3) Port Connectivity	0.119	0.223	0.593			
(4) Port Facilities	0.114	0.538	0.374	0.596		
(5) Port Policy and Management	0.233	0.412	0.310	0.509	0.712	
(6) Service Quality	0.217	0.462	0.403	0.567	0.549	0.620

Underlined values on the diagonal are the AVE scores and below diagonal are squared correlations among the latent variables.

Table 4
Descriptive statistics.

Port attractiveness factors	Mean	St. Dev.	Min	Max	Lower*	Upper*
Port connectivity	4.611	1.041	2.25	6.25	4.332	4.889
Port facilities	3.985	1.006	2.00	6.00	3.739	4.269
Port costs	4.231	1,405	1.00	7.00	3.827	4.587
Port service quality	4.317	1.102	1.00	6.25	4.019	4.620
Port policy and management	3.950	1.364	1.00	7.00	3.604	4.315
Green port management	3.481	1.246	1.00	6.00	3.154	3.812

Values are based on aggregated average scores from the respective measurement items of each port attractiveness dimension. *Lower and upper limits from 1000 bootstrap samples at 95% confidence interval.

express any comments voluntarily. One carrier representative reported: *"There is a scope to ensure the availability of port equipment, professionalism of port authority, sincerity of port labours, worker, operators etc., and […] more efficient port operations by […] better management of traffic at roads surrounding of the port."*

Some of the respondents believe that increased privatization at the port by means of adopting to landlord port governance would improve port facilities and management practices. For instance, a freight forwarder reported: *"CPA should be turned into true Landlord model and let private operators do business for the sake of sustainability."* Another freight forwarder reported: *"Chittagong port's activities should be more privatized and modern technology should be implemented in operation."*

The findings offer implications for the port attractiveness literature, too. We observe that port users with high frequency of port use find it less attractive. Evident in Fig. 2, carriers and shippers find Chittagong Port comparatively more attractive while freight forwarders consider it the least. One explanation for this phenomenon could be that in terms of frequency of port use, freight forwarders have more frequent interaction with the port, compared to the carriers and shippers. Also, freight forwarders deal with the documentation and customs process, which involve bureaucracy. The interaction between the carriers and the ports is somewhat straightforward that follows standard procedure, hence more satisfied carriers.

Meanwhile, one may wonder, why do the port users use the port if they do not find it attractive enough? In the context of this study, despite facility and management issues, Chittagong Port is still the best alternative for its users as other ports of the country are underdeveloped and not well connected with the hinterland as well as with regional transhipment hubs. Moreover, Bangladesh is not the only country in the world with one major port. According to World Port Source, there are four seaports in Bangladesh[5], while only Chittagong port is considered as the major port. Thus, following four ports as threshold value, we present countries (excluding small island nations) with four or less ports in Fig. 3. Although the majority of countries are developing countries in Africa, world's largest transhipment ports such as Sri Lanka, Hong Kong and Singapore with also have a position in Fig. 3. Thus, the proposed port attractiveness assessment framework can be used for assessing those ports as well.

The findings also offer implications for the port choice (or selection) literature. As we validate the measurement model with six dimensions of port attractiveness in Table 2, the reported items can be adopted as a

[5] From http://www.worldportsource.com/ports/BGD.php, accessed on July 5, 2018.

Fig. 2. Perceived attractiveness of different port users.

