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Determination and Examination of Tanker Ship Management Company Selection Criteria in Turkiye According to Their Level of Importance

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ABSTRACT

The maritime sector continues to exist as an area where density is high, and more changes occur every day. Shipowners are going through difficulties in operating their ships in terms of sectoral fluctuations and sustainability. Due to this difficulty, shipowners' orientation towards the companies where they will operate their ships has increased. Although existing research has emphasized the importance of the increasing use of ship management companies and the identification of selection factors, the evaluation of selection criteria for tanker companies with specific ship types seems to be insufficient. In the study, the selection criteria that will support the critical decision-making process for tanker ship operating companies in Türkiye are evaluated using Fuzzy Analytic Hierarchy Process (FAHP) method. It is aimed to identify the priority criteria for the selection of a Ship Management Company (SMC), for which 4 main criteria ('Experience and Reliability', 'Technological Infrastructure and Organization', 'Financial status' and 'Quality standards and Safe management system') and 21 sub-criteria are identified and considered. This study contributes to the development of criteria that can be used in the selection of a ship management company depending on the ship type. In the study, experts with a minimum of 10 years of experience in tanker shipping companies, who are on active duty and at least in the position of operations manager, assisted in the determination and evaluation of the selection criteria of the ship operating companies. As a result of the study, the most important main criteria identified by the experts were experience and reliability. Among the sub-criteria, the most important preferences are 'Sectoral knowledge and expertise', 'reputation and references', 'personal cost' and 'sustained performance'. The study contributes to the development of ship management company selection criteria by ship owners and identifies the areas that ship management companies need to improve their service standards.

1. Introduction.

Shipping, being the cornerstone of the global logistics and supply chain, necessitates expertise in various ship operations due to the complexity of this sector, presenting a myriad of challenges for shipowners and operators in the maritime industry (Brlecic et al., 2021).

These challenges arise in various areas such as economic fluctuations, high operating costs, compliance with safety and environmental standards, following technological developments, personnel management and constantly changing international regulations (Yan & Peng, 2022). Effective management and operation of the ship requires constant effort to achieve success in this dynamic and competitive industry (Jiang et al., 2021). In this context, ship management is a complex activity that confronts shipowners with several challenges at both operational and strategic levels (Tran et al., 2020). Within the framework of these negativities, ship management emerged. Ship management is a well-established part of the maritime industry and has operated as an integral element of the value chain for almost half a century (Hsu et al., 2021). Today, third-party Ship

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Management Companies (abbreviated as SMC), such as Vallem group, Thome, Anglo-Eastern Group, Eastern Pacific Shipping and Wilhelmsen Ship Management, which are leaders in the tanker industry, account for 47% of global shipping management (Arıcan, 2023). In Türkiye, Miklagard-s, Chemfleet and Tankmarine can be given as examples of tanker ship companies. With the increasing prevalence of SMC's, a need has emerged to identify what competitive advantages are missing from academic research (Vejvar et al., 2020).

SMCs have emerged to overcome various difficulties faced by ship owners and shipowners, to optimize business processes and to carry out maritime activities more effectively (Jiang et al., 2021). The basic needs that gave rise to these companies are technical expertise, operational efficiency, financial and legal management, personnel management, and risk management (Seo et al., 2018). The growth of SMCs has occurred because of shipowners' efforts to avoid the limitations of the unfavourable financial system of national registries and excessive crew expenses (Tran et al., 2020). Many shipowners are further encouraged by this trend due to the difficulties of coping with high operating costs in the face of a stagnant freight market (Papandreou et al., 2021). Transferring ship operations to a ship management company stands out to effectively reduce operating costs (Jahn & Bussow, 2013). As a result of the increasing trend towards outsourcing ship management activities, shipping companies and ship owners are now faced with the inevitable need to choose the most suitable third-party ship management company (Yan & Pang, 2022). The decision of shipowners to choose a SMC with which they can establish strong relationships has become a very important phenomenon (Di Vaio et al., 2021). Companies that outsource can focus on core activities within their organization by using SMC that suits their needs, which can increase their profitability in various ways (Stalmokaite & Hassler, 2020). It is important that tanker ship management generally requires more detailed and specific expertise than other ship types. The reasons for this situation are that they carry dangerous and sensitive cargoes such as liquids or gases, ship management observes higher safety standards because the cargoes are potentially dangerous, and they are subject to strict inspection and monitoring requirements due to the nature of the liquids or gases they carry (Bhardwaj, 2013). In line with this selection complexity and challenge, this study develops a methodology to design a transparent decision-making tool for shipping companies to select Tanker SMC criteria in Turkey using Fuzzy Analytic Hierarchy Process (FAHP) approach.

The continuation of the study is as follows. In Chapter 2, the current information, and studies in the literature on this subject are reviewed. Section 3 outlines the various criteria for selecting SMC. The proposed methodology is explained in section 4, followed by numerical demonstrations in section 5. Finally, discussion and conclusion are included.

2. Literature Review.

SMC is considered a fundamental element of commercial ship operations and useful for shipowners. The complexity of the ship management task arises from several factors that require managing the day-to-day operations of a merchant ship as well as various value-added services (Hsu et al., 2021). This complexity involves a few elements that require the intervention of highly trained professionals and must be managed meticulously (Arıcan, 2023). The factors that cause this complexity and ship company departments are listed in Table 1.

Table 1: Ship business management department.

Factor	Brief descriptions
Operational Management	Planning and managing operational tasks such as the ship's daily navigation, unloading and loading processes are complex. This must be carefully organized to meet safety standards, ensure on-time delivery, and increase efficiency.
Security and Compliance	The maritime industry must strictly comply with international standards and maritime safety regulations. Therefore, ship management requires diligent work to implement safety protocols and meet various compliance requirements.
Financial management	It includes financial elements such as ship operations, budget management, fuel costs, crew salaries. Financial processes must be managed correctly to ensure cost effectiveness and achieve budget targets.
Crew Management	Ship management includes factors such as training of the crew working on the ship, occupational safety, health conditions and personnel management. This requires maintaining an experienced and trained crew.
Technical Management	There is a management requirement that includes technical elements such as the technical condition of the ship, maintenance, repairs, and spare parts management. This must be carefully monitored to ensure continuous and reliable operation of the vessel.

Source: Yan & Peng, 2022.

There are various reasons why shipowners may prefer to delegate their duties in the operation of their own ships to a professional SMC. The first reason is that SMCs consist of professionals who are specialized and experienced in ship management. These companies may have extensive knowledge of ship operations, safety standards, regulations, and industry practices. Shipowners may prefer SMCs, thinking that this expertise will help them perform complex ship management tasks more effectively (Jahn & Bussow, 2013). The second reason is that SMC can provide cost efficiency by taking advantage of economies of scale. This offers ship owners the advantage of avoiding the high operating costs they may encounter if they try to manage it on their own and ensuring a more efficient operation (Vejvar et al., 2020). The third reason is that they can keep up with the latest technology and best practices in the industry. This allows ships to be managed in a safer, more efficient, and environmentally sustainable way (Mitroussi, 2013). Ship owners may prefer SMCs to gain a competitive advantage by taking advantage of these technological advantages (Arıcan, 2023). The fourth reason is that they may be experienced in protecting ship owners against potential risks (Dickie, 2014). This provides support to ship owners in dealing with legal, financial, and operational risks. The fifth and last reason is that some ship owners may want to consider their ships not only as a means of transportation but also as a financial asset (Papandreou et al., 2021). SMCs can help increase the value of these ships and im-

plement optimal financial strategies. For these reasons, many ship owners may choose to delegate ship management tasks to a professional SMC (Carriou & Wolff, 2011). This is intended to provide a more effective, safe, and cost-effective ship operation.

