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Port Competitiveness Criteria for Transshipment Container Market: A Turkish Port Industry Application

Sedat Başтuğ[1]✉ • Soner Esmer[2,3] • Enes Eminoğlu[4]

[1] Bandırma Onyedi Eylül University, Maritime Faculty, Department of Maritime Transportation and Management Engineering, Bandırma, Balıkesir, Türkiye, sbastug@bandirma.edu.tr
[2] Dokuz Eylul University, Maritime Faculty, Department of Maritime Business Administration, İzmir, Türkiye, soner.esmer@deu.edu.tr
[3] Kocaeli University, Maritime Faculty, Department of Maritime Business Administration, soner.esmer@kocaeli.edu.tr
[4] İskenderun Technical University, Barbaros Hayrettin Naval Architecture and Maritime Faculty, Department of Marine Transportation Operations Engineering, İskenderun, Hatay, Türkiye, enes.eminoglu@gmail.com

✉ Corresponding Author: sbastug@bandirma.edu.tr

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ABSTRACT

Since the 1970s when the hub and spoke system entered commercial life, it becomes a major distribution pattern in the transshipment container market. Many feeder ports feed the mega-ports with containers, they are not large by size, but they have great capacity of being flexible, agile, and close to the shippers in the local hinterland. Although it is not enough to continuously feed the maritime transportation system with different ships, this must be continuously fed by the maritime and hinterland connection. However, the connectivity of the ports is not the only criterion to have sustainable port competitiveness for terminals. There are other criteria to be identified and measured which one is important for terminal operators and users. Therefore, this study aims to determine the criteria to be followed by container terminals and to sort them in order of importance to have a sustainable competitive advantage in the transshipment container market. For this purpose, a comprehensive literature review and a quantitative research process were carried out with container line and container terminal operators, the importance levels of these criteria were defined by the Fuzzy Analytic Hierarchy Process (AHP) method, which is a multi-criteria decision-making method. The study has not only defined competitive criteria for the transshipment market but also the opinions of both parties were compared. According to the results Port Infrastructure and Superstructure criterion is defined as the most important criterion for both parties.

INTRODUCTION

Transferring the container between the ports in the maritime supply chain is a requirement of economies of scale and commercial structure (Haralambides, 2019; Notteboom et al., 2019). A total of 197 million TEU containers transported worldwide in 2019 reached a volume of approximately 800 million TEU in ports (UNCTAD, 2019). This reveals that the transported container is transferred approximately 4 times. Container terminals are located in regions such as the China Sea, Singapore, and the Mediterranean where the transshipment traffic is heavily competed to get a share of this traffic. Competition of more than

one terminal in the transshipment regions has different advantages and disadvantages of these terminals leading the container lines to make a trade-off in port selection. As the study (Campbell & Kelly, 1994) stated in their study entitled Trade-Off Theory, "Trade-offs are at the heart of economics because neither the decision-maker nor society can have everything it wants". The trade-off theory put forward by the study (Kraus & Litzenberger, 1973) is based on choosing between funding through debt or equity by balancing the costs and benefits of each source (Notteboom & Winkelmans, 2002). In other words, businesses have an optimal financial structure, or they always want to stay close to optimal. If there is a deviation from the optimal targets, measures are taken to eliminate this deviation. The optimal level achieved should strike a balance between the ratio of earnings to losses (Singh & Kumar, 2012). The trade-off is a balancing and this balancing can be seen in different sectors under different headings and different structures. A container ship operator must consider many trade-offs when choosing the transshipment port. For this reason, the criteria that container ship lines will consider in the port selection are vital. Container terminals, which create service supply and carry out marketing activities for container ship operators, are the interface connection of sea and land transportation and an integrated transportation platform. With these features, they serve logistics, manufacturing, international trade, and information transfer as an interface for the economic development of the hinterland. Ports must serve ships and other modes of transport efficiently and effectively. Because of their importance in trade, ports play a critical role in the transfer of economic prosperity to national and international economies. In this context, the ports that want to attract transit container traffic must be directed in a strategic and correct direction to increase their competitiveness in the region.

This research aims to determine the criteria that container terminals will follow to achieve sustainable competitive advantage and to sort these criteria according to their importance. These criteria should be considered both by ports that offer service supply and by container ship operators requesting this service. In the research, a theoretical framework was first established, and a mixed research method was preferred to reach the findings.

The study first explores the port choice literature. Later the paper conducts a content analysis to categorize and sub-categorize the findings by using computer-aided content analysis software. Afterward, the Fuzzy AHP process (F-AHP) is performed over container line operators and Turkish container port terminals to determine the importance of the corresponding criterion. Finally, our research's results are compared with similar research for a superior outlook.

A Theoretical Framework: The Elements of Sustainable Port Competitiveness

Most the studies (van Dyck & Ismael, 2015; Hales et al., 2016; Parola et al., 2017) divide the elements of sustainable port competitiveness into four thematic sections, including competitiveness, business sustainability, and sustainable port competitiveness.

Competitiveness

The term "competitiveness" is defined by Porter (Porter, 1980) as the skill of companies to create goods and services using efficient methods. When the companies produce goods and services, they apply a sustainable competitive strategy to achieve long-term business. UNCTAD (1995) identifies the competitiveness of a firm as the ability to build market positions by distributing quality products or services on time and at competitive prices. This ability is the reflection of the firm flexibility to respond quickly to changes in demand and manages service differentiation by establishing the appropriate capacity and greater marketing management.

Business Sustainability and Its Relatedness with Competitiveness

Business sustainability has been continuously examined by the scholars in different aspects, including internalization, organization-specific advantages, organizational strategy and competitiveness (Kolk & Pinkse, 2008). At the same time, many scholars (Yeo et al., 2008) examined the

linkages between the competitiveness and business sustainability in different business settings, such as port industry. With regard to term "business sustainable competitiveness", the term is identified as the company's capacity to enable competitiveness all its assets in order to ensure great sustainability, profitability, productivity, and effectiveness on the long term (Herciu & Ogrean, 2018). Besides, the term "competitiveness" and "business sustainability" have found its place in many areas of strategic business management and has also been a widely studied topic in the maritime discipline. One of the main fields in this discipline is the port competitiveness and several authors (Parola et al., 2017; Notteboom & Winkelmans, 2002, Bichou, 2014) argues ports as networks where each business' success is highly connected to the sustainable competitiveness.