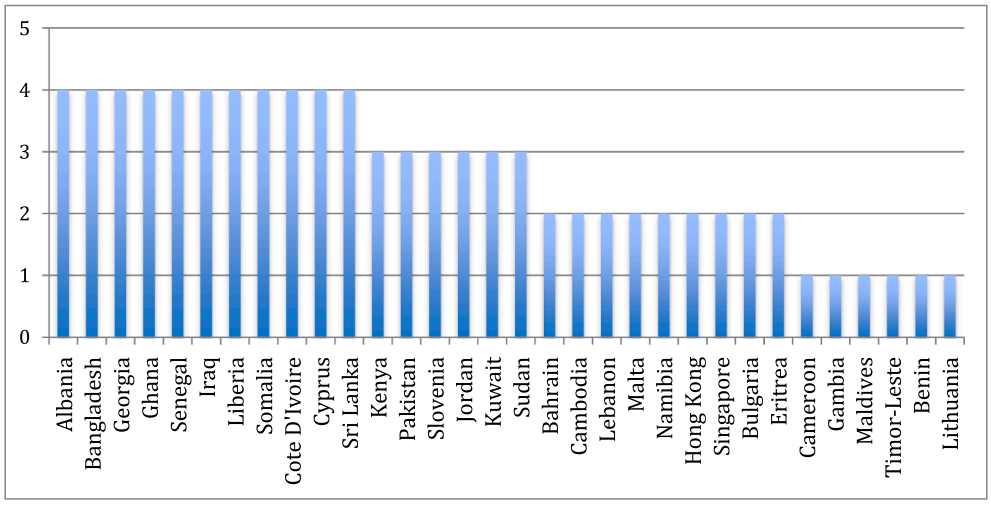

Fig. 3. Countries of the world with four or less ports *Source: World Port Source* (From http://www.worldportsource.com/countries.php, without landlocked and small island countries, accessed on July 2, 2018.)

standard tool for port attractiveness evaluation across different countries. Future research should consider a cross-country study with a similar design considering multiple ports from same as well as different countries. The measurement model can be also used to assess the attractiveness of ports to its potential distant users, when designing intermodal transhipment facilities. Further, as reported in Table 3, the significant correlations among the six port attractiveness dimensions suggest that attractiveness of ports should be modelled as a package, which was suggested by Ng (2006) earlier.

7. Conclusions

This study has several contributions to the maritime literature and industry. First, the study reviews the port attractiveness factors and reveals six factors, each with multiple indicators that form a port attractiveness assessment framework. Second, the proposed framework has been validated in the context of a major port in a developing country. Third, the study discusses the relevance of port attractiveness assessment using the proposed framework as a standard tool for countries with only one major port. Fourth, methodologically, the study demonstrates the utilization of comments received from an open-ended question at the end of the survey that supports establishing arguments for quantitative results and policy implications. Finally, the study reveals areas of improvement for the Chittagong Port of Bangladesh.

The attractiveness of Chittagong Port of Bangladesh assessed from the users' perspective was done by collecting from 52 respondents including different international shipping agents, clearing and forwarding agents and shippers on a 7-point Likert scale including 25 indicators under six dimensions including port connectivity, port facilities, port service quality, port policy and management and green port management. The attractiveness measurement model was then validated using the confirmatory composite analysis. Therefore, the measurement model can be adopted as a standard instrument for port attractiveness evaluation.

In terms of the attractiveness of Chittagong Port, port users find connectivity and service quality the most competitive, while green port management practices the least competitive (see Table 4). Therefore, Chittagong Port should consider improving its facilities and

management practices. Studies show that changing to landlord port governance would improve utility of port users (Munim et al., 2019). The respondents also reported the same through comments at the end of the survey. Further, we found that perceived attractiveness of Chittagong Port varies across carriers, freight forwarders and shippers. Future research should investigate the dynamics of user-port interaction for revealing the varying degree of perceived attractiveness.

The shippers of Bangladesh are dependent on the Chittagong port, but the attractiveness of this port has rarely been examined. Being in a monopolistic position, this port is not necessarily being threatened by the users to shift their business in alternative ports. Therefore, this very first attempt can bring the users perception to the port authority and policy makers highlighting the areas of improvement for enhancing attractiveness and users' satisfaction. The proposed attractive assessment framework could be adopted by the Chittagong Port authority to examine their attractiveness from users' perspective over time and initiate improving areas lacking attractiveness. This could be a medium of communication between the port and its users.

CRediT authorship contribution statement

Ziaul Haque Munim: Conceptualization, Data collection, Methodology, Formal analysis, Writing – original draft, Writing – review & editing. **Khandaker Rasel Hasan:** Data collection, Writing – original draft, Writing – review & editing. **Hans-Joachim Schramm:** Writing – original draft, Writing – review & editing. **Hasan Mahbub Tusher:** Validation, Writing – review & editing.

Appendix 1:. Port attractiveness measurement items used in the survey and their sources

