SEAFARER SELECTION FOR SUSTAINABLE SHIPPING: CASE STUDY FOR TURKEY

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SUMMARY

Sustainability and safety in the maritime sector mostly depend on the seafarers who ensure the safe and secure operation of ships. The selection of the ship's personnel is based on many criteria and is dictated by the seafarer's qualifications and the type of ship. The present study identifies 24 selection criteria in the form of personal, professional, physical, and technical competencies, categorized under four main headings, and calculates the weights of these criteria in terms of their importance. Then, the general seafarer criteria and the different criteria required by different types of companies are presented, and finally, a model is developed that can serve as a guide in the selection of seafarers, depending on the ship type. Step-Wise Weight Assessment Ratio Analysis (SWARA) and Additive Ratio Assessment (ARAS) are the multi-criteria decision-making methods used in this study.

KEYWORDS

Seafarer, Shipping, Turkey, SWARA, ARAS

NOMENCLATURE

AHP	The Analytic Hierarchy Process
ARAS	Additive Ratio Assessment
CDI	Chemical Distribution Institute
EDAS	Evaluation Based on Distance from Average Solution
DWT	Deadweight
FANP	Fuzzy Analytical Network Process
GHFPWA	Generalized Hesitant Fuzzy Prioritized Weighted Average
GRA	Grey Relational Analysis
HR	Human Resource
IFWA	Intuitionistic Fuzzy Weighted Averaging
INTERTANKO	International Association of Independent Tanker Owners
KM	Karnik-Mendel
MCDM	Multi-Criteria Decision-Making
MOC	Major Oil Companies
PSC	Port State Control
SIRE	The Ship Inspection Report Programme
STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarer
SWARA	Step-Wise Weight Assessment Ratio Analysis
TOPSIS	The Technique for Order of Preference by Similarity to Ideal Solution
UNCTAD	United Nations Conference on Trade and Development

1. INTRODUCTION

With increasing competition brought on by globalization, personnel selection has become the prominent process in human resource (HR) management, playing a critical role in the success of an organization, regardless of the sector or business activity (Balezentis et al., 2012; Dahooie et al., 2018; Zhang and Liu, 2011). Personnel selection necessitates the identification of the knowledge, skills, and experience required for the position, the identification of potential candidates, and the selection of suitable personnel from the pool of candidates (Yalcın and Yapıcı Pehlivan, 2019). Personnel selection should not be based solely on experience but should be conducted using various criteria by multiple people, making different evaluations (Dahooie et al., 2018).

Multiple problems can be encountered in this process. One such problem is that different criteria with different measurement units are considered simultaneously, and there are no solutions that meet all of the criteria equally (Opricovic and Tzeng, 2004). Another problem is that some criteria, such as self-confidence and sociability, are difficult to quantify (Liang and Wang, 1994). The first step in the hiring process is to identify the criteria to be used in the evaluations and assign accurate weights to their levels of importance. Failure to assign accurate weights to these criteria can decrease the efficiency of an organization (Lin, 2010). As the development and sustainability of a business depend on the qualifications of its personnel, the selection of highly qualified personnel who can deal with the full range of contemporary business challenges is a significant factor in all businesses (Karabasevic et al., 2016b).

Notably, the maritime sector accounts for approximately 90% of global trade (Coraddu et al., 2019). Furthermore, seafaring is not only labour-intensive but it is one of the most dangerous occupations in the world (UNCTAD, 2018). Seafarers cannot leave the ship, rarely communicate with their families, and have limited access to healthcare (Yildirim et al., 2022). Since the human element plays such a key role in seafaring, which is incomparable with other occupations, personnel selection and training are more crucial in the maritime sector (Davy and Noh, 2011). To compete in the harsh conditions of the maritime sector, a business must possess market intelligence, be efficient, plan well, and have a strong vision and organizational culture (Koutra et al., 2017), while also attributing value to its employees. What separates maritime businesses from other businesses is that the workplace is a ship, which is always on the move and generally isolated. Seafarers are physically distant from the central offices of the business and the employer, which creates unique management challenges, and in turn, makes HR management even more essential (Muslu, 2008).

The skills of ship personnel are critical for the commercial sustainability and competitiveness of a maritime business (Çelik, 2014). As such, the present study has two aims: to identify the general profile of a desired seafarer, as well as the specific seafarer profiles sought by different types of companies/ships; and to propose a decision-making model that companies can customize and use for hiring by selecting the desired criteria according to their organizational culture and ship types.