In their research in 2018, Seo et al. discussed the selection of the ship management company for South Korea. It is organized as a general study without determining the ship type. In their study, Seo et al. conducted the overall performance and ranking of ship management companies using an integrated model of the Analytic Hierarchy Process (AHP) and the Fuzzy Technique for Order Preference Based on Similarity to the Ideal Solution (FTOPSIS). In their study, they determined 32 subcriteria, including 5 main criteria. As a result of the study, they stated that competence is the most important criterion, followed by cost, courtesy, organizational features, and image (Seo et al., 2018).

In a study conducted in 2014, Asuquo et al. investigated the selection model of third-party ship operators. They used a questionnaire to identify the main selection criteria and aimed to develop a third-party shipping company (TPSC) selection model based on AHP and apply it to a real TPSC selection case of Bibby Line. In the case study, the criteria included price, reputation, location, experience, technical expertise, and relationship. In the research conducted on 6 criteria, the company's reputation and experience were found to be highly influential in percentage terms. The study results proved that Bibby is compatible with the existing model used in its operations and is simpler and more visible for decision makers (Asupuo et al., 2014).

In an article study conducted by Panayides and Cullinane (2002), research was conducted under the title "Vertical Fragmentation of Ship Management: Selection Criteria for Third Party Selection and Evaluation". The main purpose of the study is to determine the criteria used in the selection of ship managers, to empirically evaluate different dimensions of performance evaluation and to discuss the potential effects of this evaluation in terms of marketing. Survey and e-mail question-answer methods were used in the research. While the results of the study show that certain dimensions such as technical ability, reputation, competence and sensitivity in evaluation and reliability are important, it has also been revealed that price alone is not perceived to be that important in the selection of ship managers (Panayides & Cullinane, 2002).

In his study titled Competitive Strategies and Organizational Performance in Ship Management, Panayides (2003) empirically examines the competitive strategy-performance relationship in the context of ship management companies. He used sampling, survey, and measurement techniques as methods. The study found that there is a positive relationship between pursuing competitive strategies in ship management and company performance. He found in his study that the strongest effects on performance are achieving economies of scale, differentiation, market orientation and competitor analysis (Panayides, 2003).

Cariou and Wolff (2011) wrote an article titled Ship Owners' Decisions Toward Ship Management Outsourcing. In their study, discussed outsourcing in transportation and the determination of the main factors affecting the possibility of outsourcing. They conducted econometric analysis and found that shipowners' outsourcing decisions are explained by the characteristics of the ships in question (age, type and size) and the characteristics of the shipowner (country of residence and number of ships) (Cariou & Wolff, 2011).

In his book, Captain Dickie (2014) described and discussed ship management in the 21st century. He described a multidimensional ship operating company consisting of 18 chapters. Topics include the history of ship management, maritime laws, ship certificates and documentation, international safe management system, international ship port facilities security system, port state control, operations management, and ship management (Dickie, 2014). Table 2 presents information about the methods, objectives and research areas used in the studies on firm selection in the maritime sector.

Since the operation of tanker ships is a difficult and costly process, it has been determined that the selection of an operating company is difficult. For this reason, similar studies were reviewed, and it was determined that there are studies focusing on general company selection in the literature. When the studies conducted in Turkey and abroad are examined, it is seen that there is no study on the criteria for a specific tanker ship operating company. As this is the first study in this field, this study is expected to be a resource to guide the selection process for shipping companies and shipowners.

3. Selection Criteria of Ship Management Companies.

The most frequently identified criteria were examined by looking at studies on ship company selection. Among these criteria, 'experience and reliability', 'technological infrastructure and organization', 'financial status' and 'quality standards and safety management system' have been used from different perspectives. As a result of interviews with shipowner company officials, these criteria were discussed and included in the content of the study. The experts have the characteristics stated in Table 3 to assist determine the ship management selection criteria and sub-criteria and these experts were contacted via e-mail and semi-structured in-depth interview technique was applied.

3.1. Experience and Reliability (ER).

Sectoral Knowledge and Expertise (SKE) refers to the knowledge and expertise a company has acquired in a specific sector, under the main criterion of experience. Industry experience helps the company understand market trends, customer needs, and industry-specific challenges (Asuquo et al., 2014). This enables the company to make more effective and strategic decisions. In the Project and Operational Experience (POE) experience section, the experience the company has gained in past projects increases its ability to manage future projects more effectively (Seo et al., 2018). Operational experience can help streamline a company's daily operations, increase efficiency, and meet customer expectations. Reputation and References (RR) for a company is recognized through customer testimonials and a positive business reputation (Brlecic et al., 2021).

Table 2: Studies on ship management company selection.

Publication name	Author(s)	Research area	Method	Aim of the study
Evaluation of determinant factors influencing the selection of ship management companies	Riadi, A., & Mudaffa, F. (2022).	Maritime (General ship type)	FAHP	To identify the determining factors of SMC selection from the shipowner's point of view, to evaluate the importance of each of these factors and to obtain the different views between the shipowner and the SMC in the choice of ship management.
An evaluation of the success factors for ship management companies using fuzzy evaluation method	eon, J. W., Yeo, G. T., Thai, V. V., & Yip, T. L. (2016)	Maritime (General ship type)	Fuzzy Logic	To identify the success factors of ship management companies (SMCs), to assess the importance of these factors and finally to identify the differences in perceptions between ship owners and SMCs.
Modeling selection of third party ship management services	Asuquo, M., Coward, I., & Yang, Z., (2014).	Maritime (General ship type)	AHP	The aim of the study is to develop a methodology for designing a transparent decision-making tool for maritime companies to select TPSM using the analytical hierarchy process (AHP) approach.
The ship management firm selection: the case of South Korea	Seo, Y. J., Ha, M. H., Yang, Z., & Bhattacharya, S., (2018).	Maritime (General ship type)	AHP & Fuzzy TOPSIS	Shipowners to contribute to the development of SMF selection criteria and to identify areas where SMF should improve its service standards.
Evaluation of determinant factors influencing the selection of ship management companies	Riadi, A., & Mudaffa, F., (2022).	Maritime (General ship type)	FAHP	To identify the determining factors of SMC selection from the shipowner's point of view, to evaluate the importance of each of these factors and to obtain the different views between the shipowner and the SMC in the choice of ship management.
The vertical disintegration of ship management: choice criteria for third party selection and evaluation	Panayides, P. M., & Cullinane, K. P., (2002).	Maritime (General ship type)	Interview and survey (assesment)	Empirically identify the dimensions of ship manager selection and performance appraisal and their relative importance
An evaluation of the success factors for ship management companies using fuzzy evaluation method	Jeon, J. W., Yeo, G. T., Thai, V. V., & Yip, T. L., (2016).	Maritime (General ship type)	Fuzzy Logic	To identify the success factors of ship management companies (SMCs), to evaluate the importance of these factors and finally to identify the differences in perceptions between ship owners and SMCs.
An evaluation of the key influencing factors for tramp shipping corporations selecting ship management companies	Lin, T. Y., Chung, C. C., & Ho, T. C., (2019).	Maritime (General ship type)	Fuzzy AHP DEMATEL	Research has been conducted on the selection of the ship companies in tramp operation.
A QFD-based decision model for ship selection in maritime transportation	Sener, Z., & Ozturk, E., (2015).	Maritime (General ship type)	QFD	It presents a decision approach based on quality function propagation (QFD) methodology for ship selection in the maritime transport sector.
Growth & Selection Criteria of Ship Management Firms and Its Implications	Kim, H. D., Ryoo, D. K., & Kim, K. H., (2006).	Maritime (General ship type)	Interview and survey (assesment)	It aims to analyse the development trends of the ship management and market and to make comparative studies with Korean ship management companies.
Data-driven financial and operational risk management: Empirical evidence from the global tramp shipping industry	Bai, X., Cheng, L., & Iris, Ç. (2022).	Tram shipping	Bayesian network	They innovatively measured short and medium-term operational risk management strategies using Automatic Identification System (AIS) data.

