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The Attractiveness of Ports in West Africa: Some Lessons from Shipping Lines' Port Selection

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ABSTRACT This paper investigates the attractiveness of ports in West Africa through the development of a container shipping lines' port choice methodology. Although many multi-criteria decision-making methods have been developed and applied to facilitate a rational port choice process, few have investigated the criteria used by shipping lines when selecting ports in West Africa. With the rapid economic development of West Africa, the task of establishing a rational model to guide shipping lines to choose their favourite ports in the region becomes urgent. In this work, 16 criteria are identified to assist shipping lines in port choice from four perspectives including adequate infrastructure, port location, port charge, and port administration/port efficiency. In order to quantitatively evaluate these criteria, an analytical hierarchy process approach is used to make use of subjective judgements to compensate the incompleteness of objective data. One of the important findings from this study is that port infrastructure is the most crucial criterion in terms of the port attractiveness in West Africa. It is followed by port draught, political stability, market size/cargo volume, and international networks. The research outcomes also indicate that the port of Abidjan is the most attractive container port in West Africa, followed by Dakar when all the identified important criteria are taken into account.

Introduction

Selecting appropriate ports of call for shipping lines is an important issue in ensuring the lines' business continuity and the ports' (as well as their associated regional) economic growth. Although being considered as an integral part of supply chains, ports are not yet well integrated with other elements in supply chains and are still viewed by port users in isolation in many cases, particularly in developing countries such as those in West Africa. This situation often leads to high logistics costs for shipping lines calling at West African ports.

Meantime, ports in West Africa have undergone significant transformation in the past decades. The intensity of competition inherent in the global economy, along with the need for huge investments in modern technologies and facilities, is forcing African governments to consider that port institutions must create the basis for private participation reform (Pallis 2012; UNCTAD 2012). In

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fact, the fast growth of containerization has created problems for ports in the region (e.g., higher requirements on terminal infrastructure with more post-Panamax vessels being used in the shipping routes covering West African coasts). Without appropriate investments to upgrade facilities and technologies, many container terminals are reaching their capacity limits, which is undoubtedly causing increasing traffic and port congestion and thus reducing the attractiveness of the ports in the region. Furthermore, the recent civil wars and pirate activities in the region have also influenced shipping lines decisions when choosing their ports of call.

Unlike the most important criteria (e.g., cost, quality, and logistics service) influencing port attractiveness and selection in the other regions, those relating to West Africa have not been intensively researched, requiring a careful investigation in order to minimise the total transport costs and optimise the sustainability and reliability of shipping lines' service. In addition, ports also need to understand the important criteria and the lines' decision-making process for improving their service quality and rationalising resource management to enhance their attractiveness. However, the task of identifying important factors and developing a rational port selection decision making tool is not straightforward because it is essentially a process of multiple criteria decision making (MCDM) under uncertainty requiring analysts to derive rational decisions from ambiguous and incomplete data contained in different quantitative and qualitative forms (Yang et al. 2009).

This paper aims at developing a container shipping line's decision making methodology on port selection in West Africa, in which the important criteria are identified and the attractiveness of the top five container ports in the region are evaluated with respect to the criteria individually and wholly in a case study. Following the port selection literature review, the third section describes the methodology using an Analytical Hierarchy Process (AHP) approach, including the identification and estimation of the important port selection criteria in West Africa and the evaluation and analysis of the attractiveness of the top five container ports in the region. The results from the third section are analysed and discussed in the next. The last section concludes the paper.

Port Choice Literature

There are numerous studies on port attractiveness, competition, and selection from the perspectives of various stakeholders including carriers, shippers and ports, etc. (e.g., Brooks, Schellinck, and Pallis 2011). In the studies, factors influencing port selection are identified and categorised based on different classification methods. The detailed research and factor classification methods are documented in Gohomene (2011) and Yeo et al. (2014), while Table 1 lists the research findings from the classical works associated with this investigation in a particular way of selecting ports from a carrier's perspective as well as from a wide range of geographical regions.

The port selection literature, has shown that there are many potential determinants of port selection identified in Asia, America and Europe but few in Africa. They have been presented in quantitative or qualitative forms. Quantitative factors are those that can be potentially measured and compared in an objective manner, while qualitative factors include subjective influences such as flexibility and ease of use and the level of cooperation that may be developed between the carriers and the port. The lack of relevant research in West Africa, together with the need of dealing with subjective data from a small number of shipping lines actively engaging in West Africa, shows a research gap to be filled and highlights the novelty of this research. The fast regional economic development and seaborne trade growth in West Africa also underpin the crucial, timely, and beneficial features of this investigation and require its findings of the identified port selection criteria and attractive container ports in the area to be released.