In the first stage of the study, the seafarer selection criteria applied by maritime businesses were identified based on a literature review and interviews with the HR managers of ten Turkish maritime companies. In the second stage of the study, the criteria were weighted according to their importance, with a total of 15 HR managers from six dry cargoes, five tankers, and four container companies, all employing Turkish seafarers. The ship number and deadweight (DWT) capacity of the companies are listed in Table 1.

In the third stage, general seafarer criteria were collected, along with the differences between the seafarer criteria sought by different types of companies. In stage four of the study, a model was presented for the selection of the best seafarers for different ship types using the weighted criteria to score candidates who made applications to HR departments. A hybrid model was developed using step-wise weight assessment ratio analysis (SWARA) and additive ratio assessment (ARAS) to perform multi-criteria decision-making (MCDM). This research only included the seafarers (ship's personnel) who are defined as masters, officers, and radio operators, or who have ratings according to the STCW Convention Chapter I Regulation 1/1.

Table 1: Fleet details of companies participating to the study

No	Fleet	Number of Ships	DWT Capacity (MT)
1	Dry Cargos	6	347.024
2	Dry Cargos	4	228.000
3	Dry Cargos	8	289.500
4	Dry Cargos	4	205.292
5	Dry Cargos	15	903.201
6	Dry Cargos	7	432.873
7	Tanker	12	65.222
8	Tanker	12	102.756
9	Tanker	14	542.879
10	Tanker	5	41.529
11	Tanker	2	9.709
12	Container	26	653.174
13	Container	7	86.749
14	Container	16	610.618
15	Container	8	214.727
	Total	146	4.733.253

2. LITERATURE REVIEW

Reports have shown that, generally, personnel selection includes psychometric tests, cognitive tests, personality tests, IQ tests, competency tests, tests of professional knowledge, and verbal interviews (Morgeson et al., 2007). Having candidates take written and verbal tests is critical for hiring the appropriate personnel but is not sufficient on its own (Lin, 2010). Identifying criteria that can serve as the basis for the measurement and evaluation of a candidate, as well as the weights associated with individual criteria, is a prerequisite in personnel selection because individual criteria have different levels of importance. Accordingly, methods that do not make use of specific criteria and their associated weights result in greater subjectivity (Arvey and Campion, 1982).

Muslu (2008) studied HR management and labour relations in maritime businesses that carry cargo or passengers and identified a lack of qualified seafarers aboard ships, which was attributed to the businesses not paying sufficient attention to HR. Çelik et al. (2009) applied a fuzzy analytical network process to ship master planning in the maritime sector and identified four main criteria used in ship master planning: professional knowledge, professional discipline and responsibility, leadership and coaching, and personality traits. Zhang and Liu (2011) developed a method for personnel selection, proposing an intuitive fuzzy MCDM approach. To ensure that the expert views accurately represented reality, they incorporated an intuitionistic fuzzy weighted averaging operator in their method, in which personnel selection criteria identified by HR were assigned weights based on company requirements. Yu et al. (2013) developed an approach based on a generalized hesitant fuzzy prioritized weighted average and generalized hesitant fuzzy prioritized weighted geometric operators that can meet the HR needs of companies, owing to the ability of the hesitant fuzzy group decision-making method to prioritize criteria.

Çelik (2014) carried out a study of Turkish seafarers in support of HR planning in the maritime sector and estimated the long-term supply and demand trends, concerning unlimited officers of the watch, which showed that, in the expected likely scenario, there will be a deficit in the supply of unlimited officers of the watch in the long term and a surplus in the supply of unlimited chief officers and unlimited masters. Several solutions were proposed based on the estimated supply and demand curves, including improvements of the infrastructure for existing training institutions and organizations instead of increasing their numbers, encouraging officers to pursue graduate studies to increase the number of qualified seafaring trainers, and implementing social policies designed to prevent early retirement among the qualified labour force.