Source: Authors.

Table 3: Qualifications of experts.

Expert	Duty	Professional Experience (Years)	Number of ships under his/her management
EX 1	Charterer Manager	15	14
EX 2	Operation Manager	13	14
EX 3	Charterer Manager	14	11
EX 4	Operation Manager	14	12
EX 5	Charterer Manager	15	11
EX 6	Charterer Manager	17	13
EX 7	Operation Manager	16	12
EX 8	Charterer Manager	14	13
EX 9	Operation Manager	15	12
EX 10	Charterer Manager	20	11

Source: Authors.

Customer Satisfaction (CS) is an important element that reinforces reliability (Tran et al., 2020). Sustained Performance (SP) involves the company's ability to consistently deliver high performance. This gives customers and partners confidence that the company is focused on long-term success.

3.2. Technological Infrastructure and Organization (TIO).

Technological infrastructure and organization are important basic elements for companies. Achieving Competitive Advantage (CCA) gives companies the ability to continually innovate and improve (Hsu et al., 2021). Adopting innovative technologies and using these technologies effectively provides competitive advantage (Vejvar et al., 2020). Operational Efficiency and Cost Reduction (OECR) plays a critical role in automating business processes and increasing efficiency, helping businesses reduce operational costs and use resources more effectively (Stalmokaite & Hassler, 2020). Digital Communications and Services (DCS) improves customer experience and increases customer loyalty by using digital tools to provide better service to customers and create interactive communication channels (Bhardwaj, 2013). By providing Data Analysis and Decision-Making Processes (DDMP), technological infrastructure, big data analysis and analytical capabilities and encouraging companies to use this data, they can make more conscious and strategic decisions, thus predicting customer demands and better understanding market trends (Dickie, 2014). Team Collaboration and Communication (TCC) provides tools that increase cross-team communication and facilitate collaboration (Yan & Peng, 2022). This increases efficiency within the organization, accelerates information sharing and enables projects to be managed more effectively (Jeon et al., 2016). Security and Risk Management (SRM) plays an important role in protecting company data and information. Cybersecurity measures protect customer trust and minimize risks such as data breaches (Zhang & Tang, 2021).

3.3. Financial Status (FS).

It can be evaluated as the sum of the company's equity, expenses and service fees incurred in terms of operational sustainability to ensure the functionality of the system. The expense part of the system that monitors the loading, unloading, and washing processes of ships and manages port processes is called Tanker Operation Fee (TOF). Tanker Ship Management Costs (TSMC) ensure the compliance of tanker ships with international rules and the continuity of ship inspection systems (Riadi & Mudaffa, 2022). There must be an organization that manages the technical maintenance, attitude, and spare parts services of ships (Vejvar et al., 2020). A service is provided for the technical team within this organization to follow the processes, track spare parts and make service arrangements. Technical Support Fee (TSF) is the financial part provided to this formation of companies (Goulielmos et al, 2011). The human factor that ensures the movement, management and transportation of ships appears to be one of the biggest items in companies (Jahn & Bussow, 2013). Personnel employment is seen as problematic, especially in the tanker market (Kim et al., 2006). Therefore, salaries are highly progressive. The field where this expense item is located is called Personnel Cost (PC). Besides, it would be a wrong judgment to always talk about expense items (Poulsen & Sornn-friese, 2015). Especially when shipowners enter such a system, the net money they earn is important. This money should be expressed as Monthly Rental Fee (MCF) (Sener & Ozturk, 2015). In this way, the money that will provide systematic gain will come from this item.

3.4. Quality Standards and Safety Management System (QSM).

Ships need an established and complete International Safety Management System (ISM) to operate in the international system. This system allows the ship to continue its trade comfortably. Having ISO certification (ISO) for the company's management system shows that the company's environmental, quality and management standards are established and accredited (Dickie, 2014). In this way, it is proof that it has a more reliable and established company profile. Maritime has a wide range of activities carried out on an international basis. Many legal problems are encountered in this system. Legal Support Mechanism (LSM) must be in place within the company against the problems encountered (Arıcan, 2023). It can be considered one of the most important elements for the company's image (Chatzikosta, 2017). Authorized people working in your company's departments must have good qualifications and experience, and these authorized personnel will help ships to have a smooth operational process, documentation, and inspection (Seo et al., 2018). Personnel Quality and Experience (PQE) in the land support system of ships are among the most important elements (Mitroussi, 2004). The training given to ship personnel before joining the ship is the most important part that shows the quality of the companies (Bai et al., 2022). In this way, ship personnel are prepared to work safely on board. Ship Personnel Training System (SPTS) is one of the basic elements in the

quality standards and safe management system. The names and abbreviations used in the study are given in table 4.

Define acronyms. For example, in the introduction to this article, the meaning of JMR is defined; therefore this acronym can be used in the rest of the article without having to explain it. First comes the definition, then the acronym in brackets. Thereafter, the acronym JMR can be used.

Table 4: Names and abbreviations.

Abbravations	Names	Abbravations	Names
SMC	Ship Managemment Company	OECR	Operational Efficiency and Cost Reduction
FAHP	Fuzzy Analytic Hierarchy Process	DCS	Digital Cominication and Services
FTOPSIS	Fuzzy Technique for Order of Preference by Similarity to Ideal Solution	DDMP	Data Analysis and Decision Making Processes
TPSC	Third Party Ship Company	TCC	Team Collaboration and Communication
QFD	Quality Function Deployment	SRM	Security and Risk Management
ER	Experience and Reliability	TOF	Tanker Operation Fee
TIO	Technological Infrastructure and Organization	TSMC	Tanker Ship Management Costs
FS	Financial Status	TSF	Technical Support Fee
QSM	Quality Standards and Safety Management System	PC	Personel Cost
SKE	Sectoral Knowledge and Expertise	MCF	Monthly Charterer Fee
POE	Project and Operational Experience	ISM	International Safety Management System
RR	Reputation and References	ISO	International Standards Organization Certifications
CS	Customer Satisfaction	LSM	Legal Support Mechanism
SP	Sustained Performance	PQE	Personnel Quality and Experience
CCA	Creating Competitive Advantage	SPTS	Ship Personnel Training System

Source: Authors.

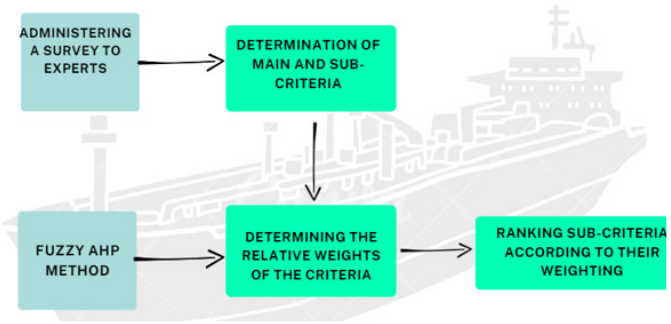
4. Materials and Methods.

The general flow of the study to determine the criteria for selecting Ship Management Companies is given in Figure 1.

4.1. Data Used.

SMC selection criteria in the literature were discussed and then a survey was applied to determine the criteria and the hierarchy of criteria. This survey also included open-ended questions. These managers, who have worked in shipowner companies and SMC for at least 10 years, are considered experts in their field. The characteristics of the experts who assisted in the study are given in Table 5.