TABLE 1. FACTORS INFLUENCING PORT SELECTION FROM DIFFERENT GEOGRAPHICAL REGIONS.

Works	Regions/areas	Major criteria
Malchow and Kanafani (2004)	U.S.	Geographic location, port characteristics, and characteristics of vessel schedules
Song and Yeo (2004)	China	Cargo volume, port facility, port location, service level, and port expenses
Lirn et al. (2004)	Global	Handling cost, proximity to main navigation routes, proximity to import/export areas, infrastructure condition, and feeder network
Tongzon and Sawant (2007)	Singapore and Malaysia	Port charges and a wide range of port services
Chou (2007)	Taiwan	The closeness to the import/export area, proximity of the feeder port, closeness to main navigation route, volume of import/export containers, volume of transshipment containers, frequency of ship calls, infrastructure condition, port facilities and equipment, inter-modal link
Tongzon (2009)	Southeast Asia	Efficiency, shipping frequency, adequate infrastructure and location
Chang, Lee, and Tongzon (2008)	East Asia, Europe, Trans-Pacific and Intra-Asia	Local cargo volume, terminal handling charge, berth availability, port location, transhipment volume, and feeder network
Wiegmans, Hoest, and Notteboom (2008)	Hamburg-Le Havre	Port reputation, port tariff, terminal handling charge, market size/cargo volume, international network
Yeo, Roe, and Dinwoodie (2011)	Northeast Asia	Port service, hinterland condition, availability, convenience, logistics cost, regional centre, and connectivity
Ng (2006)	Northern Europe	Monetary cost, time efficiency, geographical location and service quality
Ugboma, Ugboma, and Ogwude (2006)	Nigeria	Port infrastructure, port reputation, port tariff, problem handling in the port, geographical advantage
Urli and Guy (2006)	North America	Port infrastructure, port size, port tariff, terminal handling charges, geographical advantage, government taxes, and duties
Baird (2000)	UK	Relationship of the port authority with union, closeness to navigation
Brooks (2000)	Global	Port infrastructure, port tariff, relationship of the port authority with union

Port Selection in West Africa

This section applies AHP to West African port selection through an examination of the predominant factors that have a bearing on shipping lines' port selection decision and evaluation of the most attractive container port in the region through the analysis of a case of involving several major shipping lines. AHP is a useful MCDM technique. The advantages of the AHP as a decision tool have been reported by Saaty and Vargas (2001), including (but not limited) interdependence, synthesis, tradeoffs, judgement and consensus, process repetition, consistency, and measurement. The success of the AHP in previous port selection and competition research (Lirn et al. 2004) supports its adaptive application in this study, which is detailed in the following three subsections.

Competitive container ports in the West African region. West Africa has 20 commercial maritime harbours with traffic of more than 500,000 tonnes/year (excluding oil terminals) of which five are located in Nigeria (Bossard 2009). The number of vessels docking at West African coasts grew from 15,000 in the early 1990s to more than 20,000 during the early 2000s. These movements generate a trade volume (excluding petroleum exports) of more than 140 million tonnes, which equals approximately 25 percent of total African maritime traffic and 1.5 percent of the world's maritime traffic (Bossard 2009). In terms of size and activity, the port of Lagos is the most important in West Africa. Its annual merchandised traffic is in excess of 30 million tonnes, which is approximately 55 percent of Nigeria's port activities (excluding hydrocarbon exporting terminals) and 25 percent of the total ECOWAS member countries' port activity. The top five container ports (in terms of their container throughput in 2002–2008) in West Africa are Abidjan, Dakar, Lagos, Lome, and Tema. This paper analyses the container throughput statistics of all the major (10) container ports (defined as the ones being mostly used by shipping lines as well as complying at least with the minimum world standards). The result shows that the container throughput of the top five ports takes up more than 86 percent of the total from the ten major container ports, justifying the selection of the top five as the research targets for future investigation.