Sang et al. (2015) used a fuzzy logic method based on the Karnik–Mendel algorithm to calculate proximity coefficients for different criteria. Karabasevic et al. (2016c) created a system to support personnel selection based on SWARA and ARAS methods under uncertain conditions. The efficiency and feasibility of the proposed method were examined through a case involving the selection of candidates for a sales manager position. The identified criteria for sales manager positions were work experience, proactivity and general ability, organizational and analytical skills, education level, communication and problem-solving skills, and computer skills, in this order. Qin et al. (2016) examined MCDM problems based on Frank triangular norms for hesitant fuzzy information and used an application involving HR selection to demonstrate the decision steps of the proposed method. They applied the method, which involves also expert opinions, to a personnel selection problem, and found it to produce effective results that were perfectly aligned with the requirements of the HR department.

Turskis et al. (2017) developed a hybrid model combining an analytical hierarchical process, expert views, and ARAS-based methods and applied it to the selection of a director for an estate and economy office to minimize uncertainty in personnel selection data. The set of main criteria for the personnel selection problem was identified as work experience in a similar position, being motivated to work in the position, leadership skills, sociability, teamwork, the qualifications required by the job, and the valid certificates held.

Kamble and Parveen (2018) applied different fuzzy methods to a personnel selection problem for the faculty of engineering, based on the criteria of competency, years of experience, monthly salary, ability to teach different subjects, research activity, and technical and communication skills, in decreasing order of importance. Elidolu et al. (2020) used the fuzzy analytical hierarchy process and considered the selection of seafarers to work on tanker ships as a case study. The criteria for each of the captain, chief officer, junior officer, and cadet positions were determined, compared, and weighted separately.

A literature review of the personnel and seafarer selection is summarized in Table 2. There have been few studies with a focus on seafarer selection.

Table 2: Literature on personnel and seafarer selection

No	Subject	Author(s)
1	Personnel selection	Morgeson et al., 2007
2	Personnel Selection	Lin, 2010
3	Personnel interview	Arvey and Campion, 1982
4	Human resources management	Muslu, 2008
5	Ship master selection	Çelik et al., 2009
6	Personnel selection	Zhang and Liu, 2011
7	Personnel evaluation	Yu et al., 2013
8	Human resource planning	Çelik, 2014
9	Personnel selection	Sang et al., 2015
10	Personnel selection	Karabasevic et al., 2016a
11	Personnel selection	Karabasevic et al., 2016b
12	Personnel Assessment	Turskis et al., 2017
13	Staff selection	Kamble and Parveen, 2018
14	Personnel assessment	Capaldo and Zollo, 2001
15	Personnel selection	Dağdeviren, 2007
16	Personnel evaluation and selection	Chen et al., 2009
17	Personnel selection	Kelemenis and Askouris 2010
18	Project manager selection	Dodangeh et al. 2014
19	Public relations personnel selection	Chang, 2015
20	Seafarer selection	Elidolu et al., 2020

3. STEP-WISE WEIGHT ASSESSMENT RATIO ANALYSIS (SWARA) METHOD

The defining feature of the SWARA method, first proposed by Kersuliene, Zavadskas, and Turskis (2010), is its ability to estimate expert views regarding the significance ratios of the criteria at the stage in which the criteria are assigned weights. The method can be considered important in terms of its collection and organization of information from experts (Aghdaie et al., 2013). The method can directly support decision-making based on different criteria and their priorities, and it is suitable for situations in which the criteria weights are known beforehand (Zolfani et al., 2015). A literature review of the SWARA method is summarized in Table 3.

Table 3: Literature on the SWARA method

No	Subject	Author(s)
1	Conflict resolution	Keršulienė et al., 2010
2	Architect selection	Keršulienė and Turskis, 2011
3	Selection of mechanical parts	Aghdaie et al., 2013
4	Indicators used to evaluate energy sustainability	Zolfani and Saparauskas, 2013
5	Personnel selection	Zolfani and Banihashemi, 2014
6	Selection of the optimum mechanical ventilation approach	Zolfani et al., 2013
7	Selection of locations for the establishment of solar energy plants	Vafaeipour et al., 2014
8	Evaluation of regional hazards	Dehnavi et al., 2015
9	Selection of packaging design	Stanujkic et al., 2015
10	Selection of mining engineer candidates	Karabasevic et al., 2015
11	Selection of businesses on the basis of their levels of social responsibility	Karabasevic et al., 2016a
12	Personnel selections	Karabasevic et al., 2016b
13	Evaluation of house plan shapes	Juodagalvienė, et al., 2017
14	Optimization of engine operating parameters	Balki et al., 2020
15	Determining the problems caused by empty container shortage in the COVID-19 Era	Toygar et al., 2022

In the SWARA method, weights are assigned in six steps:

Step 1. First, the criteria for the problem should be identified, and the decision-making committee, comprising the decision-makers who will participate in the selection process, should be created. It is assumed that the problem has n criteria, and the decision committee has k decision-making members.