Figure 1: Ship Management Company Selection Methodology.



Source: Authors.

Table 5: Qualifications of experts.

Expert	Duty	Professional Experience (Years)	Number of ships under my management
EX 1	General Manager	11	11
EX 2	Operation Manager	14	13
EX 3	Charterer Manager	11	7
EX 4	General Manager	12	9
EX 5	business manager	13	13
EX 6	Operation Manager	15	15
EX 7	General Manager	20	12
EX 8	Operation Manager	15	15
EX 9	Charterer Manager	13	19
EX 10	General Manager	14	13

Source: Authors.

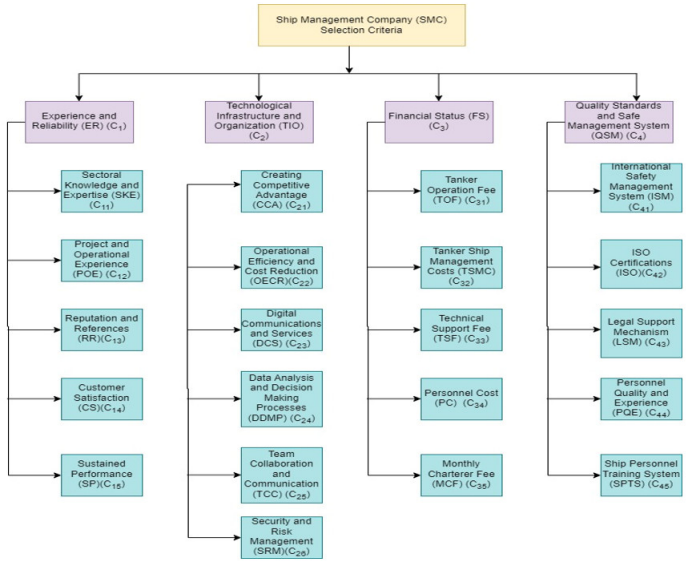
As a result, four main criteria have been identified regarding the selection of SMC. These main criteria are 'Experience and Reliability', 'Technological Infrastructure and Organization', 'Financial Status' and 'Quality Standards and Safe Management System'. Sub criteria have been determined for each of these main criteria. The main criteria and sub-criteria are hereafter abbreviated as indicated in Table 4. The main criteria and sub-criteria determined are shown in Figure 2.

4.2. Data Collection.

The main and sub-criteria stated by the experts in the selection of the ship management company were converted into questionnaires by creating comparison tables on a scale of 1-9 used in the Fuzzy AHP method. These questionnaires were sent to the experts via e-mail and online survey tools, and explanations about the purpose and importance of the questionnaire

and how the responses would be used were included. Semi-structured in-depth interview technique was used in the questionnaire application. In Fuzzy Analytic Hierarchy Process (FAHP), questionnaires are used to determine the subjective opinions and preferences of experts. The survey questions used in the study were prepared to reflect the hierarchy and criteria in the decision-making process. In addition, in the questionnaire form, questions expressed in fuzzy terms as well as illustrative examples are given for the experts to express their opinions based on fuzzy sets more accurately.

Figure 2: SMC selection criteria hierarchy.



Source: Authors.

4.3. Method.

The Fuzzy Analytical Hierarchy (FAHP) Method, which is the most common multi-criteria decision-making method, was used in the study. The rationale behind selecting this method lies in its widespread acceptance and frequent utilization, particularly in studies focusing on criteria selection. Moreover, this approach has seen extensive application in both ship selection and ship company selection contexts.

4.3.1. Fuzzy Analytic Hierarchical Process (FAHP).

The FAHP technique can be considered an evolved version of AHP. Although AHP is based on expert opinions, it does not fully reflect an individual's thought process. In AHP's evaluations, potential uncertainties regarding options or decisions are ignored, which significantly affects the decision (Cheng, 1996). Analytic Hierarchical Process (AHP) is one of the multi-criteria decision-making methods; However, it may not be effective in cases of uncertainty, so Fuzzy Analytical Hierarchical Process (FAHP) emerged by combining AHP with fuzzy logic (Leung and Cao, 2000). In FAHP applications, researchers have presented various methods to determine or rank the best option in a multi-criteria environment using fuzzy set theory (Chan et al., 2008). Chang (1996) developed a degree analysis method and presented a new approach to evaluate the synthetic dimension degrees of fuzzy AHP by using 9-scale triangular fuzzy numbers used by Saaty for pairwise comparisons (Wang et al., 2008)). In here, Chang's rank analysis method was used to determine the criterion weights related to sailboat selection, the steps of this method are as follows (Chang, 1996):

Step 1: According to criterion i, the value of the fuzzy synthetic order is defined as follows:

$$S_i = \sum_{j=1}^{m} M_g^j \times \left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^j\right]^{-1} \tag{1}$$

Here, $\sum_{j=1}^{m} M_g^j$ the fuzzy addition process in formula (2) is applied to the ? level analysis equation to make the equation:

$$\sum_{j=1}^{m} M_g^j = \left(\sum_{j=1}^{m} l_j,\ \sum_{j=1}^{m} m_j,\ \sum_{j=1}^{m} u_j\right) \tag{2}$$

And $\left(\sum_{i=1}^{n} l_j,\ \sum_{i=1}^{n} m_j, \sum_{i=1}^{n} u_i\right)^{-1} M_{gi}^j\ (j = 1, 2, \ldots, m)$ To give the fuzzy addition operation of the equation, the procedure in formula (3) is performed.

$$\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^j = \left(\left(\sum_{i=1}^{n} l_j,\ \sum_{i=1}^{n} m_j, \sum_{i=1}^{n} u_i\right)\right) \tag{3}$$

And the test of the vector in the formula is calculated according to the formula (4) below.

$$\left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^j\right]^{-1} = \left(\frac{1}{\sum_{i=1}^{n} u_i}, \frac{1}{\sum_{i=1}^{n} m_j}, \frac{1}{\sum_{i=1}^{n} l_j}\right) \tag{4}$$

Step 2: The level of possibility of M ≥M_1 is defined as in formula (5).

$$(M_2 \geq M_1) = sup_{y \geq x} \lfloor min\,(\mu_{M_1}(x),\ \mu_{M_2}(y)) \rfloor \tag{5}$$

Likewise, it is defined with the help of the formula below.

$$V(M_2 \geq M_1) = hgt(M_1 \cap M_2) = \mu_{M_2}(d)$$

$$= \begin{cases} 1, & if\ m_2 - m_1, \\ 0, & if\ l_1 - u_2, \\ \frac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)} & otherwise, \end{cases} \tag{6}$$

The upper-level intersection region is the y axis of D, as shown in Figure 3.

Figure 3. It is the intersection between M_1 and M_2 (Chang, 1996)

To compare M_1 and M_2 points, both $V(M_2 \geq M_1)$ and $V(M_2 \geq M_1)$ values must be present.

Step 3: The probability degree of a concave fuzzy number being greater than k concave fuzzy numbers $M_i\ (i = 1, 2, 3\ \ ...,\ k)$ is specified as in formula (7).

$$\begin{gathered}(\ V(M \geq M_1, M_2, \ldots, M_k) = \\ V\left[(M \geq M_1)\ and\ (M \geq M_2)\ and\ ...\ and\ M \geq M_k)\right] = \\ min\ V(M \geq M_i),\ \ i = 1, 2, 3, \ldots., k.)\end{gathered} \tag{7}$$

Assuming it is

$$d'(A_i) = min\ V(S_i \geq S_k),\ k = 1, 2, ..., n;\ k \neq i \quad (8)$$

In the next step, the weight vector is defined as in formula (9):

$$W' = (d'(A_1), d'(A_2), \ldots, d'(A_n))^T \quad (9)$$

It shows values as many as in the formula A_i ($i = 1, 2, ..., n$).
Step 4: Normalized weight vector

$$W = (d(A_1), d(A_2), \ldots, d(A_n))^T \quad (10)$$

W in formula (10) refers to a non-fuzzy number.

5. Results.

5.1. Findings.

For SMC selection, first the main criteria were compared with each other. Weights were found by creating binary matrices using Chang's rank analysis technique mentioned in the method section. The comparison matrix of the main criteria is given in Table 6.

Table 6: Pairwise comparison matrix of main criteria.

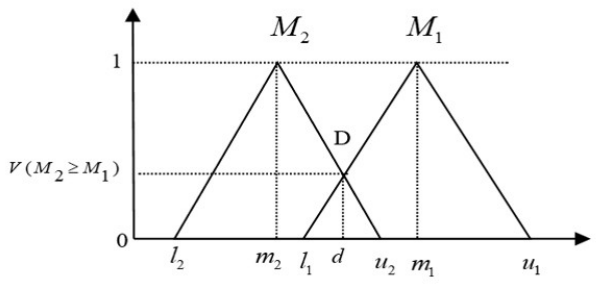
	C1			C2			C3			C4		
	l	m	u	l	m	u	l	m	u	l	m	u
C1	1	1	1	1	2	3	1	2	3	1	3	4
C2	1/3	1/2	1	1	1	1	1/2	1/3	1/4	4	5	6
C3	1/3	1/2	1	4	3	2	1	1	1	1	2	3
C4	1/4	1/3	1	1/6	1/5	1/4	1/3	1/2	1	1	1	1

Source: Authors.

The normalized weights of the data obtained after the pairwise comparison matrix of the main criteria with the data obtained by using the formula specified in step 4 are given in Table 7.

Table 7: Normalized version of main criteria.

				Mean	Normalized
C1	0.172	0.408	0.737	0.439	0.396
C2	0.155	0.210	0.333	0.233	0.210
C3	0.184	0.289	0.471	0.315	0.284
C4	0.059	0.094	0.213	0.122	0.110
Sum				1.109	1.00



Source: Authors.

Looking at the normalized weight values in Table 7, because of the comparison made by the experts, C1 main criterion ER received the highest value with a numerical value of 0.396. Second was the FS C3 main criterion with a numerical value of 0.284, C2 TIO with a numerical value of 0.21 and QSM with a numerical value of 0.19.

The expression of the sub-criteria of the ER (C1) main criterion with triple fuzzy numbers, which is the linguistic expression cycle, was taken as the average of the values given by the experts and written in the form of the binary comparison matrix in Table 8.

Table 8: Pairwise comparison matrix of sub-criteria of ER Main (C1) criterion.

	C_{11}			C_{12}			C_{13}			C_{14}			C_{15}		
	l	m	u	l	m	u	l	m	u	l	m	u	l	m	u
C_{11}	1	1	1	1	2	3	1	1	1	1	3	4	1	2	3
C_{12}	1/3	1/2	1	1	1	1	1/2	1/3	1/4	1	1	1	1/2	1/3	1/4
C_{13}	1	1	1	4	3	2	1	1	1	1	2	3	1	1	2
C_{14}	1/4	1/3	1	1	1	1	1/3	1/2	1	1	1	1	1/2	1/2	1/3
C_{15}	1/3	1/2	1	4	3	2	1/2	1	1	3	2	2	1	1	1

Source: Authors.

The pairwise comparison matrix data of the five sub-criteria of the main criterion ER (C1) and the weights of the normalized version of the fuzzy numbers with the use of the formula specified in step 4 of FAHP are given in Table 9.

Table 9: Normalized version of Sub criteria of ER (C1) Main Criterion.

	l	m	u	Mean	Normalized
C_{11}	0.157	0.299	0.445	0.300	0.290
C_{12}	0.095	0.102	0.125	0.107	0.104
C_{13}	0.207	0.261	0.357	0.275	0.265
C_{14}	0.083	0.111	0.174	0.123	0.118
C_{15}	0.180	0.227	0.286	0.231	0.223
Sum				1.036	1

Source: Authors.

Looking at the normalized relative weight values in Table 9, C11 SKE, one of the sub-criteria of the C1 main criterion, received the highest value with a numerical value of 0.29. Secondly, RR C13 sub-criterion with a numerical value of 0.265, C15 SP with a numerical value of 0.223, CS sub-criterion C14 with a numerical value of 0.118 and POE C12 with a numerical value of 0.104 were included.

The expression of the sub-criteria of TIO (C2) main criterion with triple fuzzy numbers, which is the linguistic expression cycle, is taken as the average of the values given by the experts and written in the form of the binary comparison matrix in Table 10.

Table 11 shows the weights of the pairwise comparison matrix data of the six sub-criteria of the main criterion TIO (C2), normalized by the fuzzy numbers using the formula specified in step 4.

Table 10: Pairwise comparison matrix of sub-criteria of TIO (C2) Main criterion.

	C_{21}			C_{22}			C_{23}			C_{24}			C_{25}			C_{26}		
	l	*m*	*u*	*l*	*m*	*u*	*l*	*m*	*u*	*l*	*m*	*u*	*l*	*m*	*u*	*l*	*m*	*u*
C_{21}	1.00	1.00	1.00	0.85	0.93	0.99	0.65	0.79	1.00	1.12	1.15	1.20	0.65	0.90	1.20	0.90	0.92	0.99
C_{22}	1.01	1.08	1.18	1.00	1.00	1.00	0.62	0.66	0.75	1.35	1.86	2.40	0.64	0.76	0.86	1.00	1.02	1.10
C_{23}	0.90	0.95	0.99	1.33	1.52	1.61	1.00	1.00	1.00	0.90	0.93	0.97	0.65	0.79	1.00	0.95	0.97	0.99
C_{24}	0.83	0.87	0.89	0.42	0.54	0.74	1.03	1.08	1.11	1.00	1.00	1.00	0.67	0.93	1.25	0.82	1.06	1.35
C_{25}	0.83	1.11	1.54	1.16	1.32	1.56	1.00	1.27	1.54	0.80	1.08	1.49	1.00	1.00	1.00	1.12	1.17	1.18
C_{26}	1.01	1.09	1.11	0.91	0.98	1.00	1.01	1.03	1.05	0.74	0.94	1.22	0.85	0.85	0.89	1.00	1.00	1.00

Source: Authors.

Table 11: Normalized version of Sub criteria of TIO (C2) Main Criterion.

	l	*m*	*u*	mean	Normalized
C_{21}	0.13	0.16	0.19	0.16	0.15
C_{22}	0.14	0.17	0.22	0.18	0.20
C_{23}	0.14	0.17	0.20	0.17	0.18
C_{24}	0.12	0.15	0.19	0.17	0.13
C_{25}	0.14	0.19	0.25	0.19	0.20
C_{26}	0.13	0.16	0.19	0.16	0.12
Sum				1.03	1

Source: Authors.

Looking at the normalized relative weight values in Table 10, C22 OECR and TCC C25, one of the sub-criteria of the C2 main criterion, received the two highest equal values with a numerical value of 0.20. Secondly, with a numerical value of 0.18, DCS C23 sub criterion received the value of 0.15, while CCA C21 received the value of 0.15. With a numerical value of 0.13, C24 DDMP and C26 SRM ranked last with a numerical value of 0.12.

The linguistic expression of the sub-criteria of the FS (C3) main criterion with triple fuzzy numbers was written as the pairwise comparison matrix in Table 12, taking the average of the values given by the experts.