West African port selection criteria identification and weight estimation using AHP. There is lack of literature on container port attractiveness and selection in West Africa. The similar studies focusing on other regions/areas (those listed in Table 2) therefore serve as the sources for the identification of an initial pool of twenty nine criteria for container port selection. There is also one more criterion (i.e., political stability) specific to West Africa being identified through interviews of experts. Consequently, a total of 30 criteria have been obtained initially in this study from the combination of literature review and interviews. However, through the interview process, it was found that some criteria may not be important or suitable for inclusion in the port choice analysis in West Africa. To eliminate those criteria from the pool, a panel of four experts having experience of container shipping in West Africa (three senior managers from the shipping industry and one senior lecturer from the academy) was formed to screen the criteria in a preliminary study. The survey is conducted with the experts using a six-point Likert scale, where 1 means the least important, 3 indicates the average, and 6 represents the most important. The judgements are consistent among the four experts to a large extent, showing the competence of the experts in this screening process and providing the confidence of distinguishing the trivial criteria from those crucial ones. Any criterion that scored below the average value of 3 was eliminated. The reduced list of 16 determinants was employed and presented in Figure 1. The 16 criteria are split into four groups—adequate infrastructure, location, port charges, and port administration/port efficiency—according to their characteristics. It is also noteworthy that security under port administration/port

TABLE 2. PRELIMINARY STUDY OF CONTAINER PORT SELECTION CRITERIA.

	Criteria	Source									
		Brooks (2000)	Baird (2000)	Lirn et al. (2004)	Ugboma, Ugboma, and Ogwude (2006)	Guy and Urli (2006)	Wiegmans, Hoest, and Notteboom (2008)	Tongzon and Sawant (2008)	Yeo, Roe, and Dinwoodie (2011)	Tongzon (2009)	Chou (2007)
1	Port infrastructure	v		v	v	v			v	v	v
2	Port size					v			v		
3	Port reputation				v		v	v	v	v	
4	Port tariff	v			v	v	v	v	v	v	v
5	Berth availability			v							v
6	Terminal handling charge			v		v	v	v	v		v
7	Service reliability			v				v		v	
8	Service speed			v						v	
9	Cargo handling safety			v						v	
10	Quality of staff			v						v	
11	Relationship of the port authority with union	v	v	v				v			
12	Port depth			v				v			v
13	Information technology			v				v			
14	Market size/cargo volume			v			v	v			v
15	Nearness to hinterland			v							
16	International network/characteristics	v		v			v	v	v		v
17	Intermodal cost			v				v		v	v
18	Problem handling in the port				v					v	
19	Congestion			v							v
20	Container handling efficiency	v		v						v	
21	Geographical advantage	v		v	v	v		v		v	
22	Port security			v							v
23	Closeness to main navigation routes	v	v	v						v	
24	Port administration and customs regulation			v							v
25	Terminal security and port safety			v							
26	Risk management and terminal operation			v				v			
27	Government tax and duties			v		v					v
28	Ownership of port and terminal			v							
29	Privileged terms to ocean carriers			v							
30	Political stability										

Note: v indicates the associated criterion appeared in the relevant reference in the literature.

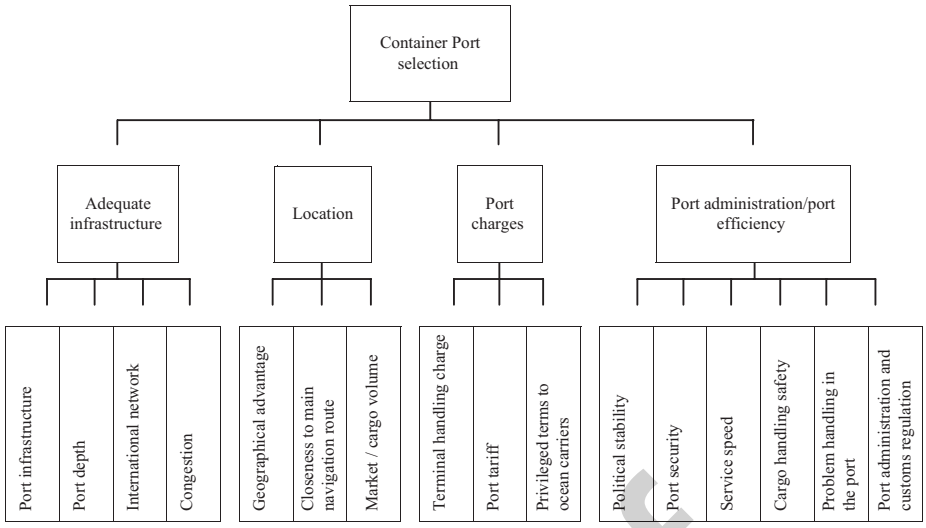

FIGURE 1. DECISION HIERARCHY TO SELECT A CONTAINER PORT IN WEST AFRICA.

efficiency received a relatively high score in the preliminary estimation, highlighting the uniqueness of this investigation.