Step 2. In this step, all of the decision-making members evaluate the criteria based on their knowledge and experience. Following this evaluation, the decision-makers are asked to rank the individual criteria from the most to least important.

Step 3. Next, each decision-maker identifies the relative importance of the criteria. Decision-makers assign a score of 1 to the most important criterion, and the other criteria are assigned scores between 0 and 1. The decision-makers compare the j^{th} criterion with the previous criterion $(j-1)$ to produce a ratio known as the comparative significance of the mean value, denoted as S_j.

Step 4. For each criterion, a coefficient (k_j) is calculated, as shown in Equation 1. In ranking the criteria, the k_j coefficient of the most important criterion is expressed as:

$$X = \begin{bmatrix} x_{01} & \cdots & x_{0j} & \cdots & x_{0n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{i1} & \cdots & x_{ij} & \cdots & x_{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mj} & \cdots & x_{mn} \end{bmatrix}; \quad (4)$$

$$i = 0,1,\ldots,m \qquad j = 0,1\ldots,n$$

$$k_j = \begin{cases} 1 & if \quad j = 1 \\ S_j + 1 & if \quad j > 1 \end{cases} \quad (1)$$

Step 5. Weights (w_j) are calculated for each criterion using Equation 2. The w_j coefficient of the most important criterion is 1.

$$w_j = \begin{cases} 1 & if \quad j = 1 \\ \dfrac{w_{j-1}}{k_j} & if \quad j > 1 \end{cases} \quad (2)$$

Step 6. The individual criterion weights (w_j) are divided by the sum of the criterion weights to calculate the final weight (q_j) of each criterion.

$$q_j = \frac{w_j}{\sum w_j} \quad (3)$$

Reducing the criterion weights assigned by individual decision-makers into a single value necessitates integration, which is achieved by calculating the arithmetic means of the criterion weights assigned by the individual decision-makers to the relevant criterion, thus obtaining final the criterion weights.

4. ADDITIVE RATIO ASSESSMENT (ARAS) METHOD

Turskis and Zavadskas (2010) proposed the ARAS method to address the resolution of MCDM problems. ARAS can be modelled in integration with fuzzy logic and gray system theory. The classical approach in decision analysis and MCDM methods focuses on subjective classifications (ranking). Existing MCDM approaches in the literature account for the relative distances from the ideal positive or ideal negative solutions or compare the utility function values of existing solutions with the value of ideal positive alternative solutions. Moreover, in the ARAS method, the utility function values of the alternatives being studied are compared with the utility function value of the optimal alternative added to the decision problem by the researcher. For example, in a decision problem with an optimal score of 100, in which all alternatives are lower than this value and the highest score is 80, the ratio of the best alternative for this criterion is taken to be 80 percent (0.80), instead of the 100 percent (1) that would be assumed in existing methods (Sliogeriene et al., 2013). The ARAS method comprises four steps (Zavadkas et al., 2010).

Step 1. Creating a Decision Matrix

As is the case with all MCDM methods, the first step in the ARAS method, after identifying the alternatives in the decision problem and the criteria to be used to assess the alternatives, is to create a decision matrix that shows the scores of the different alternatives for each criterion. Unlike typical MCDM methods, the initial decision matrix in the ARAS method presents a row of optimal solutions. X decision matrix can be expressed as:

Where *m* denotes the number of alternatives, and *n* denotes the number of criteria. In the decision matrix, x_{ij} denotes the performance value of the i^{th} alternative for the j^{th} criterion, and x_{0j} denotes the optimal value for the criterion.