Sustainable Port Competitiveness

Sustainable port competitiveness is determined by many different factors, with the multidimensional use of ports and various demands related to logistics and it is mainly focused on port selection criteria from a different perspective of both port users and terminal operators (Sayareh & Alizmini, 2014). From the perspective of shipping lines, the study (Tongzon & Sawant, 2007) argued port cost and range of port services to be the only significant criteria in the port competition. A study also (Tongzon & Sawant, 2007) focused on sustainable port competitiveness for a particular region and used the following criteria to determine competitive ports: port services (quick response, zero waiting time for ships, 24 hours a day, 7 days a week service), hinterland connections, accessibility (suitability of the port at the port of destination, port congestion), availability (depth of approach channel and water in the dock, port information systems and the scope of application versatility, consistency of port workers), logistics costs (inland transportation costs, the entry of the ship and cargo into the port costs, time given for free storage at the terminal), becoming a regional hub (accessibility to the port, deviation distance to major routes) and connectivity with other ports (land distance and connectivity to key load holders, effective internal transfer network). Besides, the hinterland proximity and connectivity improve the hub port competitiveness by feeding ports with inland transport networks (Parola et al., 2017). In transshipment hub ports, port service quality (i.e., berth availability) was found important criterion in hub and spoke networks (Kavirathna et al., 2018). Another research study (Yuen et al., 2017) the hub port competitiveness in West European ports, considering ship frequency, port costs, transit time, and service quality. A different study (Wang, 2011) examined the various port services under the topic of the service factors. The study (Yap et al., 2006) affirms that port location, feeder services, and intermodal connections, the size of the hinterland, and port efficiency are critical transit port selection criteria in Western Europe. Similar to this study, the factors affecting port competitiveness were defined as cargo volume in the port, the facilities owned by the port, the geographical location of the port, and the level of service provided, while a study (Vaidya & Kumar, 2006) focused on the port's connectivity with other ports. A study (Robinson, 2002) analyzed variables such as ship types, total handling, ship frequency, and frequencies of ship lines with a linear model developed. A scholar (Tiwari et al., 2003) used suitable geographical location, port costs, suitable infrastructure, high port efficiency, a wide range of port services, and port connectivity with other ports as port selection criteria. While the study (Bichou, 2014) developed a theoretical framework on port selection criteria, firstly it formed three main categories and classified them under these categories. These categories are route factors (location, accessibility, port connection, backyard network, frequency, and transit time), cost factors (freight rates, tariffs, and capacity), and service factors (congestion, reliability, flexibility, safety, and security). In their study, physical criteria (sufficient water depth, the capacity of port facilities, number of docks, port location, ship control, and port technology) and service criteria (port working time, port tariffs, port security, port entry, operating cost, international policies, night navigation, port management, port workers, customs formalities) are the most important port selection variables (Saeed, 2009). Regarding the study (van Dyck & Ismael, 2015), operational efficiency in port is connected to the port size, that is,

bigger ports are more efficient than smaller ones due to the quality of port infrastructures, storage, and cargo handling. On the other hand, a study (Akbayirli et al., 2016) list the port selection criteria as "port location and hinterland connections, port physical and technical infrastructure and superstructure, port management and administration, port service quality, port efficiency, and productivity, port tariffs and costs, and the number and frequency of ships belonging to container carriers". In recent years, dimensions such as "Corporate Social Responsibility" and "Alliances made by container line operators" have been added to the existing criteria (Watson et al., 2012).

Although many criteria have been evaluated in these studies, they are in fact one-dimensional. All studies have separately focused on either port users or terminal operators for sustainable port competitiveness. For example, studies (Parola et al., 2017; Notteboom & Winkelmans, 2002, Bichou, 2014) examining transit ports have mainly evaluated the port competitiveness adjacent to each other in terms of port users. Briefly, there is no study has been found that simultaneously examines the factors affecting port competitiveness in terms of neither port users nor terminal operators. A new study (Munim, 2022) states that relevant studies focusing on transshipment port's competitiveness are very limited while the availability of the studies from the port users' perspectives. Finally, the major criteria concerning sustainable port competitiveness are listed as port services, hinterland connectivity, nautical accessibility, operational efficiency, maritime connectivity, hinterland proximity, route factors, cost factors, service factors, port location, port physical and technical infrastructure and superstructure, port management and administration, the port service quality, port efficiency, and productivity, others.

METHODOLOGY

This research aims to determine and prioritize the criteria that container ports will be suggested to follow the sustainable competitive advantage. For the research, a mixed-method regarding port selection criteria was preferred. In the first stage of the study, a systematic literature review was carried out and the criteria were determined. Then these criteria, which were determined by qualitative research, were prioritized by a "multi-criteria decision-making method", Fuzzy AHP (Saaty, 2008).

Qualitative Research Process

Since systematic literature reviews are conducted meticulously and systematically, they are regarded as original studies (Rother, 2007). They (Sayareh & Alizmini, 2014) state that such studies consist of four stages, these are collecting data (1), giving descriptive statistics (2), examining categories (3), and evaluating data (4). The first sample was obtained during the data collection phase. These studies have been eliminated according to certain criteria, as can be seen in Tables 1 and 2. Besides, certain constraints/criteria (internal and external) have been introduced to ensure that existing studies in the literature are excluded from or within this research, and the final sample has emerged. In the next stage, descriptive statistics about chronological studies based on countries and research types were prepared. The selection of the categories was made in line with the theoretical framework and the data were reduced to consolidate the categories.

Collection of Data

A literature review strategy was developed using electronic databases, time flow, and keywords. This literature review was carried out in February 2020 by scanning EBSCO Host, ProQuest, Scopus, Web of Science, ULAKBİM, and Microsoft Academic databases. These databases were determined in terms of ease of electronic access and reliability of data in social sciences. Also, library scanning was carried out to enrich the literature review. Studies of many authors researching sustainable port competition (Liou & Wang, 1992; Song & Yeo, 2004) were scanned by using "business sustainability", "port competitiveness", "port selection", "container terminal selection", "transit market", and "sustainable hinterland" keywords (Table 1).

After the stage of determining the keywords, a clear search sequence ("business sustainability" AND "port competitiveness" OR "port selection" OR "container terminal selection" OR "sustainable hinterland" AND "transit market") needs to be created. The results of the search string determined have been reached 35 papers.

Table 1. Literature review strategy in data collection process

#	Databases	Restrictions				Results
		Search Area	Document Type	Time Range	Language	
1	EBSCO Host	Theme	Article	From all years to today	English	210
2	Proquest	Theme, Title, Abstract, Keywords	Article and/or critics	From all years to today	English	110
3	Scopus	Theme, Title, Abstract, Keywords	Article and/or critics	From all years to today	English	75
4	Web of Science	Theme	Article	From all years to today	English	52
5	Microsoft Academic	Theme	Article	From all years to today	English	33
6	ULAKBİM	Theme	Article	From all years to today	Turkish	10
First sampling						**490**

Table 2. Constraints used in literature review

Internal Constraints	External Constraints
Full-text studies published in scientific journals	Non-academic writings and reviews
Empirical studies	Interviews
Doctoral theses	Book reviews
Scientific articles in English	Conference summaries
In-field studies on port and sustainability in social sciences	Out-of-field studies other than social sciences
Theoretical studies	Works written in languages other than English
Case Studies	
Notes are written to the editor	
Congress papers presented in full text	

The most important point in the systematic literature review is the clear definition of the constraints (internal and external) that will keep existing studies in or out of this research. These constraints in Table 2 facilitate the elimination of non-academic, non-field, and different languages.

Descriptive Statistics

In this section, the frequency distribution technique is used in the analysis of the studies that make up the sample of the study. The frequency distribution technique is very useful for researchers. With this technique, formal features that can form the basis of content analysis can be presented (Seuring & Gold, 2012). In the descriptive statistics section, publication years of the publications, and research of the authors (empirical, theoretical, or conceptual) are examined. At the same time, the sectors and fields in which the authors work are included in this analysis. The descriptive statistics section will be presented after the creation of the main categories and subcategories.

Determination of Main Categories

In terms of the theoretical framework of the study, (1) port services, (2) hinterland connectivity, (3) nautical accessibility, (4) operational efficiency, (5) maritime connectivity, (6) hinterland proximity, (7) route factors, (8) cost factors, (9) service factors, (10) port location, (11) port physical and technical infrastructure and superstructure, (12) port management and administration, (13) the port service quality, (14) port efficiency and productivity, (15) others are the main criteria divided into main

categories. The main categories belonging to the studies that are listed according to the purpose of the study and do not provide enough information from different sources are not included in the study.

Data Analysis

The data analysis phase is the last part of the systematic literature review and consists of three qualitative steps, these steps are (1) data reduction, (2) data display, and (3) conclusion (McHugh, 2012).

While there is enough analytical framework in the deductive approach to move towards content analysis, the inductive nature of the analytical framework requires that the analyzed data be summarized under predefined themes (McHugh, 2012). Thus, the data is gradually reduced and intensified (Eisenhardt, 1989). In this study, a two-stage process development approach is proposed in creating an analytical category pattern: in the first stage, after creating the basic framework of categories and sub-criteria based on the existing theory, all categories were consolidated in the coding process. In the continuation of the data reduction, the iteration cycle method was used for coding the categories of sub-criteria.

As a result of this process, eight main categories and 53 subcategories were formed. In particular, the most studied sub-criteria were determined and sub-criteria that had a little or similar contribution to the theory were excluded from the analysis. Thanks to the work done here, all sub-criteria in the main categories were compared, and similar sub-criteria were collected under the same main category, and the data reduction phase was completed. In the conclusion stage, 53 different sub-criteria whose iteration process was completed were determined as sub-categories. For example, the route factor in the study (Bichou, 2014) was not used in this study, (1) land distance to cargo owners, (2) effective internal transfer network, (3) port-road connection, (4) port-rail connection, (5) the origin of the load and its distance from the destination and (6) as sub-criteria of location are consolidated under the main category of connectivity with ports **(**Table 3).

RESULTS

Descriptive Statistics

The first step used to summarize the data and interpret the research results on the eight main categories determined in Table 4 is descriptive statistics. In other words, descriptive statistics covers the process of statistical compilation, collection, summarization, and analysis of data. In the study, several questions have been identified to decide what the descriptive statistics issues will be:

(1) What is the distribution of publications regarding port selection criteria over time?

(2) What is the distribution of the publications regarding the port selection criteria according to the journals in which they are published?

(3) What is the distribution of publications regarding port selection criteria on a country basis?

(4) What types of analysis methods have been applied in the studies?

When attention is paid to time distribution in studies, it has been observed that studies on port selection criteria have increased in recent years. This increase has become more evident especially since 2018 and concentrated on different journals (Figure 1).

When studies are analyzed by journal names, it is seen that high-impact sea transportation journals such as “Maritime Economics & Logistics” and “Maritime Policy & Management” are at the forefront. For example, the impact factor of “Maritime Economics & Logistics” journal is 1.661 for 2018, and the impact factor for “Maritime Policy & Management” is 2.5. The fact that the impact factor of the journals is greater than 1 indicates that the journal’s contribution to the field is satisfactory (Baştuğ et al., 2013). Apart from the transportation magazines, SSCI and SCI - Expanded indexed journals belonging to different fields have been determined to work on port selection criteria. The distributions of these studies are presented in Table 4.

Table 3. Main category layout resulting from data reduction

#	Main Categories	Subcategories
1	Hinterland connections	Experts and trained workforce
		The size and activities of free zones in the port hinterland
		Cargo Volume
2	Port location and accessibility	Suitability of the dock at the port of destination
		Port congestion
		Ship waiting times
		The number of ships making calls to the port
		Ship frequencies
		Transit time for cargoes
		Accessibility to the port
		Deviation distance to main routes
3	Convenience	Approach channel and water depth at the dock
		Port information systems and versatility
		Consistency of port workers
4	Connectivity with ports	Land distance and connectivity to cargo owners
		Effective internal transfer network
		Port location
		Port-road connection
		Port-rail connection
		The distance of cargo from origin and destination
5	Cost factors	Freight rates
		Tariffs and capacity
		Inland transportation costs
		Costs related to the entry of the ship and cargo into the port
		The time allowed for free storage at the terminal
		Flexibility in prices
		Ease of payments
		Total logistics costs due to port preference
6	Port Infrastructure and Superstructure	Port storage area size
		Number of port equipment
		Quality and technology of port equipment
		Cooled storage area of the port
7	Port management and administration	Management type
		Feature of port management
8	Service factors	Value-added services at the port
		Reliability offered in port services
		Social responsibility
		Green port applications
		Logistics services at the ports
		Flexibility in port services
		Special services
		Providing customers with information about the installation
		Port performance related to cargo losses and damages
		Port security
		Behavior, attitudes, and competencies of port staff
		Quick reply
		24 hours a day, 7 days a week service
		Zero waiting time service

Table 4. Distribution of studies according to journals

	Journal Name	#
1	Maritime Economics & Logistics	8
2	Maritime Policy & Management	4
3	Transport Reviews	3
4	The Asian Journal of Shipping and Logistics	3
5	Int. Journal of Physical Distribution & Logistics Management	1
6	Journal of ETA Maritime Science	1
7	Applied Economics	1
8	Journal of Shipping and Trade	1
9	Energy Policy	1
10	Marine Policy	1
11	Journal of Global Business and Social Entrepreneurship	1
12	Planning Perspective	1
13	Transportation Research Part D	1
14	Transportation	1
15	Transportation Research Part A	1
16	Energy Policy	1
17	Research in Transportation Business & Management	1
18	Sustainability	1
19	EconStar	1
20	Utilities Policy	1
21	Transport Policy	1
22	Thermal Science	1

In studies, China has seven (7) scientific types of research. After China and Turkey, developed economies have a significant proportion of work. In research, especially in Western Europe and Asia effect can be seen (Figure 2).

Since it does not require sampling, facilitates the comparative analysis, and is easy to repeat, case analysis (Kavirathna et al., 2018) is mostly preferred. Mathematical modeling and analytical hierarchy process analysis, which are frequently encountered in the studies on decision-making processes in social sciences, have also been identified as the most used analysis methods. However, the SWOT analysis method was preferred in studies that are very easy to perform and require basic analysis (Figure 3).

Content Analysis

In this section, content analysis was carried out on the articles that make up the sample, and the categories that were studied the most were determined. "NVIVO 12.0 Qualitative Content Analysis Software" was used to analyze the data in the sample. In content analysis, themes and clusters are the main categories and sub-categories found as a result of a systematic literature review. The articles were converted into digital texts with NVIVO software for analysis.

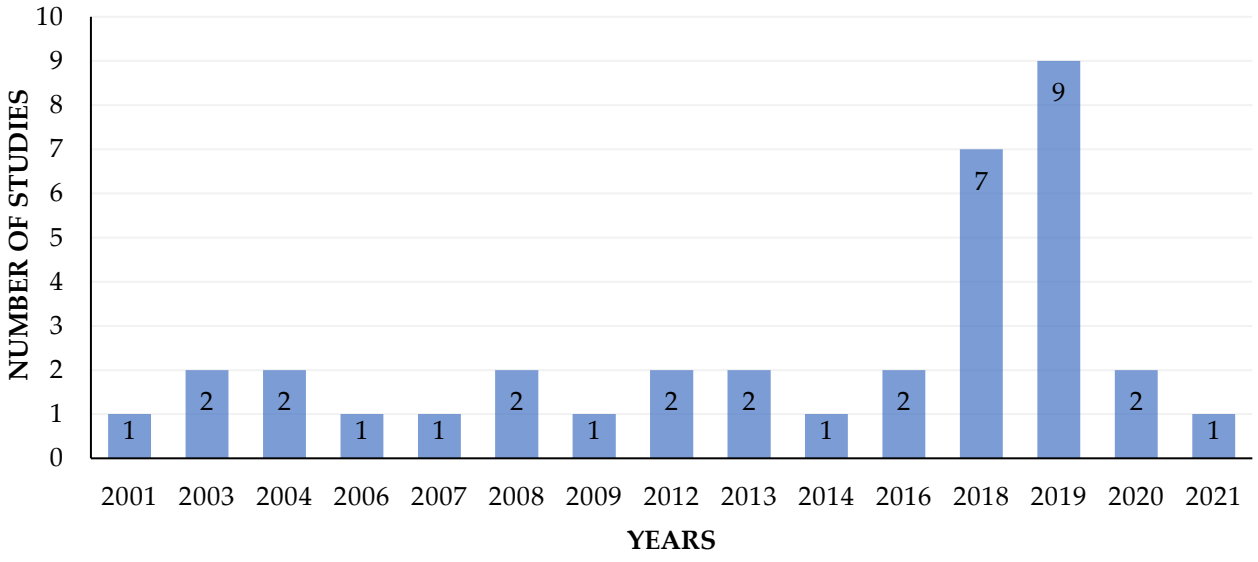

Figure 1. Annual distribution of studies on port selection criteria

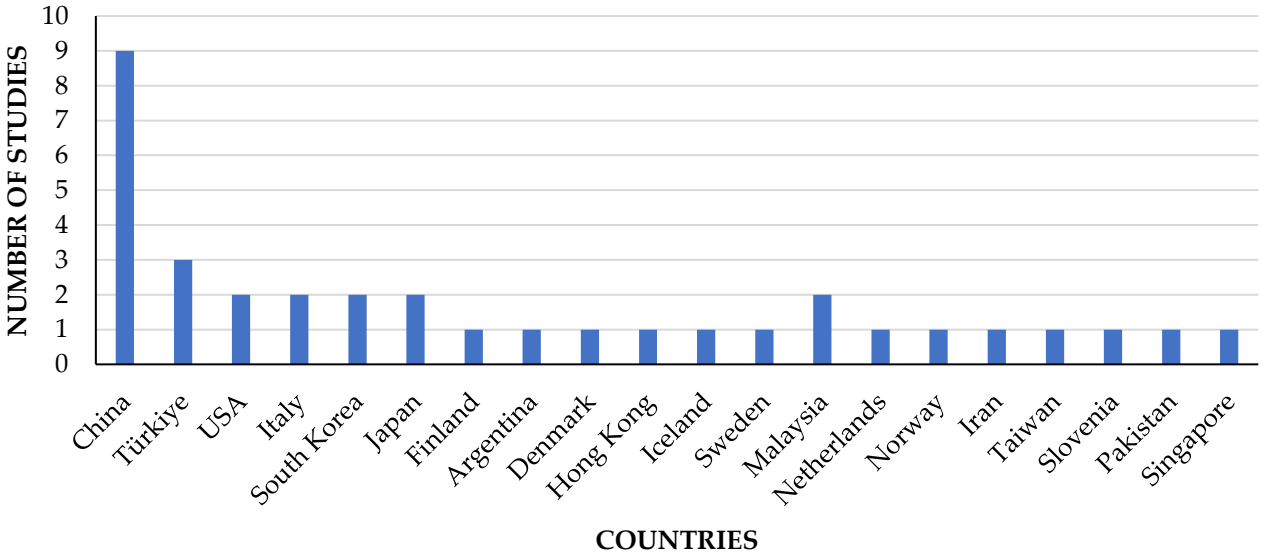

Figure 2. Territorial distribution of studies on port selection criteria

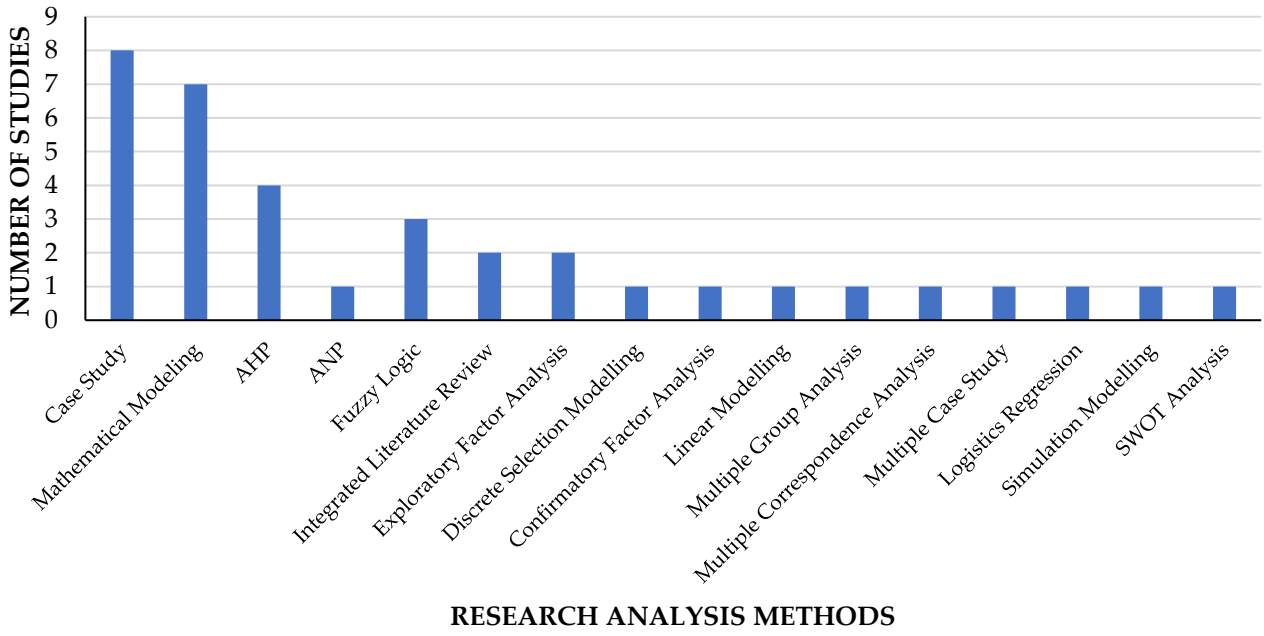

Figure 3. Distribution of Studies on port selection criteria according to research analysis methods

In traditional content analysis, the research team creates a coding scheme and trains the coders before analyzing the content. Scholars have evolved numerous algorithms and software to reduce subjective interpretations among coders (Krippendorff, 2018). Thanks to the software, a frequency table can be created, and content analysis can be performed on similar documents many times.