The next step is to estimate the weights of the criteria using an AHP approach, as demonstrated in equation (1) (Saaty 1980).

$$w_k = \frac{1}{n}\sum_{j=1}^{n}\left(\frac{a_{kj}}{\sum_{i=1}^{n} a_{ij}}\right) \quad k = 1, 2, 3 \ldots n \tag{1}$$

where w_k is the weight of the k_{th} criterion and a_{ij} stands for the entry of row i and column j in a comparison matrix of order n. Each a_{ij} ($i = 1, \ldots n$; $j = 1, \ldots n$) is an element in the $n \times n$ matrix, representing the relative importance of the i_{th} criterion compared with the j_{th} one. When numerous pairwise comparisons are evaluated, perfect consistency is usually difficult to achieve. A consistency ratio (CR) is therefore calculated (Godaliyadde et al. 2011) to ensure the degree of inconsistency among the comparisons in each matrix smaller than 0.1 (Saaty 1980).

The data required to calculate the weights are obtained through the questionnaires based on pair-wise comparison matrixes in AHP. Fourteen shipping lines and shipping business consulting companies serving the container ports in West Africa are identified and contacted for the data collection. Ten provide effective/valid feedbacks. Average values, a_{ij}, of the 10 feedbacks are used as the input data in the matrixes to calculate the weights of the criteria. Tables 3 and 4 show the process of calculating the weights of the criteria in the group of adequate infrastructure (group 1). The criteria weights of group 1 are calculated as 0.5034, 0.32, 0.1132, and 0.0634, representing the importance of port infrastructure, port berth, international network, and congestion, respectively. The weights of the 12 remaining criteria and the four main groups can be calculated in a similar way. The relative weights of the 16 sub-criteria can be computed by multiplying their individual weights under different groups with the ones of their associated main group. For example, the relative weight of port infrastructure is equal to 0.2791, which is the result of multiplying 0.5034 (the port infrastructure weight under group 1) and 0.5545 (the weight of the main group adequate infrastructure). Consequently, the weights of the 16 sub-criteria are obtained in Table 5.

TABLE 3. COMPARISON MATRIX (GROUP I).

	Port infrastructure	Port depth/draught	International network characteristics	Congestion
Port infrastructure	1	2.81	5.5	4.82
Port depth/ draught	0.3558	1	5.71	5.61
International network	0.1818	0.1751	1	3.35
Congestion	0.2074	0.1782	0.2985	1
Sum	1.745	4.1633	12.5085	14.78

TABLE 4. NORMALIZED RELATIVE WEIGHTS (GROUP I).

	Port infrastructure	Port depth/draught	International network characteristics	Congestion	Priority vector
Port infrastructure	0.5730	0.6749	0.4397	0.3261	0.5034
Port depth/ draught	0.2039	0.2402	0.4565	0.3795	0.32
International network	0.1042	0.0421	0.0799	0.2267	0.1132
Congestion	0.1189	0.0428	0.0239	0.0677	0.0634

CR = 0.0922

West African port attractiveness evaluation with respect to individual or all criteria. In this section, the attractiveness rating of the five ports with regard to each criterion is calculated through the data collected from seven companies, who are the regular users of the top five container ports.[1] Initially, a questionnaire based on the AHP approach was designed and used to collect port attractiveness data. However, it was found that the questionnaire was too long to be well received by the companies. As a result, it was difficult for the companies to provide feedbacks and to ensure the consistency among them. It was therefore suggested to use a six-point Likert scale through interviews to facilitate the data collection and to evaluate the attractiveness of the five ports, where 1 means the least attractive and 6 indicates the most attractive. The average value of the scores by the seven interviewees is used to show how much the ports are attractive to the interviewees with respect to each criterion, as seen in Table 5. The overall attractiveness score of each port is obtained in Table 5 by summing the weighted attractiveness scores (WAS), which are calculated by multiplying the port attractiveness score with respect to each individual criterion and the weight of the associated criterion.