Port attractiveness factors	References
Port connectivity	
1. Connection to the mainline navigational route	Chou (2007); Da Cruz et al. (2013)
2. Service coverage of the major import/export areas of the country	Chou, (2007); Yuen et al. (2012)
3. Feeder shipping network	Chang et al. (2008); Chou (2007)
4. Inland waterway connectivity	*Authors, in discussion with experts*
Port facilities	
5. The maximum water draft	Da Cruz et al. (2013); Yeo et al. (2011)
6. Resource for moving special cargo/shipments	Chang et al. (2008)
7. Number of berths at the port	Saeed (2009)
8. Sufficiency and security of storage facilities	Saeed (2009); Yuen et al. (2012)
9. I.T. and advanced technology	Sanchez et al. (2011); Yeo et al. (2015)
Port costs	
10. Container/cargo handling fees	Saeed (2009), Wiegmans et al. (2008)
11. Storage fees	Hales et al. (2016), Wiegmans et al. (2008)
Port Service quality	
12. Reliability of the berth schedule	Yeo et al. (2011)
13. Slot exchange facility with cooperating shipping lines	Chang et al. (2008)
14. Ability to handle large volume shipments	Saeed (2009)
15. Reliability of cargo/container handling at the port	Yeo et al. (2015); Yuen et al. (2012)
Port policy and management	
16. Custom clearance procedure	Chou (2007); Yuen et al. (2012)
17. Support from the Port staffs	Sanchez et al. (2011); Yeo et al. (2008)
18. Port authority policy and regulations	Sanchez et al. (2011)
19. Public reputation of the port	Yeo et al. (2015); Yeo et al. (2011)
20. Efficiency of administrative procedure	Yuen et al. (2012)
Green port management	
21. Environmental sustainability of the economic activities linked to the port	Yeo et al. (2015)
22. Reward/punishment of port operators over/under performing against specific environmental goals	Lam and Notteboom (2014)
23. Waste reception facilities within the port	Puig et al. (2014)
24. Communication of information on green activities of the port, e.g., environmental report	Puig et al. (2014)
25. Implementation of national/regional/global environmental regulation	Puig et al. (2014)

In the questionnaire survey, respondents evaluated each of the attractiveness factors of Chittagong Port based on the 25 measurement items on a 7-point likert scale, where (1) indicated extremely poor and (7) extremely good.

References

Ambastha, A., Momaya, K., 2004. Competitiveness of firms: review of theory, frameworks, and models. Singap. Manag. Rev. 26, 45–62.

Anderson, J.C., Gerbing, D.W., 1988. Structural equation modeling in practice: a review and recommended two-step approach. Psychol. Bull. 103 (3), 411–423.

Anderson, E.W., Fornell, C., Lehmann, D.R., 1994. Customer satisfaction, market share, and profitability: Findings from Sweden. J. Mark. 58 (3), 53–66.

Bennett, R., Gabriel, H., 2001. Reputation, trust and supplier commitment: the case of shipping company/seaport relations. J. Bus. Ind. Mark. 16 (6), 424–438.

Castillo-Manzano, J.I., Castro-Nuño, M., Laxe, F.G., López-Valpuesta, L., Teresa Arévalo-Quijada, M., 2009. Low-cost port competitiveness index: Implementation in the Spanish port system. Marine Policy 33 (4), 591–598.

Chang, C.-H., Thai, V.V., 2016. Do port security quality and service quality influence customer satisfaction and loyalty? Marit. Policy Manag. 43 (6), 720–736.

Chang, Y.-T., Lee, S.-Y., Tongzon, J.L., 2008. Port selection factors by shipping lines: Different perspectives between trunk liners and feeder service providers. Mar. Policy 32 (6), 877–885.

Chou, C.-C., 2007. A fuzzy MCDM method for solving marine transshipment container port selection problems. Appl. Math. Comput. 186, 435–444.

CPA, 2018. Chittagong Port Authority. Chittagong, Bangladesh.

Rosa Pires da Cruz, M., Ferreira, J.J., Garrido Azevedo, S., 2013. Key factors of seaport competitiveness based on the stakeholder perspective: An Analytic Hierarchy Process (AHP) model. Marit. Econ. Logist. 15 (4), 416–443.

De Langen, P.W., 2007. Port competition and selection in contestable hinterlands; the case of Austria. Eur. J. Transp. Infrastruct. Res. 7, 1–14.

Feurer, R., Chaharbaghi, K., 1994. Defining competitiveness: a holistic approach. Manag. Decis. 32 (2), 49–58.

Flynn, M., Lee, T., Notteboom, T., 2011. The next step on the port generations ladder: customer-centric and community ports. In: Notteboom, T. (Ed.), Current Issues in Shipping, Ports and Logistics. Academic and Scientific Publishers, Brussels, pp. 497–510.

Fornell, C., Larcker, D.F., 1981. Evaluating structural equation models with unobservable variables and measurement error. J. Mark. Res. 18 (1), 39–50.

Goss, R.O., 1990. Economic policies and seaports: The economic functions of seaports. Marit. Policy Manag. 17 (3), 207–219.

Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E., 2010. Multivariate data analysis, 7th ed. Pearson, Upper Saddle River, NJ.

Hair, J.F., Risher, J.J., Sarstedt, M., & Ringle, C.M. (2019). When to use and how to report the results of PLS-SEM. European business review.
Hair, J.F., Howard, M.C., Nitzl, C., 2020. Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. J. Bus. Res. 109, 101–110.
Hales, D., Lee Lam, J.S., Chang, Y.T., 2016. The balanced theory of port competitiveness. Transp. J. 55 (2), 168–189.
Heaver, T.D., 1995. The implications of increased competition among ports for port policy and management. Marit. Policy Manag. 22 (2), 125–133.
Jenssen, J.I., Rand⌀y, T., 2006. The performance effect of innovation in shipping companies. Marit. Policy Manag. 33 (4), 327–343.
Hossain, T., Adams, M., Walker, T.R., 2019. Sustainability initiatives in Canadian ports. Marine Policy 106, 103519. https://doi.org/10.1016/j.marpol.2019.103519.
Kaliszewski, A., Kozłowski, A., Dąbrowski, J., Klimek, H., 2020. Key factors of container port competitiveness: A global shipping lines perspective. Marine Policy 117, 103896. https://doi.org/10.1016/j.marpol.2020.103896.
Kang, D.-J., Woo, S.-H., 2017. Liner shipping networks, port characteristics and the impact on port performance. Marit. Econ. Logist. 19 (2), 274–295.
Kim, A.R., 2016. A study on competitiveness analysis of ports in korea and china by entropy weight topsis. Asian J. Shipp. Logist. 32 (4), 187–194.
Krugman, P., 1994. Competitiveness: a dangerous obsession. Foreign Aff 28–44.
Lam, J.S.L., Notteboom, T., 2014. The greening of ports: a comparison of port management tools used by leading ports in Asia and Europe. Transp. Rev. 34 (2), 169–189.
Lee, P.-T.-W., Lam, J.S.L., 2015. Container port competition and competitiveness analysis: Asian major ports. Springer, Handbook of Ocean Container Transport Logistics.
Lun, Y.H.V., 2011. Green management practices and firm performance: a case of container terminal operations. Resour. Conserv. Recycl. 55 (6), 559–566.
Malchow, M.B., Kanafani, A., 2004. A disaggregate analysis of port selection. Transp. Res. Part E Logist. Transp. Rev. 40 (4), 317–337.
Maskell, P., Malmberg, A., 1999. Localised learning and industrial competitiveness. Camb. J. Econ. 23, 167–185.
Munim, Z.H., Haralambides, H., 2018. Competition and cooperation for intermodal container transhipment: a network optimization approach. Res. Transp. Bus. Manag. 26, 87–99.
Munim, Z.H., Saeed, N., Larsen, O.I., 2019. 'Tool port'to 'landlord port': a game theory approach to analyse gains from governance model transformation. Marit. Policy Manag. 46 (1), 43–60.
Munim, Z.H., Schramm, H.-J., 2018. The impacts of port infrastructure and logistics performance on economic growth: the mediating role of seaborne trade. J. Shipp. Trade 3, 1–19.
Munim, Z.H. (2021). Regulation and Finance in the Bangladesh Port Industry. In book: Regulation and Finance in the port sector: Lessons from worldwide experiences, edited by Haralambides, H., Ferrari, C., Prete, S., and Tei, A. Palgrave Studies in Maritime Economics series. DOI : 10.1007/978-3-030-83985-7 .
Munim, Z.H., Duru, O., Ng, A.K., 2021. Transhipment port's competitiveness forecasting using analytic network process modelling. Transp. Policy. https://doi.org/10.1016/j.tranpol.2021.07.015.
Murphy, P.R., Daley, J.M., Dalenberg, D.R., 1992. Port selection criteria: an application of a transportation. Logist Transp Rev 28:237Ng KY (2006) Assessing the attractiveness of ports in the North European container transhipment market: an agenda for future research in port competition. Marit Econ Logist 8, 234–250.
Nazemzadeh, M., Vanelslander, T., 2015. The container transport system: Selection criteria and business attractiveness for North-European ports. Marit. Econ. Logist. 17 (2), 221–245.
T. Notteboom A. Pallis J.-P. Rodrigue Port Economics, Management and Policy 1 Routledge London.
Pagano, A.M., Wang, G.W.Y., Sánchez, O.V., Ungo, R., 2013. Impact of privatization on port efficiency and effectiveness: results from Panama and US ports. Marit. Policy Manag. 40 (2), 100–115.
Parola, F., Risitano, M., Ferretti, M., Panetti, E., 2017. The drivers of port competitiveness: a critical review. Transp. Rev. 37 (1), 116–138.