In the decision problem, if the optimal value for the criterion is unknown, then the optimal value is calculated using Equation 5 or Equation 6, depending on whether the criterion is a cost or a benefit.
If it is a benefit:

$$x_{0j} = \max_i x_{ij} \quad (5)$$

If it is a cost:

$$x_{0j} = \min_i x_{ij} \quad (6)$$

Step 2. Creating a Normalized Decision Matrix

Given that criterion performance values used in the decision problem can have different units and different scales, it is necessary to transform the performance values into a common unit to create a comparable series. This transformation, which also allows for the use of smaller ranges when criterion performance values vary over a wide range, is referred to as normalization (Yıldırım, 2014).

In the ARAS method, the normalized decision matrix $\overline{X}$ consists of $\overline{x}_{ij}$ values that are calculated in two different ways depending on whether or not the criterion in question is a cost or a benefit. If higher criterion performance values are advantageous (i.e., considered a benefit), normalized values are calculated using Equation 7.

$$\overline{x}_{ij} = \frac{x_{ij}}{\sum_{i=0}^{m} x_{ij}} \quad (7)$$

However, if lower criterion performance values are more desirable (i.e., considered a cost), normalization is achieved in two stages. In the first stage, the performance values are transformed into benefits using Equation 8, and in the second stage, Equation 9 is used to calculate the normalized values.

$$x_{ij}^{*} = \frac{1}{x_{ij}} \quad (8)$$

$$\overline{x}_{ij} = \frac{x_{ij}^{*}}{\sum_{i=0}^{m} x_{ij}^{*}} \quad (9)$$

After calculating the normalized values, the normalized decision matrix $\overline{X}$ is obtained by arranging these values into the form of a matrix, as shown Equation 10.

$$= ; \qquad i = 0,1,\ldots,m \qquad j = 0,1\ldots,n \quad (10)$$

Step 3. Creating the Weighted Normalized Decision Matrix

After obtaining the normalized decision matrix, the weighted normalized decision matrix $\hat{X}$ is created using either MCDM methods to calculate the criterion weights based on expert views, or w_j criteria significance levels (weights), identified subjectively by the decision-makers. The criterion weights meet the condition $0 < w_j < 1$, and the sum of the weights is limited, as shown in Equation 11.

$$\sum_{j=1}^{n} w_j = 1 \quad (11)$$

Equation 12 is used to obtain $\hat{x}_{ij}$-weighted normalized values on the basis of normalized values.

$$\hat{x}_{ij} = \overline{x}_{ij} \cdot w_{ij} \quad (12)$$

The weighted normalized values $\hat{x}_{ij}$ are written in the form of a matrix, as shown in Equation 13, to obtain the weighted normalized decision matrix $\hat{X}$.

$$\hat{x}_{ij} = \begin{bmatrix} \hat{x}_{01} & \cdots & \hat{x}_{0j} & \cdots & \hat{x}_{0n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \hat{x}_{i1} & \cdots & \hat{x}_{ij} & \cdots & \hat{x}_{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \hat{x}_{m1} & \cdots & \hat{x}_{mj} & \cdots & \hat{x}_{mn} \end{bmatrix} \quad (13)$$

$$i = 0,1,\ldots,m \qquad j = 0,1\ldots,n$$

Step 4. Calculating Optimal Function Values

In the final step of the ARAS method, the alternatives are assessed by calculating the optimal function values of all alternatives. The scores for the alternatives are obtained using Equation 14, where S_i denotes the optimal function value of the i^{th} alternative.

$$S_i = \sum_{j=1}^{n} \hat{x}_{ij} \; i = 0,1,\ldots,m \tag{14}$$

Values higher than the calculated S_i value indicate efficient alternatives. Using Equation 15, the S_i values of the alternatives are divided by optimal function value S_0 to obtain K_i utilities

$$K_i = \frac{S_i}{S_0} i = 0,1,\ldots,m \tag{15}$$

K_i ratios, which vary between 0 and 1, can be used to calculate the relative efficiency of the utility function values of the alternatives, which are then evaluated by ranking the values in decreasing order.