Analysis and Discussion

Analysis of the weight of the 16 criteria. The results in Table 5 indicate the most important criteria influencing West African port attractiveness are port infrastructure (27.9 percent), port draught (17.8 percent), and political stability (12.4 percent). Port infrastructure, as the most important criterion, refers to the number and quality of container berths, cranes, tugs, and terminal areas as well as the quality and effectiveness of information and control systems in this study. It is not surprising to have port infrastructure as the key decision criterion simply because good infrastructure

TABLE 5. PERFORMANCE RATING OF EACH PORT WITH RESPECT TO EACH CRITERION.

Criterion	Weight	Attractiveness of each port under different criteria									
		Abidjan		Dakar		Lagos		Lome		Tema	
		EAS	WAS	EAS	WAS	EAS	WAS	EAS	WAS	EAS	WAS
Port infrastructure	0.2791	4.57	1.275	3.57	0.996	3	0.837	2.85	0.795	3.42	0.955
International network	0.0628	4.52	0.284	3.28	0.206	2.57	0.161	2.71	0.17	3	0.188
Congestion	0.0352	3.85	0.136	3.57	0.126	1.85	0.065	3.28	0.115	3.85	0.136
Political stability	0.1236	2	0.247	4.42	0.546	2.71	0.335	3.71	0.459	5.14	0.635
Port security	0.0553	4.57	0.253	3.71	0.205	2.14	0.118	3.42	0.189	4.14	0.229
Service speed	0.0265	4.71	0.125	3.71	0.098	2.42	0.064	3	0.08	3.42	0.09
Cargo handling safety	0.0227	4.57	0.104	3.85	0.087	3.14	0.071	3.28	0.074	4.14	0.094
Problem handling in the port	0.0147	4.57	0.067	3.85	0.057	2.85	0.042	3.42	0.05	4	0.059
Port administration and customs	0.0065	4.14	0.027	3.71	0.024	2.14	0.014	3.14	0.02	4.42	0.029
Geographical advantage	0.015	5	0.075	4.42	0.066	2.85	0.043	3.14	0.047	3.85	0.058
Closeness to main navigation routes	0.0082	4.85	0.04	5.14	0.042	2.85	0.023	3.85	0.032	4.71	0.039
Market size/cargo volume	0.0815	4	0.326	3.28	0.267	4.85	0.395	2.71	0.221	3.85	0.314
Terminal handling charges	0.062	3.85	0.239	3.71	0.23	3	0.186	3.57	0.221	3.85	0.239
Port tariff	0.0122	4.28	0.052	3.71	0.045	2.42	0.03	3.28	0.04	3.71	0.045
Privilege terms to carriers	0.0172	3.85	0.066	3.42	0.059	2.14	0.037	3.14	0.054	3.14	0.054
Port depth/draught	0.1775	4.43	0.786	5.29	0.939	3.71	0.659	5	0.888	4.29	0.761
Overall attractiveness score		4.102		3.995		3.081		3.456		3.924	
Ranking		1		2		5		4		3	

EAS, estimated attractiveness score.

is the foundation for effective maritime operations and many container ports in West Africa have not yet achieved the standard of the third generation ports (PMAWCA 2008). It also explains the contradiction between this result and the findings from similar studies focusing on other regions in which port infrastructure reaches the required standards to a certain extent, thus usually being ranked behind service quality, handling cost, and proximity to main navigation routes. Port draught comes as the second most important criterion because nowadays, bigger container ships are being used in West African shipping routes to fit the increasing growth of the associated seaborne trade (ECLAC 1999). Political stability is ranked third making the results of this study unique compared with those available in the literature, where it is hardly considered as a selection criterion. The political unrest seen in most of West African countries constrains shipping activities and raises both transportation costs and insurance premiums.

Evaluation of the attractiveness score of the top five container ports in West Africa. This analysis is split into two parts. The first part analyses the attractiveness score of each port with regard to their strongest criteria. The second part is about the overall attractiveness score of each port. From Table 5, the port of Abidjan is the most attractive with regard to the 11 criteria, which are port infrastructure, international network, congestion, port security, service speed, cargo handling safety, problem handling in the port, geographical advantage, terminal handling charges, port tariff, and privilege terms to carriers. These results are partially attributed to the comparatively long peaceful climate that the Ivorian economy had have since the nation's independence in 1960 until the beginning of its civil war in 2003. This situation helped the Ivorian government to invest significantly in port infrastructure, which turned the port into the largest container port in West Africa and the second largest in Africa after the port of Durban (South Africa).

The port of Dakar is more attractive with regard to two criteria, closeness to main navigation route, and port draught. The port enjoys the great advantage of its closeness to Europe compared with the other four ports, as the first port met by ships coming from Europe to West Africa. The Port of Dakar being built into the sea has larger port draught. The port of Tema has a better performance in terms of congestion, political stability, port administration and customs, and terminal handling charges. It is largely because that since 1992, Ghana has been a perfect example of democracy and good public management in Africa. The port of Lagos is the most attractive with regard to its market size/cargo volume. Nigeria is the most populated country of Africa with an estimated population of 150 million people. This large population and the associated market make the port attractive to shipping lines.

From an overall perspective, Abidjan is evaluated as the most attractive container port in West Africa, followed by Dakar and Tema. In terms of quantitative results, the three ports' attractiveness scores are of insignificant difference, particularly the ones between Dakar and Tema. Lome and Lagos are less attractive than the three ports in this case study. Although Lagos is one of the largest ports in Africa and its container throughput remains at a high level, it is not very attractive to shipping lines evidenced by the low attractiveness scores received from the interviewees in the aspects of congestion, port security, cargo handling speed, and service quality. It provides insights for shipping lines to select their ports of call in the West African region. More importantly, it, using the case of the port of Lagos as an example, demonstrates the significance of this work in assisting port managers and authorities in facilitating optimal resource allocation and enhancing port attractiveness.

Conclusions

This paper applies AHP to develop a container shipping lines' port choice methodology and investigate port attractiveness in West Africa through analysing a survey of seven major shipping

lines. It provides empirical analysis to support the unique and interesting findings that the most important factors influencing shipping lines' port choice decisions in West Africa are port infrastructure, port draught, political stability, market size/cargo volume, and international network, while the most attractive container ports are Abidjan, Dakar, and Tema in the region. The results show much difference from the ones of previous port selection studies in other geographical regions such as Asia, North America, and Europe, where port cost and service quality often appear to be in the top priority criteria for carriers' port selection decisions. It also triggers further discussion on West African port and regional development strategies. For instance, it is arguable to ascertain the perception that port competiveness and port attractiveness are of high consistency in West Africa. It means that improving port service quality may not necessarily lead to an increase in market share and throughput growth in West Africa. Furthermore, it is not guaranteed that the ports of large market size show high attractiveness in West Africa, evidenced by the finding that the port of Lagos, which is characterised by the largest market size among the five selected container ports, has received the least attractiveness score from shipping lines in this investigation. Market size/cargo volume and international network become important selection criteria only when a port's infrastructure, draught, and its nation's political stability satisfy shipping lines' basic requirements. The lesson learnt from shipping lines' port selection is that port infrastructure, port draught, and political stability, having over 58 percent importance among the 16 criteria, largely determine the port attractiveness in West Africa. It provides significant insights for port development in this area to improve their attractiveness.

Having the empirical analysis of this study based on a small number of participants highlights the need to collect more survey data to reduce the possible bias in future studies. It is also noteworthy that while the data collected for estimating the weights of the criteria exhibit consistency (partially because the CR mechanism in the AHP method), the evaluation of port performance appears to be less consistent, reflecting the involved shipping lines' own preference and choice particularly with respect to the qualitative criteria. It is therefore suggested that compared with the results from the analysis on the importance of port selection criteria, the findings on port ranking based on the average values of a wide range of input data are subject to further validation in the future. It will also be valuable to investigate the interdependency among the criteria in order to further improve the accuracy of their weight estimation given that modelling variable interrelationship is revealed to be a research gap in port selection, competitiveness, and attractiveness literature in general. Nevertheless, the paper demonstrates how the AHP approach can be adapted to provide shipping lines with a powerful and transparent decision-making tool to select their most preferred ports of call in the region from an analytical perspective. The decision support tool can be used to assist in the selection of ports of call for specific shipping lines and to evaluate and benchmark the attractiveness of the competitive ports in the region through a longitudinal study, which is crucial for regions such as West Africa that experience rapid economic growth and have dynamic business and political environments.

NOTE

1. Seven out of 10 companies are used here because the other three are engaged with the container shipping business through other container ports in West Africa.

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