Table 12: Pairwise comparison matrix of sub-criteria of FS (C3) Main criterion.

	C_{31}			C_{32}			C_{33}			C_{34}			C_{35}		
	l	*m*	*u*	*l*	*m*	*u*	*l*	*m*	*u*	*l*	*m*	*u*	*l*	*m*	*u*
C_{31}	1	1	1	1/2	1/3	1/4	1	1	1	1/3	1/4	1/5	1/2	1/3	1/3
C_{32}	4	3	2	1	1	1	1/2	1/3	1/4	1	1	1	1/2	1/3	1/4
C_{33}	1	1	1	4	3	2	1	1	1	1/2	1/3	1/4	1	1	1
C_{34}	5	4	3	1	1	1	4	3	2	1	1	1	1	2	3
C_{35}	3	3	2	4	3	2	1	1	1	1/3	1/2	1	1	1	1

Source: Authors.

The pairwise comparison matrix data of the five sub-criteria of the main criterion FS (C3), the weights of the normalized version of the fuzzy numbers with the use of the formula specified in step 4 of FAHP are given in Table 13.

Table 13: Normalized version of sub-criteria of FS (C3) Main Criterion.

	l	*m*	*u*	Mean	Normalized
C_{31}	0.103	0.088	0.087	0.093	0.093
C_{32}	0.170	0.145	0.130	0.148	0.148
C_{33}	0.195	0.181	0.172	0.182	0.182
C_{34}	0.309	0.341	0.351	0.334	0.334
C_{35}	0.224	0.244	0.260	0.243	0.243
Sum				1.00	1

Source: Authors.

Looking at the normalized relative weight values in Table 13, C34 PC, one of the sub-criteria of the C3 main criterion, received the highest value with a numerical value of 0.334. Secondly, MCF C35 sub-criterion ranked last with a numerical value of 0.243, C33 TSMC with a numerical value of 0.182, and TOF sub-criterion C31 ranked last with a value of 0.093.

The linguistic expression cycle of the sub-criteria of the QSM (C4) main criterion, represented in triple fuzzy numbers, was determined by averaging the values provided by the experts. These values were then transcribed into a pairwise comparison matrix, which is presented in Table 14.

Table 14: Pairwise comparison matrix of sub-criteria of QSM (C4) Main criterion.

	C_{41}			C_{42}			C_{43}			C_{44}			C_{45}		
	l	*m*	*u*	*l*	*m*	*u*	*l*	*m*	*u*	*l*	*m*	*u*	*l*	*m*	*u*
C_{41}	1	1	1	1	2	3	1	2	3	1/2	1/2	1/3	1	1	2
C_{42}	1/3	1/2	1	1	1	1	1	1/2	1/3	1	1/2	1/2	1/2	1/3	1/4
C_{43}	1/3	1/2	1	3	2	1	1	1	1	1/2	1/3	1/4	1	1	1
C_{44}	3	2	2	2	2	1	4	3	2	1	1	1	1	2	3
C_{45}	1/2	1	1	4	3	2	1	1	1	1/3	1/2	1	1	1	1

Source: Authors.

The weights of the normalized fuzzy numbers, calculated using the formula specified in step 4 of the pairwise comparison matrix data, for the five sub-criteria of the main criterion of QSM (C4), are presented in Table 15.

Table 15: Normalized version of the sub-criteria of the QSM (C4) Main Criterion.

	l	*m*	*u*	Mean	Normalized
C_{41}	0.158	0.211	0.273	0.214	0.214
C_{42}	0.127	0.097	0.101	0.108	0.108
C_{43}	0.158	0.147	0.144	0.150	0.150
C_{44}	0.343	0.346	0.313	0.334	0.334
C_{45}	0.167	0.199	0.219	0.195	0.195
Sum				1.001	1

Source: Authors.

When examining the normalized relative weight values in Table 15, it's observed that the sub-criterion C44 PQE of the main criterion C4 received the highest value, standing at 0.334. Following this, the sub-criterion ISM C41 secured the second position with a numerical value of 0.214. C45 SPTS ranked third with a value of 0.195, LSM C43 came next with a value of 0.150, and finally, ISO C42 obtained the lowest value at 0.108.

The hierarchy of importance weights for the sub-criteria is presented in Table 16.

Table 16: General ranking of sub-criteria according to their importance weights and importance weights.

Criteria	Main Criteria Weight	Sub Criteria weight	Sub Criteria Importance Weight	Ranking
C_{11}	0.396	0.290	0.115	1
C_{12}	0.396	0.104	0.041	11
C_{13}	0.396	0.265	0.105	2
C_{14}	0.396	0.118	0.047	7
C_{15}	0.396	0.223	0.088	4
C_{21}	0.210	0.15	0.032	14
C_{22}	0.210	0.20	0.042	10
C_{23}	0.210	0.18	0.038	12
C_{24}	0.210	0.13	0.027	15
C_{25}	0.210	0.20	0.042	8
C_{26}	0.210	0.12	0.025	17
C_{31}	0.284	0.093	0.026	16
C_{32}	0.284	0.148	0.042	9
C_{33}	0.284	0.182	0.052	6
C_{34}	0.284	0.334	0.095	3
C_{35}	0.284	0.243	0.069	5
C_{41}	0.110	0.214	0.024	18
C_{42}	0.110	0.108	0.012	21
C_{43}	0.110	0.150	0.017	20
C_{44}	0.110	0.334	0.037	13
C_{45}	0.110	0.195	0.021	19

Source: Authors.

Upon reviewing the importance ranking of the sub-criteria in Table 16, it is evident that C11 SKE secured the top position with an importance weight of 0.115. Following this, C13 RR sub-criterion was ranked second with a numerical value of 0.105 according to its importance weight. C34 PC obtained the third position with a numerical value of 0.095. The fourth rank was attributed to the sub-criterion C15 SP with an importance weight of 0.088. Finally, the fifth most important criterion was determined to be C35 MCF based on the calculation of importance weights for all sub-criteria.

5.2. Sectoral Implications.

The findings of the study regarding the selection of ship management companies in the maritime sector will serve as an asset for shipowners and maritime enterprises alike. These results will facilitate the decision-making process for shipowners when choosing among multiple alternative ship management companies, providing insight into the criteria that should be considered during the selection process. For instance, leveraging the study results, a shipowner can make an informed decision by evaluating the alignment of each potential ship management company with the identified criteria. Furthermore, the study outcomes will enable companies to assess their existing relationships with their current operating company and enact strategic adjustments as needed. By effectively applying these findings, ship management companies can enhance their operations to be more efficient, reliable, and competitive in the industry. Overall, the study's conclusions offer practical guidance for stakeholders in the maritime sector, fostering improved decision-making and strategic management practices.

6. Discussion.

The study empirically assessed the comprehensive ranking of criteria for Ship Management Companies (SMCs) by employing the Fuzzy Analytic Hierarchy Process (AHP) model. This approach was chosen to aid in crucial decision-making processes involved in the selection of SMCs, especially under multiple criteria scenarios. The study successfully determined the importance weights of significant criteria influencing the selection of tanker ship operating companies. These findings provide valuable insights for stakeholders involved in the selection process, offering a structured and data-driven approach to decision making within the maritime industry.

In the study, four main criteria to be sought in SMC selection were determined: ER, TIO, FS and QSM. According to these main criteria, 6 sub-criteria were determined in the TIO main criterion and 5 sub-criteria under the other main criteria. SKE, POE, RR, CS and SP were included under the ER main criterion. It consists of CCA, OECR, DCS, DDMP, TCC and SRM sub-criteria under the main criterion TIO. It was created from TOF, TSMC, TSF, PC and MCF sub-criteria under the FS main criterion. It was created from ISM, ISO, LSM, PQE and SPTS sub-criteria under the QSM main criterion. As a result of the comparison survey data created by experts, first the normalized weights of the main criteria were found. ER, which is the main criterion of C1, had the highest value. Experience and reliability have been determined as the most important main criteria for tanker ship operator selection. Here, it has been seen that being an experienced and reliable company for the shipowner is significantly more important than the other main criteria. Secondly, financial situation emerged as one of the main criteria.

The financial situation, the company's own budget, company expenses and the net rental fee are determined to be important. Economic impact value was seen as dominant over other main criteria except experience and reliability. Among the main criteria, the criteria with the lowest weight impact were quality standards and safe management system. The reason for this can be interpreted as the systems are already established and every company should be ready in this regard. Criteria such as 'ER' and 'FS' are prioritized by experts because these factors are regarded as fundamental to a successful business. Conversely, 'QSM', as well as 'TIO', are not deemed decisive for the success of a particular tanker vessel operation and are therefore not prioritized by experts. In the case of a tanker vessel operation, experts believe that 'ER' and 'FS' have a greater impact.

In interpreting the sub-criteria of the main criteria in the study, sectoral knowledge, and expertise (C11) and reputation and references (C13) emerge as vital sub-criteria within the ER category. Companies' emphasis on sectoral knowledge and expertise can yield numerous advantages. As recognition of these advantages grows, it becomes easier to attract customers in the competitive market landscape. Ship owners, as customers, tend to favor companies that demonstrate a deep understanding of their industry and effectively cater to their needs. This, in turn, leads to increased customer satisfaction and fosters loyalty. The study highlights the significance of these sub-criteria, emphasizing their importance in meeting customer demands effectively. Additionally, within the reference criterion, a company's track record of successful past endeavors significantly enhances its appeal. Given the close-knit nature of the maritime market, positive references spread quickly, making reputation a crucial factor. This underscores the importance of reputation and references in influencing decision-making processes within the maritime industry.

The most significant criteria within the TIO main criterion, with equal weight values, were 'operational efficiency and cost reduction' and 'team collaboration and communication'. Operational efficiency has garnered increasing importance within maritime companies. It refers to a maritime business's ability to conduct its operations more effectively and efficiently, aiming to enhance business processes and achieve optimal results through the judicious use of resources. In the maritime context, operational efficiency encompasses various factors, including cost savings, time management, fuel consumption, equipment management, and shipowner satisfaction. By optimizing operational efficiency and reducing costs, shipowners can effectively minimize expenses and enhance profitability.

In the sub-criteria of the FS main criterion, Personnel Costs (PC) and Monthly Charter Fee (MCF) were found to carry significant weight. Personnel costs represent one of the largest expense items for companies, especially in the maritime industry. Salaries for personnel on tanker ships are notably higher compared to other vessels due to the demanding and stressful nature of working on tanker ships. The shortage of qualified personnel across all ship types further exacerbates this discrepancy, directly impacting costs. Additionally, the monthly charter fee, another sub-criterion, plays a crucial role as it directly influences the shipowner's earnings. It is customary for shipowners to prioritize this issue as the income generated from charter fees is often allocated towards covering the costs, loans, and other expenses associated with the ships they own.

In the sub-criteria of the QSM main criterion, C44 and C41 were identified as significant. Personnel quality and experience hold paramount importance for maritime companies, particularly in the tanker ship industry, known for its stringent safety and security standards. Incidents have demonstrated that experienced and qualified personnel play a pivotal role in ensuring ship safety, crew well-being, and compliance with maritime regulations. Additionally, given the complex regulatory environment at both national and international levels, experienced personnel are instrumental in ensuring compliance, facilitating inspections, and averting non-compliance issues. The other sub-criterion, the ISM system, serves as the operational backbone of the ship, ensuring systematic integrity through documentation, certification, maintenance, and sustainability efforts. It is evident that this system holds significant importance as a sub-criterion for tanker ship operating companies, reflecting the industry's emphasis on adherence to operational standards and regulatory compliance.

When considering the overall ranking of sub-criteria, C11, C13, C34, C14, and C35 emerge as the top five preferred criteria. Among these, 'Customer Satisfaction' (C14), 'Personnel Cost' (C34), 'Team Collaboration and Communication' (C25), and 'Tanker Ship Management Cost' (C32) are identified as other important priority sub-criteria by experts in the selection criteria for ship management companies in the study. These sub-criteria represent distinct factors not commonly found in previous studies. For instance, in Seo et al.'s (2018) study on ship management companies, 'Company Experience', a sub-criterion under the main competency criterion, parallels the 'Sectoral Knowledge and Expertise' (C11) sub-criteria in this study. Similarly, the 'Reputation of the Company' sub-criterion identified by Asuquo et al. (2014) aligns with the 'Reputation and References' (C13) sub-criteria in this study, both being among the top preferred criteria. Furthermore, while ship personnel expenses are typically categorized under the umbrella of economy in previous studies, the 'Personnel Fee' (C34) sub-criterion in this study highlights a similar concern. Unlike other studies, the 'Technical Support Cost' (C33) and 'Tanker Ship Management Cost' (C31) sub-criteria emerge as top priorities in this study. Conversely, sub-criteria such as ISO Certification (C42) and Legal Support (C43) are deemed less preferred compared to others in terms of importance.

Conclusions.

The rapid progress and complexity in the maritime industry has made SMC formation a vital issue for shipowners. Therefore, the selection of operating company is very important. The study has established a recommendation framework for the selection of tanker ship SMC in Turkiye using Fuzzy AHP methodology. The study is limited to ship management companies and tanker ship management in Türkiye.

In the study, it was tried to determine on which criteria the most ideal SMC should be shaped, with 21 sub-criteria under

4 main criteria headings. Among these sub-criteria, Sectoral Knowledge and experience, Reputation and references and personnel cost were among the most important sub-criteria and were preferred for the selection of companies.

As a result, from the different perspectives of shipowners, deciding on the selection of the most suitable SMC is a challenging task due to the lack of objectivity and quantity. In this way, a guide was presented to shipowners to enable them to make the fastest checks to determine the importance of SMC criteria and to eliminate difficulties or uncertainties. Especially considering the difficulties in the tanker market and the lack of a study of a specific tanker ship operating company, the study data will make it easier for the process to be faster. There may be great differences between ship management companies. Some may offer better service and quality, while others may be of lower standards. In addition, the prices and costs offered by different ship management companies may vary significantly. There is a need to conduct more comprehensive research in the future to find the operating company that best suits the shipowner's needs and expectations. In the study, alternative ship management companies were not selected based on determined criteria. However, for future investigations, a wide array of operating companies from both Türkiye and abroad could be considered, facilitating an in-depth analysis of their differences. By conducting such comparisons, insights can be gleaned regarding the disparities between Turkish and foreign ship operators, potentially leading to the development of a model that identifies areas for improvement within Türkiye's ship management sector. According to the results of the study.

- Turkish shipowner companies will have criteria to quickly eliminate SMC companies among many companies.
- If a ship operating company is to be established, company owners can ensure the formation of the company according to the sub-criteria determined in the study.
- In the study, especially the operation of tanker type ships has been studied. Selection criteria for different types of ships will be referenced in other studies.
- It will help take quick action for ship operation to reduce the difficulties of the maritime industry and prevent loss of time.

References.

Arıcan, O. H., *Ship selection model for chemical tanker management*, Doctoral Dissertation İstanbul University-Cerrahpaşa (2023) İstanbul.

Arıcan, O. H., *Determination of dedweight tonnage range according to time charter in chemical tankers*, International Journal of Management and Administration, 7(14) (2023) 195-213. https://doi.org/10.29064/ijma.1320254.

Asuquo, M., Coward, I., & Yang, Z., *Modeling selection of third party ship management services*. Case Studies on Transport Policy, 2(1) (2014) 28-35. https://doi.org/10.1016/j.cstp.2013.11.002.

Bai, X., Cheng, L., & Iris, Ç., *Data-driven financial and operational risk management: Empirical evidence from the global tramp shipping industry*, Transportation Research Part E: Logistics and Transportation Review, 158 (2022) 102617.

Bhardwaj, S., *Challenges and potential of technology integration in modern ship management practices,* Doctoral Dissertation Plymouth University (2013) Playmouth.

Brlečić Valčić, S., *Utilisation of ANFIS in analysing impact of cost structure on Croatian maritime companies development*. Pomorstvo 35(1) (2021) 179-185. https://doi.org/10.31217/p.35.1.19

Cariou, P. And Wolff, F.-C., *Ship-owners' decisions to outsource vessel management,* Transport Review, Vol. 31 (6) (2011) 709-724. https://doi.org/10.1080/01441647.2011.587907.

Chatzikosta, D., *Third party ship management-Literature review*, (2017).

Chan, F. T., Kumar, N., Tiwari, M. K., Lau, H. C., & Choy, K., *Global supplier selection: a fuzzy-AHP approach*, International Journal of production research, 46(14) (2008) 3825-3857. https://doi.org/10.1080/00207540600787200.

Chang Da-Yong, *Applications of the Extent Analysis Method on Fuzzy AHP*, European Journal of Operational Research, 95(3) (1996) 649-655. https://doi.org/10.1016/0377-2217(95)00300-2.

Cheng, CH., *Evaluating naval tactical missile systems by fuzzy AHP based on the grade value of membership function,* European Journal of Operational Research, 96(2) (1996) 343–350. https://doi.org/10.1016/S0377-2217(96)00026-4.

Dickie, J.W, *Reeds: 21st Century Ship Management*, Bloomsbury, London (2014).

Di Vaio, A., Varriale, L., Lekakou, M., & Stefanidaki, E., *Cruise and container shipping companies: A comparative analysis of sustainable development goals through environmental sustainability disclosure,* Maritime Policy & Management, 48(2) (2021) 184-212. https://doi.org/10.1080/03088839.2020.1754480.

Goulielmos, A. M., Giziakis, K. V., & Pallari, B., *Advantages and disadvantages of managing own ships by a third party ship management company: an empirical investigation*, International Journal of Shipping and Transport Logistics, 3(2) (2011) 126-150. https://doi.org/10.1504/IJSTL.2011.039375.

Hsu, W. K., Huang, S. H. S., Tseng, W. J., & Li, D. F., *An assessment of the policy gap in port selection of liner shipping companies,* Transportation Letters, 13(4) (2021) 273-281. https://doi.org/10.1080/19427867.2020.1724648.

Jahn, I.C. and Bussow, T., *Best practice ship management: study* (2013), http://www.cml.fraunhofer.de/content/dam/cml/-de/documents/Studien/Best-practice-Studie-2013.pdf. Accessed 12 Dec 2023.

Jeon, J. W., Yeo, G. T., Thai, V. V., & Yip, T. L., *An evaluation of the success factors for ship management companies using fuzzy evaluation method*. International Journal of Shipping and Transport Logistics, 8(4) (2016) 389-405. https://doi.org/10-.1504/IJSTL.2016.077307.

Jiang, H., Xia, J., Devers, C. E., & Shen, W., *Who will board a sinking ship? A firm–director interdependence perspective*

of mutual selection between declining firms and director candidates, Academy of Management Journal, 64(3) (2021) 901-925. https://doi.org/10.5465/amj.2018.0452.

Kim, H. D., Ryoo, D. K., & Kim, K. H., *Growth & Selection Criteria of Ship Management Firms and Its Implications*, In Proceedings of the Korea Port Economic Association Conference (2016), 277-290.

Leung, L. C., & Cao, D., *On consistency and ranking of alternatives in fuzzy AHP*, European journal of operational research, 124(1) (2000) 102-113. https://doi.org/10.1016/S0377-2217(99)00118-6.

Mitroussi, K., *Ship management: contemporary developments and implications*, The Asian Journal of Shipping and Logistics, 29 (2) (2013) 229-248. https://doi.org/10.1016/j.ajsl.2013.08.006.

Mitroussi, K., *The ship owners' stance on third party ship management: an empirical study*, Maritime Policy & Management, 31(1) (2004) 31-45.

Panayides, P. M., & Cullinane, K. P., *The vertical disintegration of ship management: choice criteria for third party selection and evaluation*, Maritime Policy & Management, 29(1) (2002) 45-64. https://doi.org/10.1080/03088830110057844.

Panayides, P.M. (2003), *Competitive strategies and organizational performance in ship management,* Maritime Policy & Management, 30 (2) (2003) 123-140. https://doi.org/10.1080/0308832000084850.

Papandreou, A., Koundouri, P., & Papadaki, L., *Sustainable shipping: levers of change* (pp. 153-171). Springer International Publishing (2021).

Poulsen, R. T., & Sornn-Friese, H., *Achieving energy efficient ship operations under third party management: How do ship management models influence energy efficiency?*. Research in transportation business & management, 17 (2015) 41-52. https://doi.org/10.1016/j.rtbm.2015.10.001.

Riadi, A., & Mudaffa, F., *Evaluation of determinant factors influencing the selection of ship management companies*, TransNav, International Journal on Marine Navigation and Safety od Sea Transportation, 16(4) (2022) 711-716. http://dx.doi.org/10.12716/1001.16.04.12.

Sener, Z., & Ozturk, E., *A QFD-based decision model for ship selection in maritime transportation. International Journal of Innovation*, Management and Technology, 6(3) (2015) 202.

Seo, Y. J., Ha, M. H., Yang, Z., & Bhattacharya, S., *The ship management firm selection: the case of South Korea*, The Asian Journal of Shipping and Logistics, 34(3) (2018) 256-265. https://doi.org/10.1016/j.ajsl.2018.09.008.

Stalmokaitė, I., & Hassler, B., *Dynamic capabilities and strategic reorientation towards decarbonisation in Baltic Sea shipping*, Environmental Innovation and Societal Transitions, 37 (2020) 187-202. https://doi.org/10.1016/j.eist.2020.09.002.

Tran, T. M. T., Yuen, K. F., Li, K. X., Balci, G., & Ma, F., *A theory-driven identification and ranking of the critical success factors of sustainable shipping management*, Journal of Cleaner Production, 243 (2020) 118401. https://doi.org/10.1016/j.jclepro.2019.118401.

Vejvar, M., Lai, K. H., & Lo, C. K., *A citation network analysis of sustainability development in liner shipping management: A review of the literature and policy implications*, Maritime Policy & Management, 47(1) (2020) 1-26. https://doi.org/10.1080/03088839.2019.1657971.

Wang, Y. M., Luo, Y., & Hua, Z., O*n the extent analysis method for fuzzy AHP and its applications,* European journal of operational research, 186(2) (2008) 735-747. https://doi.org/10-.1016/j.ejor.2007.01.050.

Yan, R., Wang, S., & Peng, C., *Ship selection in port state control: status and perspectives,* Maritime Policy & Management, 49(4) (2022) 600-615. https://doi.org/10.1080/0308883-9.2021.1889067.

Zhang, P., & Tang, L., *Ship Management: Theory and Practice. Routledge*, (2021).