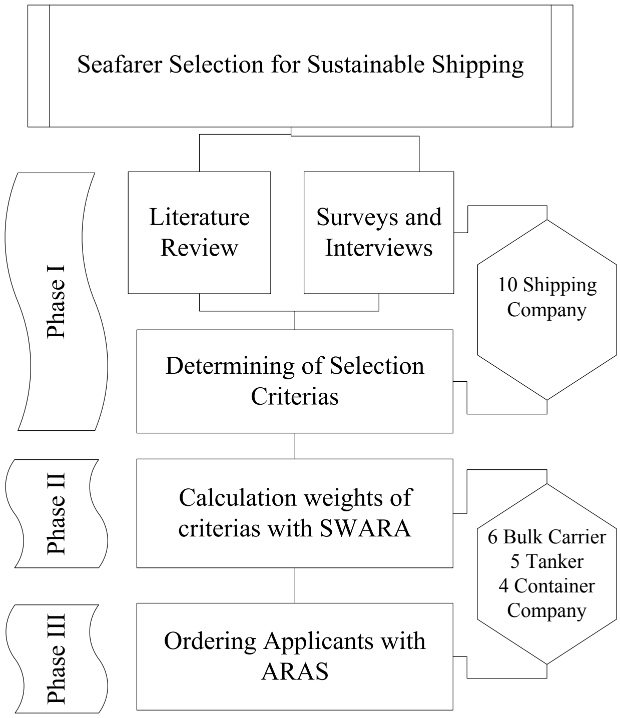

Figure 1. Flowchart of the study

5. APPLICATION

The efficiency of a maritime business is proportional to the efficiency of the ships it operates, and the efficient and safe operation of a ship, in turn, depends on the selection and hiring of the seafarers. The present study presents a model to guide the selection of seafarers in the maritime sector.

In the first stage of the study, seafarer selection criteria were identified through a literature review and by performing surveys and interviews with the HR managers of ten Turkish maritime companies.

In the second stage, weights were assigned to the seafarer selection criteria for three different sectors. The criterion weights for seafarer selection were calculated using the SWARA method based on the views of six dry cargoes, five tankers, and four container shipping companies. In the third and final stage of the study, five different seafarers were assessed based on the identified criteria for three different sectors, with scores varying between 10 and 100, and the candidates were ranked using the ARAS method.

5.1 MAIN CRITERIA AND SUB-CRITERIA FOR THE SELECTION OF SEAFARERS

According to the literature review, surveys, and interviews, four main criteria were identified for the selection of seafarers: personal competency, professional competency, physical competency, and technical competency, and these main criteria, in turn, are made up of sub-criteria. Table 4 summarizes the criteria

6. RESULTS

Table 5 presents a sample calculation table for Expert 1, based on the opinions of respondents working in the HR departments of six Turkish bulk carrier companies, garnered through a survey. Expert 1 for the bulk industry is just an example calculation. At the same time, considering the opinions of a higher number of companies can enable more accurate criterion weighting. The criterion weights of the HR managers at the bulk carriers were chosen because six of the fifteen companies participating in the research were bulk carriers. To express the common views of these companies, the arithmetic means of the criterion weights were calculated. The mean weights for all sub-criteria are reported in Table 6. To make the study clearer and avoid an unnecessary increase in the number of tables, criteria weight calculation tables for tanker and container companies are not given here.

The mean weights of the main criteria for selecting seafarers for the bulk carrier industry were 0.3194 for personal competency, 0.2979 for professional competency, 0.1959 for physical competency, and 0.1800 for technical competency.

The criterion weights for the three different types of companies, calculated based on the survey responses, are reported in Table 7, along with the ranking of these criteria by weight. The most important main criterion was professional competency in the container and tanker companies and personal competency in the bulk carrier firms. The least important main criterion was physical competency for the container and tankers and technical competency in the bulk carrier companies.

In the following stage, five different candidates with qualifications as an officer of the watch were scored by three different HR departments from each sub-sector using the criterion weights obtained following the steps of the SWARA weighting method. A decision-making matrix must be created using the ARAS method to evaluate the existing alternatives, for which the candidates were assigned scores varying between 10 and 100 based on the identified criteria. As the candidates were scored by three different experts from each sector, the final scores were calculated as the arithmetic means. Table 8 is a sample decision matrix for the bulk carrier, based on these final scores. Table 9 shows the final rankings of the candidates, calculated separately for each sector using the ARAS method.

Looking at the final rankings for each sector, Candidate 5 was the top candidate for the tankers and was close to being the top candidate in the rankings for the other companies. The top candidate for the tanker sub-sector was close to the top candidates for the other sub-sectors, probably because the tanker sub-sector is strictly supervised by the Ship Inspection Report Programme (SIRE), the Chemical Distribution Institute (CDI), major oil companies and Port State Controls (PSCs). