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The Selection of Ocean Container Carrier: An Analytic Network Process (ANP) Approach

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Abstract

Carrier selection is a complicated problem as it includes many quantitative and qualitative criteria. Due to the complexity of this issue, many criteria that influence decision making interact with each other, making it necessary to consider these interactions in order to make the best decision. The analytical network process (ANP) method enables us to solve the carrier selection problem of decision making more effectively and realistically. This study, which aims to contribute to the research field, employs the previously unused ANP method, which permits criteria interaction, and investigates the carrier selection problem in order to determine the similarities and differences between different industries' expectations of ocean container carriers. In this context, this study has been applied in three different industries: textiles, white goods, and chemicals. In this way, the study contributes to the literature on ocean container carriers. From the results, the most important criterion for the three shipper groups was found to be reliability. However, there were significant differences in the ranking of other criteria.

Keywords: Carrier, Shipper, Carrier selection criteria, Container transportation, Analytic network process

1. Introduction

In parallel with the expanding trade volume between countries with globalization, transportation is increasing day by day. Maritime transport is the backbone of international trade, accounting for more than 80% of the world's trade volume [1]. Container transportation, which is easily integrated with other transportation modes, is the fastest-growing component of maritime transportation. With this feature, it has increased more than two and a half times in the last 25 years and reached 151 million TEUs in 2019 [2,3]. In addition, during the coronavirus disease-2019 (COVID-19) pandemic, restrictions have been imposed on all transportation systems in the world at specific periods, except maritime transportation. Maritime transportation is a strategic mode of transportation with its sustainability in a crisis, as well as being cheaper and more environmentally friendly than other transportation systems. Container freight rates have increased significantly due to the impact of the COVID-19 pandemic, congestion in the ports, and equipment availability problem. This situation has increased the interest of researchers in studies on container transportation.

Many global supply chains work with specialized carriers to improve the competitiveness of their logistic operations. Carrier selection is not easy as it is a strategic decision for the supply chain, and it constantly involves uncertainty and complexity [4]. In supply chain management, the purpose of carrier selection decisions is to minimize logistic costs as much as possible and to achieve high quality, high delivery performance. In this way, supply chains increase competitiveness by reducing total logistic costs in the purchasing and distribution processes. To achieve this, it is important for carriers to accurately determine the demands and needs of their supply chains. Although carrier selection

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studies have been carried out for the last fifty years, most of the studies have been conducted by considering the shippers' view in road transport [5-9]. Murphy and Hall [10] stated that there are significant ranking differences between motor carrier selection and ocean container carrier selection studies. This situation increases the necessity of performing more studies on maritime transport, which is the backbone of world trade. Studies have been conducted on the selection of ocean container carriers [11-15], and although there has been an increase in the number of studies, especially after 2010 [16-19], the expectations of shippers from carriers vary depending on the size of the shipper and the industry they are in. However, a limited number of studies have examined the differences in perspectives among large shippers. Brooks examined carrier selection criteria for North American and European large and small shippers. It was emphasized that there are significant differences in the expectations of large and small shippers from ocean container carriers [20]. The expectations of shippers for carriers differ from industry to industry. In this context, it is necessary to research the differences in perspectives among large shippers with high carrying capacity in the ocean carrier selection process. This study fills the gap in this field by investigating the expectations of large shippers operating in different industries in the Turkish market from their container carriers.

Bagchi [7] argued that an analytical hierarchy process (AHP), a multi-criteria decision-making method, is a good model for the carrier selection. In contrast, many criteria that influence decision making interact with each other in carrier selection problems, and it is necessary to consider these interactions to make the best decision. The AHP method proposed by Bagchi [7] for carrier selection does not allow interaction between criteria. On the other hand, the analytical network process (ANP) captures interdependencies among decision qualities [21]. With this structure, the ANP method enables decision-making problems to be analyzed more effectively and realistically [22]. It has been observed that ANP is used effectively in many areas such as the selection of logistics service providers [21], ERP software selection [23], and energy policy planning [24]. The ANP method, which allows the interaction of criteria, is proposed for the first time in ocean container carrier selection studies to enrich the relevant literature.