To increase reliability among encoders, two coders were chosen from professionals who previously attended related studies and were trained to code. As a result of comparing the coding of the two encoders, it was observed that the Kohen-Kappa coefficient scores were not less than 0.65. This shows that there is an agreement between the coded texts (Mayring, 2000). If both encoders have reached full agreement on what content to encode, the Kappa coefficient is 1. If there is no agreement between the two coders (except for random events), the Kappa coefficient is ≤ 0. The value between 0 and 1 suggests a partial agreement. In this case, it is seen that part of the study has been agreed upon.

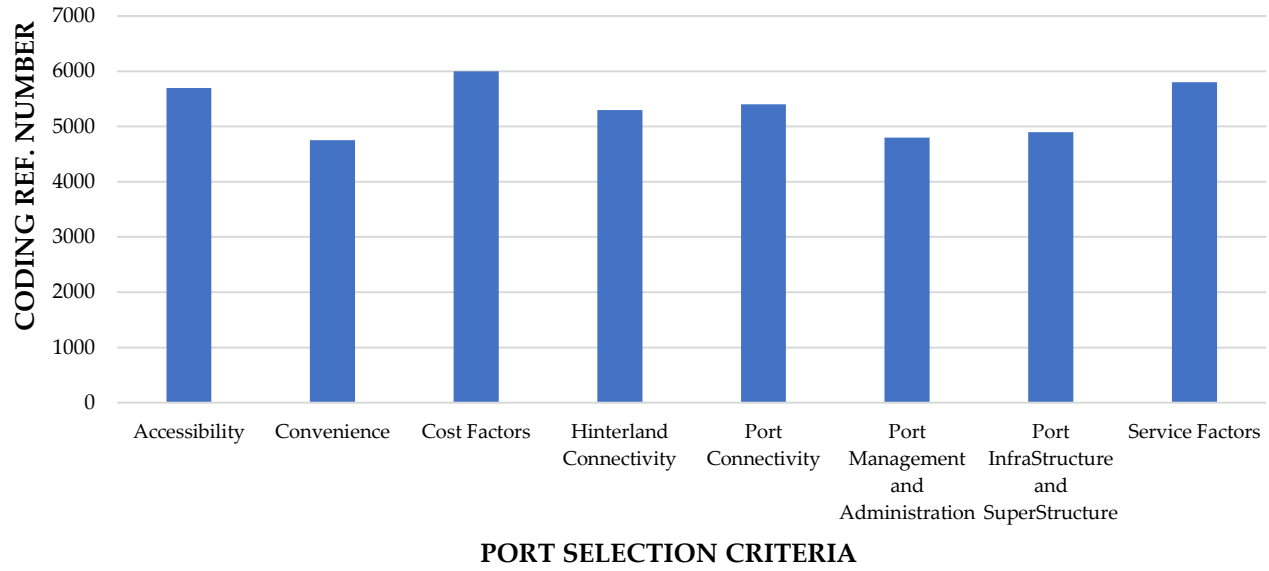

Figure 4. Coding frequencies of main criteria for port selection criteria (According to coding ref. number)

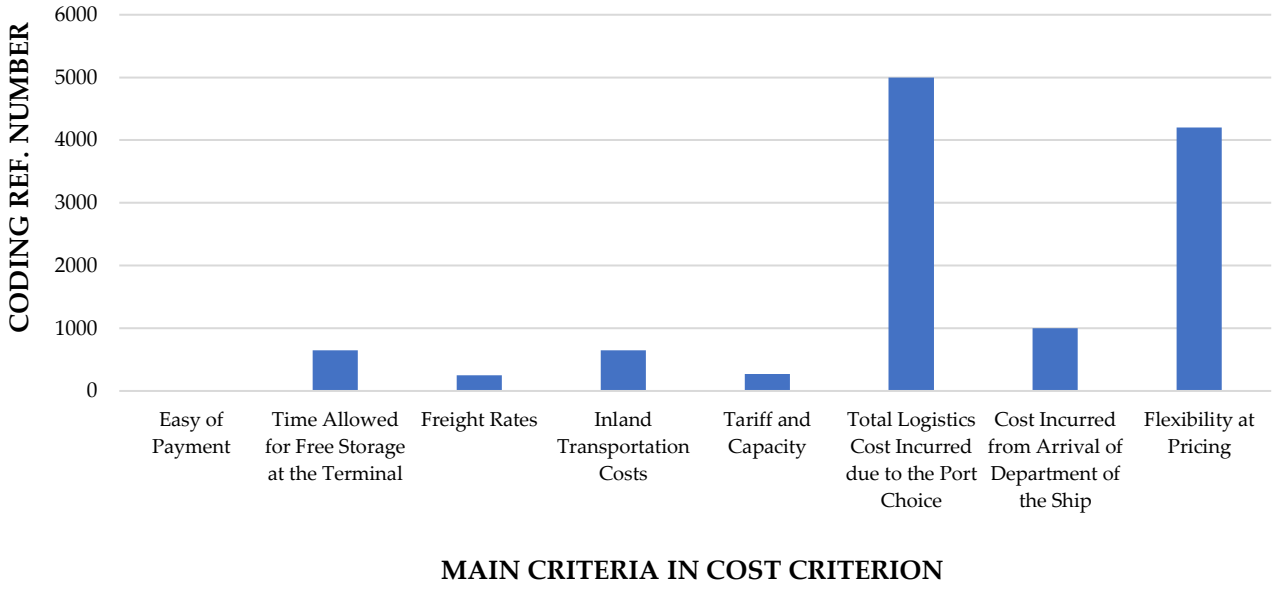

Figure 5. Coding frequencies of main criteria for cost criterion (According to coding ref. number)

For the research, matrix coding was performed for checking the relationships between the categories. Matrix coding queries are accustomed to define the scope of the main categories and concepts to make numerous comparisons between concepts and cases. Particularly, matrix encoding can match various collections of keywords in categories. They display information in Tables about the item pair corresponding to each row (for example, clusters, category-coded references, or percentage of corresponding coded data). Matrix encoding can query data like frequency, duration, encoding references, row, and column percentages, and encoding rate. In this study, coding references were accustomed to match coding differences between categories. Coding references represent a context of keywords about information collected from data sources such as focus groups, internet pages, interviews, scientific articles, social media messages, or surveys. Special words and characters can be used as operators in matrix coding.

Qualitative Research Findings

Content analysis of port selection criteria (Figure 4) shows that cost factors are the most studied topic in the 30 years between 1990 and 2020. The port operator,

which wants to create better customer value, must reduce its costs to have an advantage in the market against its competitors. The decrease in costs is very effective in determining the price. Many studies examined in the research (Tongzon & Sawant, 2007; Esmer, 2011) emphasize that pricing strategies should be strategic due to the high cost of port investments and the length of return on investment.

The most studied subject among cost factors is the total logistics costs arising from the port preference and the flexibility in prices (Figure 5). Logistics costs due to port preference are stated in the literature as THC (terminal handling cost), LCL (less than container load), documentation, handling, storage costs, and port taxes. Also, static or dynamic methods are used to calculate port logistics costs in these studies.

On the other hand, port pricing strategies can be analyzed in three categories (Frankel, 1987; Esmer, 2011): cost-based pricing strategies, value-based pricing strategies, and competition-based pricing strategies. Findings show that cost-based pricing strategies are the most studied and produced information criterion in the 30 years.

In studies conducted on port selection criteria, it was determined that the suitability category was the least studied criterion. The scarcity of studies on port workers and the innovation-oriented development of new technologies (especially Industry 4.0) in port management down the coding reference of this criterion.

Quantitative Research Process: Fuzzy AHP

The systematic literature review is ideal to ensure the first outlook into a phenomenon; however, it does not provide which criteria are to be rank-ordered from most important to least important. Hence, Fuzzy AHP was applied to find the importance of weights for the selection criteria.

The AHP method was first announced by a study (Robinson, 2002). The method is referred to as "a theory of measurement owing to pair-wise collations and depends on the judgments of professionals to evolve priority scales" (Robinson, 2002). Thanks to its ability to handle multiple qualitative and quantitative criteria, it is widely used in different fields including personnel selection, energy alternative selection, performance evaluation, job selection, factors influencing maritime transportation, and port selection and competition studies (Eisenhardt, 1989; Tongzon & Sawant, 2007; Seuring & Gold, 2012; Herciu & Ogrean, 2018; Krippendorff, 2018; Munim et al., 2022).

However, the AHP method, as Saaty (2008) first developed, has been criticized by many authors for not fully reflecting human thoughts (Durán & Aguilo, 2008). Since the pairwise formulation of the AHP contains explicit numbers from 1 to 9, scholars are not able to convey their thoughts to this certainty (Kim, 2016). At this point, fuzzy logic supports the AHP to achieve a comprehensive judgment for persons in charge of decision-making (Sarfaraz et al., 2007). Like many other studies, Fuzzy AHP is implemented in port selection studies as well (van Dyck & Ismael, 2015; Balci et al., 2018).

In the study, an analysis (Chang, 1996) has used and crisp numbers were converted into triangular fuzzy numbers. Afterward, the fuzzy numbers had created the comparison matrix and had calculated the synthetic values, extent analysis method was used. Afterward, defuzzification was performed regarding the study of (Liou & Wang, 1992). Finally, the weight of each criterion was calculated.

The AHP survey consists of a total of 8 criteria (ease of payment, the time allowed for free storage at the terminal, freight rates, inland transportation cost, tariff and capacity, total logistics cost incurred due to the port choice, costs incurred from arrival and departure of the ship, flexibility at pricing) collected from the interviews. The criteria were discovered to be comprehensive by the systematic literature review and three industry experts.

After identifying the criteria, a questionnaire was developed for the pairwise comparisons of the eight substitutes. As the study (Robinson, 2002) suggests, the 9-point comparative scale was used in the form. The studies of (Balci et al., 2018) and (Lirn et al., 2004) were preferred in the design of the comparison questions.

A cover letter has been attached to the first page of the questionnaire including instructions regarding the completion of the questionnaire. The cover letter has stated that general/deputy managers and department managers should complete the questionnaire to provide robust findings regarding their decision-making choices. Afterward, the questionnaire which consists of two sections has been prepared. In the first section of the questionnaire, the profile questions have been asked to the respondents. The second part consists of a pairwise comparison of the variables collected from the literature review.

In Table 5, it is seen that the total number of respondents was 20 and the survey was collected between May and June 2020. 10 of the survey participants are container terminal operators and the rest are container line operators (see Table 5). While container terminal operators are selected among competing container terminals that handle transshipment containers in the Eastern Mediterranean region, container ship operators have been selected from the ship lines that make calls to these ports.

The respondents were selected using judgmental sampling whereby interviewees are chosen based on the researcher's knowledge and judgment. Container terminal operators were chosen from container terminals in the Eastern Mediterranean region, whereas container line operators were chosen from the shipping lines calling at those ports. 40 questionnaires were back in April 2021, corresponding to a 65% response rate. In Table 5, both sets of respondents were key decision-makers in top management roles, having had long experience in the industry, with 12 managers having between 11-18 years of experience, and 8 having between 7-10 years' experience.

Quantitative Research Findings

The fuzzy comparison matrix is developed as shown in Table 6 and the fuzzy synthetic values are reached by using the extent analysis method (Chang, 1996).

The fuzzy synthetic value calculation for the container terminal selection criteria are as follows:

S_{HC} = (0.0416, 0.0592, 0.0860)

S_{PLA}= (0.1044, 0.1520, 0.2212)

S_{C} = (0.0395, 0.0564, 0.0840)

S_{CWP} = (0.0749, 0.1058, 0.1515)

S_{CF} = (0.1275, 0.1846, 0.2644)

S_{PIAS} = (0.2000, 0.2897, 0.4134)

S_{PMAA} = (0.0424, 0.0606, 0.0886)

S_{SF} = (0.0631, 0.0917, 0.1335)

Table 5. Profile of respondents

Container Terminal Operator			**Container Line Operator**		
#	**Position**	**Years of Experience**	**#**	**Position**	**Years of Experience**
1	CSR	10	11	Sales Vice-Manager	11
2	Agency Manager	17	12	Port Manager	16
3	CSR	10	13	General Manager	8
4	Agency Manager	9	14	Operations Director	18
5	Marketing Manager	13	15	CSR (Senior)	9
6	Agency Manager	12	16	Vice-Sales Manager	11
7	CSR	16	17	Marketing Manager	14
8	Agency Manager	8	18	General Manager	15
9	CSR	14	19	Marketing Manager	10
10	Marketing Manager	11	20	General Manager	9

Note: CSR: Customer Service Representative

Table 6. Fuzzy table comparison matrix

	Hinterland connectivity (HC)	**Port location and accessibility (PLA)**	**Convenience (C)**	**Connectivity with ports (CWP)**
HC	**(1.00, 1.00, 1.00)**	(0.32, 0.38, 0.44)	(0.87, 1.09, 1.34)	(0.72, 0.83, 0.96)
PLA	(2.26, 2.66, 3.08)	**(1.00, 1.00, 1.00)**	(3.07, 3.87, 4.65)	(1.26, 1.53, 1.91)
C	(0.75, 0.92, 1.15)	(0.21, 0.26, 0.33)	**(1.00, 1.00, 1.00)**	(0.56, 0.70, 0.87)
CWP	(1.04, 1.20, 1.39)	(0.52, 0.65, 0.80)	(1.15, 1.43, 1.78)	**(1.00, 1.00, 1.00)**
CF	(2.94, 3.65, 4.44)	(0.92, 1.18, 1.53)	(2.44, 3.07, 3.67)	(1.10, 1.39, 1.66)
PIAS	(4.25, 5.40, 6.49)	(1.91, 2.45, 3.08)	(3.33, 4.34, 5.28)	(2.42, 2.90, 3.43)
PMAA	(0.98, 1.21, 1.51)	(0.43, 0.54, 0.70)	(0.73, 0.91, 1.12)	(0.36, 0.44, 0.55)
SF	(1.12, 1.51, 1.97)	(0.45, 0.57, 0.72)	(1.60, 2.13, 2.66)	(0.54, 0.64, 0.77)
	Cost factors (CF)	**Port infrastructure and superstructure (PIAS)**	**Port management and administration (PMAA)**	**Service factors (SF)**
HC	(0.23, 0.27, 0.34)	(0.15, 0.19, 0.24)	(0.66, 0.83, 1.02)	(0.51, 0.66, 0.89)
PLA	(0.66, 0.85, 1.08)	(0.32, 0.41, 0.52)	(1.42, 1.85, 2.31)	(1.40, 1.77, 2.23)
C	(0.27, 0.33, 0.41)	(0.19, 0.23, 0.30)	(0.90, 1.10, 1.38)	(0.38, 0.47, 0.63)
CWP	(0.60, 0.72, 0.91)	(0.29, 0.34, 0.41)	(1.81, 2.25, 2.81)	(1.30, 1.57, 1.85)
CF	**(1.00, 1.00, 1.00)**	(0.50, 0.60, 0.72)	(3.23, 3.98, 4.72)	(1.55, 1.92, 2.38)
PIAS	(1.39, 1.67, 2.00)	**(1.00, 1.00, 1.00)**	(2.97, 3.70, 4.54)	(2.48, 3.03, 3.63)
PMAA	(0.21, 0.25, 0.31)	(0.22, 0.27, 0.34)	**(1.00, 1.00, 1.00)**	(0.53, 0.63, 0.77)
SF	(0.42, 0.52, 0.64)	(0.28, 0.33, 0.40)	(1.30, 1.57, 1.88)	**(1.00, 1.00, 1.00)**

Table 7. The overall importance of criteria

Criteria	**Weight**	**Rank**
Hinterland connectivity (HC)	6.2%	7
Port location and accessibility (PLA)	15.9%	3
Convenience (C)	6.0%	8
Connectivity with ports (CWP)	11.1%	4
Cost factors (CF)	19.2%	2
Port infrastructure and superstructure (PIAS)	30.1%	1
Port management and administration (PMAA)	6.4%	6
Service factors (SF)	9.6%	5

Table 8. Respondent groups' comparisons

Criteria	Line Operators		Terminal Operators	
	Weight	Rank	Weight	Rank
Hinterland connectivity (HC)	8.6%	6	4.3%	8
Port location and accessibility (PLA)	21.7%	2	11.5%	3
Convenience (C)	6.8%	7	5.1%	7
Connectivity with ports (CWP)	11.8%	4	10.0%	4
Cost factors (CF)	17.3%	3	20.5%	2
Port infrastructure and superstructure	25.7%	1	34.0%	1
Port management and administration (PMAA)	4.5%	8	8.8%	6
Service factors (SF)	9.8%	5	8.9%	5

In whole tables, the weight of criteria and rankings were listed. All criteria have been also named with capital letters. While the results obtained from all the collected questionnaires are shown in Table 7, the answers of the respondent groups are also analyzed separately in Table 8. The overall results prove that the most important criterion is Port infrastructure and superstructure, followed by Cost factors, Location, and Port location and accessibility. The least and second least important criterion are the Conveniences of port services and Hinterland connectivity (Table 7).

On the other hand, container line and container terminal operators generally made different evaluations with their perspectives (Table 8).

While the Port Infrastructure and Superstructure criterion is still defined as the most important criterion for both parties, the Convenience criterion is defined as the second most insignificant criterion. Apart from these two criteria, there were differences in other criteria. While the Port Location and Accessibility criterion are determined as the second most important criterion according to container terminal operators, this criterion is defined as the Cost Factor for container terminal operators. Among the eight criteria, the Port Management and Administration criterion was the most unimportant criterion for line operators, while terminal operators determined hinterland connectivity as the least important criterion.

DISCUSSION

This research is based on (1) qualitative method and (2) quantitative method. In the view of a qualitative study, a study has performed a deductive-based content analysis to find out the most important determinant of the sustainable port competitiveness in the literature, and secondly, the study has checked the accuracy of content analysis findings by performing Fuzzy AHP methodology. At the first stage, the study found that "total logistics costs incurred by port choice" are the most important determinant of the cost in the relevant literature. A study (Chou, 2009) suggests the fact that shippers concentrate on decreasing all logistics costs, and not only the inland costs, which was neglected by prior studies. Shippers prefer using the nearest port as it takes lower logistics cost, transport time, and less cargo damage. Historical studies showed cost-related determinants as the most important criteria for shippers; a port's infrastructure did not carry much significance (Mittal & McClung, 2016). However, this has changed dramatically over the years. A study (Cullinane et al., 2004) found the efficiency of the port infrastructure influences a shipper's port choice decision. From this research, there is no further study observed so that the cost determinant is not the most important compared to the port infrastructure. From the port operator perspective, a study (Kavirathna et al., 2018) proves that the berth availability is the most significant criterion for the transshipment ports. In many articles, berth availability is the one of the elements for the port infrastructure. Feeder market needs high circulation of vessels to avoid any delay in the line operator's schedule. Otherwise, the ports should face big penalties for jeopardizing performance guarantees of the transshipment ports in the hub and spoke system. A study (Pham et al., 2019) also confirms that terminal

accessibility is the most important criterion for the transshipment port from the perspective of line operators. A study (Yeo, 2010) confirms that, the selection decision on transshipment hub port has become more complex because of the competitive offerings at the same time. Hence, a great competition between hub ports in neighboring regions have supported the hub-hopping nature of the container shipping sector. Although port infrastructure investments are extremely expensive and long-term projects, they play an effective role especially in sustaining the transshipment port competitiveness. To ensure sustainable competitiveness in shipping, many carriers have invested in mega-container ships, which dictates extraordinary operational challenges to the port industry. Especially, they require deeper terminal water and channel as well as longer quays and larger terminal areas and they also mean bigger container cranes, wider storage space, and a more developed logistics infrastructure. These provisions become mandatory for those ports to keep their market shares and defend their competitiveness. The scholars (Cullinane et al., 2006; Guy & Urli, 2006; Hales et al., 2016) mentioned that capacities and efficiencies of the port infrastructure and superstructure are of particular importance to carriers and shippers because ports operate during peak and off-peak periods. Another challenge for sustainable port competitiveness is the direct calls of container operators. There are constraints to the depth of the port access channel and the draft of the container berths, which means any type of ship can call when fully loaded. This study proves that the criterion of the port infrastructure and superstructures is really important for both sides. Huge container carriers require bigger terminal areas, wharfs, cranes and therefore, the infrastructure limits the growth of the seaport in the competition (Haralambides, 2019). If the terminal does not provide such service, the economies of scales turn into the diseconomies of scale. European ports continuously modernize and develop their terminals due to the peripheral port structure. Slack & Wang (2002) mentioned that peripheral port structure needs port centralization, economies of scale between peripheral ports, convenient water depths, and low distance to shipping lanes. This provides attractiveness for terminal users from port terminals.

Besides, the cost did not lose its importance in the port industry regarding the study findings. It still plays an important role to attract shippers in the context. A study (Parola et al., 2017) suggests that cost determinant emerges as a relevant economic-related driver of port competitiveness. In many sectors, the price of goods and services is a key element that customers pay special attention to while deciding on industrial buying. This is also the same in the port industry where tariffs (to be paid to the Port Authority) and costs (to be paid to the terminal) comprise an important part of total transportation costs for ocean carriers and shippers. The carriers can compare the tariff and port costs similar to other sectors.

On the other hand, port location and accessibility include cargo routing decisions, which are responsible for the dispatch of goods between production facilities and ports. Port competitiveness may significantly be increased by the strategic location of the port. Especially, port location deals with the concept of "diversion distance", which is the sailing deviation from main trunk routes, which is important to call a certain port. A study (Akbayirli et al., 2016) found that port users give importance to total transit time, the directness of sailing, and freight rate from the location of the loading and discharging port.

Limitation

The study has several limitations due to the difficulties in data collection and other reasons. Although the port sector has a wider place in global trade, the study was carried out only on port users and terminal operators operating in the eastern Mediterranean region, due to time and money constraints. Of course, this situation makes data collection harder and a wider sample from different regions would better enable cross-cultural validation of the constructs evolved in this study. Another limitation is generally covering the transshipment port terminals. Therefore, future research should be conducted on the other types of port terminals (hub ports, green ports, and conventional ports).

Recommendations for Future Studies

AHP is a cogent method for decision-making, however generally recognized as subjective. To secure the reliability of the study, a comparison from various methods may be used to demonstrate the superiority of the AHP method. Another study orientation may be performed to do correlation analyses between influencing determinants. Although the admonitions to these results through the underlying model selection and formulation, the study will be beneficial to terminal managers and port planners in designing and compelling policies for seizing shippers' attention. During the fierce port competition, port managers and terminal operators will clearly understand the determinants that influence sustainable port competitiveness, this study aids them to identify and explain the determinants that have freshly become more important and precisely affect their port operations.

CONCLUSION

This study proposed an adaptation of AHP implementation for the port competitiveness from dual perspectives (port users and terminal operators). It also offers an analytical approach to compare which criterion is more competitive for both sides. As a result, this study contributes that port infrastructure and superstructure directly affect sustainable port competitiveness. Port infrastructure and superstructure increasingly help and become integrated with port operations and hinterland logistics by changing shore extensions and offshore ports and by building resilient and flexible solutions for future ship and ship types, logistics, innovative port activities and the port's climate change. The expansion of port infrastructures and superstructures needs a long time, capital-intensive investments and hence long-run planning. That is, the design of port infrastructures and superstructures should predict the needs of customers such as container shipping lines. It is a particularly painful job at a time when the shipping sector is deeply involved with extensive transformation affecting both maritime and inland aspects (autonomous shipping and cargo handling, zero emissions, new IT architecture, etc.). Therefore, innovative facilities (generation of zero-emissions energy or green supply, chain for ships) are much necessary for keeping port competitiveness from the perspective of shipping lines. Port infrastructures and superstructures are more resilient to environmental problems. To ensure the quick application of the energy transition, clarity in port terminal management is required on the most likely transition way. Against any type of IT based risks (i.e., cyber-attacks, or data losses), adaptive secure communication is required for benefit of strategic port and traffic management and infrastructures (towage, moorings, smart berths, bunkering and etc.) which assists the ship's services for terminal operators. Moreover, city-port-nature-oriented infrastructures will contribute to leisure and business integrated centers for sustainable port competitiveness. On the other hand, transshipment is an important section of port infrastructure development plans in many places. Türkiye is not at the center of the main trunk routes of the container market. Turkish ports are at the end of the line rather than at the gateway to a district of feeder ports. Therefore, they would like to increase their innovative port facility investments to attract major carriers in the container shipping market. However, the priority between the determinants has dramatically been changed to keep more resilient sustainable competitiveness for the ports. The most important priority is that the terminal operators especially focus on the coordination of port investment projects so that the port may accommodate very large container ships. Especially, port access should be the main investment area to attract the mega-ship container carriers.

Compliance with Ethical Standards

Authors' Contributions

Study conception and design: SB, SE

Data collection: SE

Analysis and interpretation of results: SB, SE, EE

Draft manuscript preparation: SB

All authors reviewed the results and approved the final version of the manuscript.

Conflict of Interest

The authors declare that there is no conflict of interest.

Ethical Approval

For this type of study, formal consent is not required.

Data Availability Statement

Not Applicable.

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SUPPLEMENTARY MATERIAL

Table S1. AHP and F-AHP scales

Linguistic variables	**Scale**	**Reciprocal Scale**	**Triangular Fuzzy Scale**	**Triangular Fuzzy Reciprocal Scale**
Equal importance	1	1/2	(1,1,1)	(1/1, 1/1, 1/1)
Equal to moderately importance	2	1/3	(1,2,3)	(1/3, 1/2, 1/1)
Moderate importance	3	1/4	(2,3,4)	(1/4, 1/3, 1/2)
Moderately to strongly the importance	4	1/5	(3,4,5)	(1/5, 1/4, 1/3)
Strongly importance	5	1/6	(4,5,6)	(1/6, 1/5, 1/4)
Strongly to very strong importance	6	1/7	(5,6,7)	(1/7, 1/6, 1/5)
Very strongly importance	7	1/8	(6,7,8)	(1/8, 1/7, 1/6)
Very strongly to the absolute importance	8	1/9	(7,8,9)	(1/9, 1/8, 1/7)
Absolute importance	9	1/10	(8,9,9)	(1/9, 1/9, 1/8)

Source: Adopted from Ayag et al. (2006)