Perez-Labajos, C., Blanco, B., 2004. Competitive policies for commercial sea ports in the EU. Marine Policy 28 (6), 553–556.
Porter, M.E. (1992) Competitive advantage: creating and sustaining superior performance. PA Consulting Group, London.
Puig, M., Wooldridge, C., Darbra, R.M., 2014. Identification and selection of environmental performance indicators for sustainable port development. Mar. Pollut. Bull. 81 (1), 124–130.
Saeed, N., 2009. An analysis of carriers' selection criteria when choosing container terminals in Pakistan. Marit. Econ. Logist. 11 (3), 270–288.
Sanchez, R.J., Ng, A.K., Garcia-Alonso, L., 2011. Port selection factors and attractiveness: The service providers' perspective. Transp. J. 50, 141.
Sayareh, J., Iranshahi, S., Golfakhrabadi, N., 2016. Service quality evaluation and ranking of container terminal operators. Asian J. Shipp. Logist. 32 (4), 203–212.
Schøyen, H., Odeck, J., 2013. The technical efficiency of Norwegian container ports: A comparison to some Nordic and UK container ports using Data Envelopment Analysis (DEA. Marit. Econ. Logist. 15 (2), 197–221.
Slack, B., Gouvernal, E., 2011. Container freight rates and the role of surcharges. J. Transp. Geogr. 19 (6), 1482–1489.
Song, D.-W., Yeo, K.-T., 2004. A competitive analysis of Chinese container ports using the analytic hierarchy process. Marit. Econ. Logist. 6 (1), 34–52.
Starr, J.T., 1994. The mid-Atlantic load centre: Baltimore or Hampton roads? Marit. Policy Manag. 21 (3), 219–227.
Tiwari, P., Itoh, H., Doi, M., 2003. Shippers' port and carrier selection behaviour in china: a discrete choice analysis. Marit. Econ. Logist. 5 (1), 23–39.
Tongzon, J., Heng, W.u., 2005. Port privatization, efficiency and competitiveness: Some empirical evidence from container ports (terminals. Transp. Res. Part Policy Pract. 39 (5), 405–424.
Tongzon, J.L., 2009. Port choice and freight forwarders. Transp. Res. Part E Logist. Transp. Rev 45 (1), 186–195.
Tovar, B., Hernández, R., Rodríguez-Déniz, H., 2015. Container port competitiveness and connectivity: The Canary Islands main ports case. Transp. Policy 38, 40–51.
Ugboma, C., Ugboma, O., Ogwude, I.C., 2006. An Analytic Hierarchy Process (AHP) Approach to Port Selection Decisions – Empirical Evidence from Nigerian Ports. Marit. Econ. Logist. 8 (3), 251–266.
Vermeiren, T., Macharis, C., 2016. Intermodal land transportation systems and port choice, an analysis of stated choices among shippers in the Rhine-Scheldt delta. Marit. Policy Manag. 43 (8), 992–1004.
Wiegmans, B.W., Van Der Hoest, A., Notteboom, T.E., 2008. Port and terminal selection by deep-sea container operators. Maritime Policy & Management 35 (6), 517–534. https://doi.org/10.1080/03088830802469329.
Yeo, G.-T., Roe, M., Dinwoodie, J., 2008. Evaluating the competitiveness of container ports in Korea and China. Transp. Res. Part Policy Pract. 42 (6), 910–921.
Yeo, G.T., Thai, V.V., Roh, S.Y., 2015. An analysis of port service quality and customer satisfaction: The case of Korean container ports. Asian J. Shipp. Logist. 31 (4), 437–447.
Yuen, C.-L., Zhang, A., Cheung, W., 2012. Port competitiveness from the users' perspective: An analysis of major container ports in China and its neighboring countries. Res Transp. Econ. 35 (1), 34–40.
Yuen, K.F., Wang, X., Wong, Y.D., Zhou, Q., 2018. The effect of sustainable shipping practices on shippers' loyalty: The mediating role of perceived value, trust and transaction cost. Transp Res Part E Logist Transp Rev 116, 123–135.
Zeithaml, V.A., Berry, L.L., Parasuraman, A., 1996. The behavioral consequences of service quality. J Mark 60 (2), 31–46.
Ng, K.Y., 2006. Assessing the attractiveness of ports in the North European container transhipment market: an agenda for future research in port competition. Marit. Econ. Logist 8, 234–250.
Lirn, T.C., Wu, Y.C.J., Chen, Y.J., 2013. Green performance criteria for sustainable ports in Asia. International Journal of Physical Distribution Logistics Management 43 (5/6), 427–451. https://doi.org/10.1108/IJPDLM-04-2012-0134.