2. Literature Review

The carrier selection process has been explored for nearly 50 years; therefore, it is not new in the relevant literature. However, although more than 80% of world trade is carried out by maritime transport, the number of studies on this subject is limited. Collison the Pacific examined the ocean carrier selection criteria for the Northwest-Central Alaska inland trade route. In the study, it was determined how the order of importance changed among different customer groups. The importance given to the criteria may vary according to the characteristics of the cargo and the needs of the shipper [11]. Kent and Stephen Parker [13] detected the three most important container carrier selection criteria for American shippers to be equipment availability, service frequency, and reliability. The leading criteria for Taiwanese shippers are accurate documentation, availability of cargo space, and reliability of sailing, respectively [14]. Kannan et al. [16] evaluated the ocean carrier selection criteria of Indian shippers using the AHP method. As a result of their analysis, the most important three criteria were low freight, pricing flexibility, flexibility, and equipment availability. Tasmanian shippers found the freight rate less significant according to the criteria of cargo security and safety and capacity availability [25]. Taiwanese shippers considered transport reliability, transit time, and timely delivery as the most important criteria in the selection of ocean container carriers [26]. Brooks [20], in her study in 1989, stated that the importance given to transit time and carrier reputation criteria has decreased compared to 5 years ago. D'agostini et al. [27] stated that the top ten container carriers have a market share of 85% and the strategic partnerships they have made among themselves have an impact on the shippers. In their study, they examined the expectations of Hong Kong shippers from ocean container carriers.

In the literature on carrier selection, studies have been carried out by considering the perspectives of the shipper, consignee, freight forwarder, and carrier. Although many studies consider the shipper's perspective, the number of studies focusing on large shippers is limited. Pearson and Semeijn [28] investigated whether carrier selection behaviors of shippers change according to their size on motor carriers. While the order of important criteria such as reliability, transit time, and freight was the same for both groups (large shipper, small shipper), there were differences in the ranking of less important criteria such as over/short/damage, carrier considerations, and forwarding services [28]. Lu [29] studied the expectations of Taiwanese large shippers. Cargo safety, cargo tracking, and inland transport were among the important criteria in the study. While the most important criterion for small shippers was freight, the most important criterion for American large shippers was equipment availability in the Brooks [20] study. The main reason why many studies have examined this issue in detail is that shippers' decision criteria have changed significantly over time. There are serious differences according to the importance given by the shippers to the carrier selection criteria, transportation mode, the shippers' region, export or

import trade, its size, and the industry it is in. Although the ANP method has not been used in ocean container carrier selection studies until now, studies have been conducted with this method in the transportation sector. Chen [30] used the ANP method to select airline service quality improvement criteria for the airline industry. Jharkharia and Shankar [21] have proposed the ANP model, which enables them to better understand complex problems for logistic service provider selection. Onut et al. [31] utilized the ANP method, which takes into account the interaction between the criteria, to evaluate container port selection.

3. ANP Model

Recently, a method widely used in decision-making problems is the Analytic hierarchy process (AHP), which was developed by Thomas L. Saaty and takes into account qualitative values and quantitative values [32,33]. AHP models decision-making problems in a top-down hierarchical structure [34]. At the top of the hierarchy is an objective, and under this objective, there are options at the bottom for the criteria, sub-criteria, and hierarchy, respectively. The criteria found at the same level within this hierarchical structure are independent of each other, and the impact of the criteria on each other in the decision-making process is not considered [35]. In contrast, many factors that influence real-world decision making interact with each other, and making the best decision requires recognition of these relationships. The method that uses the relations between factors in the process mentioned above and eliminates the necessity of modeling the problem in a single direction is the ANP method developed by Saaty [34]. The ANP method models the decision-making problem by constructing a network structure that takes into account factors and internal dependencies during the modeling phase. With this feature, the ANP method permits us to solve the problems of decision making more effectively and realistically.

While AHP shows hierarchical relations with a unidirectional framework, ANP allows for more complex relationships between decision levels and features. In this way, it enables easy modeling of complicated issues that hierarchical structures cannot model [33]. The structural difference between a hierarchy and a network is shown in Figure 1 [36].

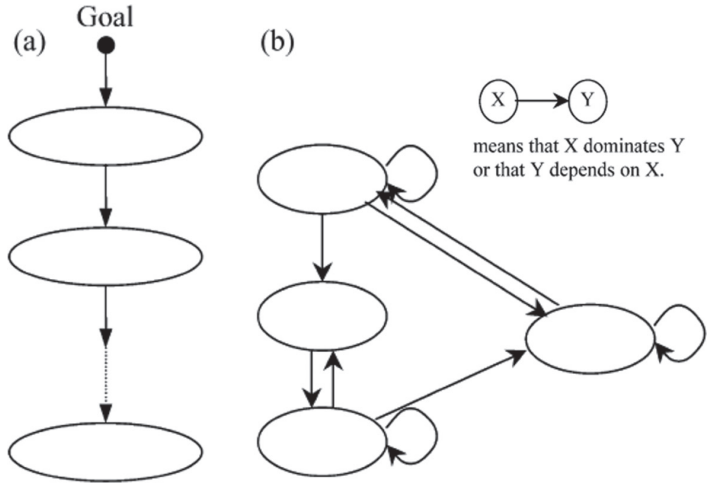

Figure 1. *Structural difference between a hierarchy and a network*

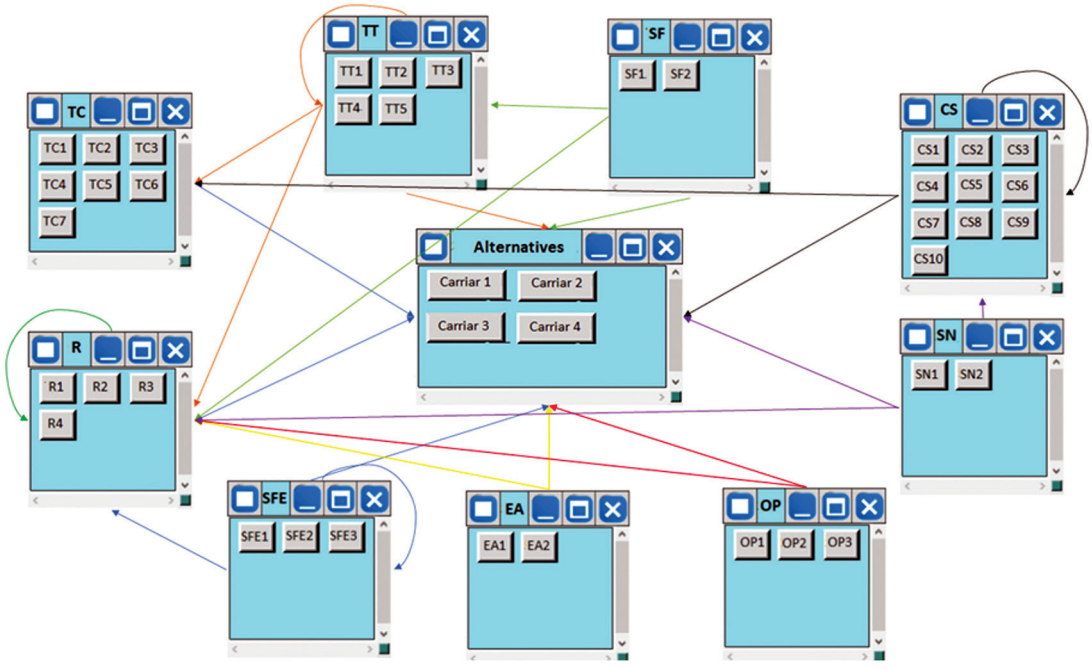

Figure 2. *Network structure*

In the ANP method analyzes are conducted by employing three types of matrices: unweighted supermatrix weighted supermatrix, and limit supermatrix. The unweighted supermatrix is the matrix that gives the relative importance vector of each component as a result of pairwise comparisons.

The steps of the ANP model presented in the selection of the ocean carrier are as follows. The container carrier selection model flowchart is given in Figure 2.

Step 1: Defining the problem and establishing the model. In this step, the decision-making problem should be clearly defined and the objective, main criteria, sub-criteria, and alternatives should also be clearly defined. Figure 1 provides an illustration of a network's format.

Step 2: Determine relationships the interactions between the criteria are determined.

Step 3: Pairwise comparison matrices and priority vectors: In ANP, the factors affecting each decision, as in AHP, are subjected to two comparisons, so the significant weights of the factors are determined.

$$A \times w = \lambda_{max} \times w \tag{1}$$

where w is the eigenvector, λ_{max} is the maximum eigenvalue and A is the pairwise comparison matrix.

Step 4: Consistency of comparison matrices: to determine if the comparisons are consistent, the consistency ratio (CR) for each matrix should be calculated after the comparison matrices are constructed. In this study, super decision is utilized to compute the eigenvectors from pairwise comparison matrices and to determine the CRs.

Step 5: Supermatrix is constructed: to obtain global priorities in a system with interdependent effects, local priority vectors are written to the columns of a matrix known as supermatrix. As a result, a supermatrix is, in fact, a fragmented matrix, where each matrix segment shows the relationship between two factors in a system. The long-term relative effects of the criteria on each other are determined by calculating the supermatrix force. The supermatrix (2k+1) is incremented to ensure that the weighted priorities are equalized at one point where k is a large number randomly selected. The resulting new matrix is called a limit supermatrix. A supermatrix can be represented in its standard form as in expression [33].

$$W = \begin{array}{c} \\ e11 \\ e12 \\ \vdots \\ e1ml \\ \vdots \\ ek1 \\ ek2 \\ \vdots \\ ekmk \\ \vdots \\ en1 \\ en2 \\ \vdots \\ enmn \end{array} \begin{array}{c} \begin{array}{cccccccccccc} e11 & e12 & \cdots & e1ml & \cdots & ek1 & ek2 & \cdots & ekmk & \cdots & en1 & en2 \cdots enmn \end{array} \\ \begin{bmatrix} W_{11} & \cdots & W_{1k} & \cdots & W_{1n} \\ \vdots & & \vdots & \vdots & \vdots \\ W_{k1} & \cdots & W_{kk} & \cdots & W_{kn} \\ \vdots & & & \vdots & \\ W_{n1} & \cdots & W_{nk} & \cdots & W_{nn} \end{bmatrix} \end{array} \tag{2}$$

Step 6: Determining the best alternative: with limit supermatrix, alternatives and compared criteria of importance weights determined. The alternative, which has the highest importance in the selection problem, is determined as the best alternative. In addition, the criterion with the highest importance in the problem is the most important criterion affecting the decision process [33].

4. ANP Model for Ocean Container Carrier Selection

In this study, the ocean container carrier selection was performed for three different industries using the ANP method, which allows interaction between the criteria. First, to determine the carrier selection criteria, a thorough literature review was carried out. A group of 10 people working in shippers' logistic departments and ocean container carriers was then determined and the criteria were discussed. This group consists of two CEOs and eight senior executives with at least 20 years of industry experience. The final selection criteria for ocean container carriers were made following that. Table 1 displays the ocean container carrier selection criteria that were applied in the study. These criteria are formed in the literature based on carrier selection research [13,14,17,37-42]. The ocean container carrier selection model included 9 main and 38 sub-criteria. Ocean container carrier selection has been performed to compare the textile, white goods and chemical industries, which have high export potential in Türkiye. The survey results were gathered from Türkiye's top 500 exporting companies with 15 experts in 51 textile companies, 2 experts in 5 white goods companies, and 16 experts in 71 chemicals companies.

Respondents to our study were asked to rate how satisfied they were with the ocean carriers operating between Türkiye and the United States. Carriers with high capacity on the determined route are named A_1, A_2, A_3 and A_4. The

real names of selected carriers have been not used to obey the fair competition rules.

5. Discussion

The ANP method was utilized to evaluate the differences and similarities between the three diverse large shippers' expectations of ocean container carriers. After the main and sub-criteria to be used in the ocean container carrier selection model are determined as in Table 1, the interaction between the criteria should be determined. Besides the studies in the literature, the dependencies, relationships, and interactions between the criteria were revealed by referring to the opinions of experts working in shippers' logistics departments and ocean container carriers. These interactions are shown in Table 2. The Super Decision program was used to decide the priorities of the criteria in the ocean container carrier selection study.

The network structure of the "container carrier firm selection" model, including the relationships between the criteria of the Super Decisions program, is shown in Figure 2.

A comparison of the priority weights of the main criteria of three different large shipper groups (textiles, white goods, and chemicals) is shown in Table 3. As a result of evaluation with ANP, although its significance is changeable in different industries, the most notable main criterion for the ocean container carrier selection model has been reliability, while

Table 1. *Ocean container carrier selection criteria*

Main Criteria	Sub Criteria
Transportation cost (TC)	TC1 Freight
	TC2 Freight validity period
	TC3 Freight quote time
	TC4 Clarity and detail of freight
	TC5 Credit facility
	TC6 Inland cost
	TC7 Demurrage and detention tariff
Transit time (TT)	TT1 Direct shipping to destination port
	TT2 Short transit time
	TT3 Transit time reliability
	TT4 On-time notification for the customer
	TT5 Detention free days
Service frequency (SF)	SF1 Service frequency reliability
	SF2 Short service frequency
Customer satisfaction (CS)	CS1 Employees' availability
	CS2 The competence of operation employees
	CS3 The competence of sales employees
	CS4 Shipment trace
	CS5 The accuracy of documentation
	CS6 Effect of ship age on insurance premiums
	CS7 Accurate and detailed invoice
	CS8 Carrier service quality
	CS9 Willingness to solve customers' problems
	CS10 Behavior against complaints and suggestions
Reliability (R)	R1 Carrier's brand-name
	R2 Carrier's reputation
	R3 Damage cargo record
	R4 Lost and stolen cargo records
Special facilities and equipment (SFE)	SFE1 Special equipment availability
	SFE2 Special equipment cost
	SFE3 Special cargo transport ability
Equipment availability (EA)	EA1 The ease of booking
	EA2 Condition of equipment
Operation performance (OP)	OP1 Information flow rate between carrier and port
	OP2 Operation flexibility in making declarations
	OP3 The condition of container (CC)
Service network (SN)	SN1 Geographical coverage (GC)
	SN2 Willingness to solve customers' problems from international offices

Table 2. *Interaction between criteria*

Affecting Criterion	Affected Criterion
TT1	TT2
TT3	R2
TT1	TT3
TT5	TC7
SF1	R2
SF2	TT2
CS1	CS8
CS2	CS5
CS2	CS7
CS2	CS8
CS3	TC3
CS3	TC4
CS3	CS8
CS4	CS8
CS5	CS8
CS7	CS8
CS9	CS8
CS10	CS8
R3	R2
R4	R2
SFE1	SFE3
EA2	R3
OP3	R3
SN1	R1
SN2	CS9

Table 3. *The priority of main criteria between three large shipper groups*

Main Criteria	Textiles/Rank	White Goods/ Rank	Chemicals/ Rank
TC	0.140 (4)	0.170 (3)	0.172 (3)
TT	0.215 (2)	0.135 (4)	0.136 (4)
SF	0.062 (5)	0.051 (6)	0.059 (5)
CS	0.158 (3)	0.206 (2)	0.212 (2)
R	0.255 (1)	0.259 (1)	0.252 (1)
SFE	0.015 (9)	0.024 (9)	0.030 (9)
EA	0.060 (6)	0.070 (5)	0.053 (6)
OP	0.056 (7)	0.040 (8)	0.035 (8)
SN	0.036 (8)	0.045 (7)	0.051 (7)
CR	0.042	0.027	0.023

special facilities and equipment were the least important criterion. The order of the other seven main criteria was also different for the three large shipper groups. Transportation cost has been the third most important criterion for the white goods and chemical industries and the fourth for the textile industry. Consistent with the study, in many articles, the importance given to service-based criteria was found to be more important than freight rate [13,14,25,43].

The importance of global weights and rankings of the sub-criteria for three large shipper groups is as in Table 4. Although the weights of importance differ for each of the three major shipper groups, the most prominent criterion was "carrier's reputation", while the most unimportant subcriterion was the special equipment cost". While freight was the third most important subcriterion for the white goods and chemical industries, it was only the fifth most significant criterion for the shipper group in the textile industry. Freight, which was the most important criterion in previous carrier selection studies [12,16,44], was replaced by criteria such as reliability, customer satisfaction, and transit time. Freight has been the second most important criterion for Canadian and American shippers (Maloni et al. [17]). Similar to the study in Kent and Stephen Parker's [13] study, freight was one of the most considerable criteria, if not the most important criterion, for American shippers. Likewise, freight was not the most considerable criterion for North American and European large shippers in Brooks's [20] study. Since shippers in the white good industry mostly prefer their own transporters for domestic transportation, they find this criterion less notable than the other two industries. Consistent with the study, "inland cost" was not considered important in many studies [16,17].

For the textile industry, the second most important subcriterion is transit time reliability. Again, the short transit time was the fourth most significant criterion for this industry.

Table 4. *Overall priority of the sub-criteria between three large shipper groups*

Sub-Criteria	Textiles/ Rank	White Goods/ Rank	Chemicals/ Rank
TC1	0.060 (1)	0.070 (1)	0.072 (1)
TC2	0.008 (6)	0.030 (2)	0.015 (4)
TC3	0.014 (4)	0.007 (6)	0.014 (7)
TC4	0.021 (2)	0.022 (4)	0.020 (3)
TC5	0.016 (3)	0.012 (5)	0.015 (5)
TC6	0.013 (5)	0.004 (7)	0.014 (6)
TC7	0.008 (7)	0.024 (3)	0.021 (2)
CR	0.014	0.052	0.005
TT1	0.034 (3)	0.019 (3)	0.017 (3)
TT2	0.071 (2)	0.043 (2)	0.050 (2)
TT3	0.092 (1)	0.056 (1)	0.051 (1)
TT4	0.012 (4)	0.006 (5)	0.007 (5)
TT5	0.006 (5)	0.010 (4)	0.011 (4)
CR	0.064	0.028	0.004
SF1	0.042 (1)	0.040 (1)	0.035 (1)
SF2	0.020 (2)	0.011 (2)	0.024 (2)
CR	0.000	0.000	0.000
CS1	0.006 (7)	0.008 (7)	0.012 (5)
CS2	0.014 (3)	0.015 (5)	0.013 (4)
CS3	0.013 (4)	0.011 (6)	0.010 (7)
CS4	0.004 (9)	0.006 (8)	0.005 (9)
CS5	0.012 (5)	0.020 (3)	0.021 (3)
CS6	0.002 (10)	0.002 (10)	0.003 (10)
CS7	0.012 (5)	0.016 (4)	0.012 (5)
CS8	0.076 (1)	0.102 (1)	0.105 (1)
CS9	0.015 (2)	0.022 (2)	0.023 (2)
CS10	0.004 (8)	0.005 (9)	0.008 (8)
CR	0.038	0.023	0.007
R1	0.021 (4)	0.028 (4)	0.039 (2)
R2	0.167 (1)	0.157 (1)	0.141 (1)
R3	0.036 (2)	0.034 (3)	0.038 (3)
R4	0.030 (3)	0.039 (2)	0.034 (4)
CR	0.026	0.021	0.001
SFE1	0.003 (2)	0.009 (2)	0.009 (2)
SFE2	0.003 (3)	0.004 (3)	0.005 (3)
SFE3	0.009 (1)	0.012 (1)	0.015 (1)
CR	0.011	0.004	0.028
EA1	0.044 (1)	0.054 (1)	0.036 (1)
EA2	0.016 (2)	0.016 (2)	0.017 (2)
CR	0.000	0.000	0.000
OP1	0.010 (2)	0.013 (2)	0.007 (3)
OP2	0.009 (3)	0.012 (3)	0.008 (2)
OP3	0.037 (1)	0.015 (1)	0.019 (1)
CR	0.001	0.013	0.000
SN1	0.027 (1)	0.035 (1)	0.038 (1)
SN2	0.009 (2)	0.010 (2)	0.013 (2)
CR	0.000	0.000	0.000

Shippers in textile industry prefer container carriers with short transit times as an alternative to road and air transport modes. Although the weights of importance differ in the white goods and chemical industries, the fourth and fifth most important sub-criteria are transit time reliability and short transit time, respectively. Consistent with the study, American shippers [17] and Taiwanese shippers [14] found transit time reliability more remarkable than short transit time. Shipper groups did not see all the on-time notification for the customer criteria as effective. Service frequency reliability was a notable criterion in each of the three shipper groups. Short service frequency, which impacted transit time, was not seen as notable by the three shipper groups. This criterion was not remarkable for American shippers [17] and Taiwanese shippers [14] parallel to the study.

The impact of carrier service quality is the second position for the white goods and chemical industries and the third position for the textile industry. This criterion has been affected by criteria such as the availability of employees the competence of operations or sales employees and the accuracy of documentation. Large shippers stated that they had no problems with employee availability. Shippers and freight forwarders under a certain capacity have problems in this regard. Unlike the study, Kannan et al. [16] considered this criterion moderately significant. The three shipper groups that had no problem reaching the carrier also did not see the shipment tracking criterion as effective. Contrary to the study, Kent and Stephen Parker [13] found this criterion moderately important. The criteria of competence of operation and sales employees were found to be of moderate importance by three groups. Taiwanese shippers, especially the knowledge of sales personnel, are considered to be important criteria [14]. However, competence employees were among the top five most important criteria for Canadian and American shippers [17]. Influenced by criteria such as transit time reliability, service frequency reliability, damage cargo record, and lost and stolen cargo record, the carrier's reputation has been the most prominent criterion for each of the three shipper groups. Similarly, damage cargo records and lost and stolen cargo records were among the important criteria. This criterion was of moderate significance to American shippers in the study of Kent and Stephen Parker [13] and Maloni et al. [17].

One of the striking findings of the study is that special transportation facilities were determined as one of the least priority criteria since three shipper groups mostly carried out their transportation in standard containers. Consistent with this study, it was among the less important criteria in the carrier selection problem for American and Indian shippers [13,16]. Although the ease of booking criterion is not among the top five most important criteria for all three shipper groups, it has remarkable significance. It was considered more essential, especially for the white good industry, which has a much larger cargo capacity than the other two industries. In the studies of Maloni et al. [17], this criterion was among the five most important criteria. For the textile industry, the condition of the container was more effective than in the other two industries. The container must be cleaned so that the sent textile products are not damaged. Maloni et al. [17], like the white goods and chemical industries, gave moderate importance to this criterion. Another notable finding is that the geographical coverage is remarkable for all three groups. This finding is supported by studies by Lu [14].

Table 5 shows the importance weights of the four alternative ocean container carriers. The results of this study indicated that carrier B was the most preferred company between Türkiye and the USA for container transport in maritime exportation, followed by carriers A, C, and D, respectively.

Table 5. *Ocean container carrier priority weight between three large shipper groups*

Ocean Container Carriers	Textiles/ Rank	White Goods/ Rank	Chemicals/ Rank
Carrier A	0.298 (2)	0.278 (2)	0.284 (2)
Carrier B	0.380 (1)	0.375 (1)	0.369 (1)
Carrier C	0.178 (3)	0.192 (3)	0.187 (3)
Carrier D	0.145 (4)	0.156 (4)	0.160 (4)

6. Conclusion

This study enriches the literature on ocean container carrier selection and provide comprehensive research on three large shipper groups. The study contributes to carrier selection literature by examining the textile industry, white goods industry, and chemicals industry, which all have a high export capacity in Türkiye. Many criteria that influence decision making interact with each other in carrier selection problems, and it is necessary to consider these interactions to make the best decision. To solve this problem, ANP method is extremely suitable. This study also brings innovation to the literature by using ANP, which permits criterion interaction in ocean container carrier selection studies for the first time.

The results of ANP demonstrated that the range of importance given to the criteria among the three large shipper groups is not the same. Although the relative priority weights were different for each of the three industries, while the most important main criterion was reliability, the most important subcriterion was carrier reputation. The carrier reputation was the most significant subcriterion because it was influenced by important subcriterion such as transit time reliability, service frequency reliability, damaged cargo record, and lost and stolen cargo record. Unlike the textile

industry, the first four sub-criteria in the white goods and chemical industries are in the same rank. In the textile industry, transit time reliability and short transit time have been more important than in the other two industries. After the carrier's reputation and carrier service quality, freight is the third most important criterion for the white goods and chemistry industries, while it has been the fifth criterion in the textile industry. Such findings are critical to understanding ocean container carriers from supply chain expectations, as they can provide better service to companies in different industries and increase customer satisfaction and market share.

One of the remarkable results of the study is that none of the criteria such as special equipment availability, shipment tracing, and direct shipping to destination port, which require high investment costs by the carriers, are included in the top ten criteria and not considered significant by large shippers. In line with these results, carriers should use their resources to ensure a high level of satisfaction for the criteria of the highest importance.

In future studies, hybrid methods can be utilized by integrating different MCDM methods with ANP. In addition, the increasing importance of the environment in future research makes it necessary to include more environmental sustainability criteria in ocean carrier selection criteria. Most of the carrier selection literature has been done on container transportation. In the future, studies can be conducted on the selection of carriers for other maritime transportation segments such as tanker or dry cargo transportation.

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Authorship Contributions

Concept design: A. Ergin, G. Alkan, Data Collection or Processing: A. Ergin, Analysis or Interpretation: A. Ergin, Literature Review: A. Ergin, Writing, Reviewing and Editing: A. Ergin.

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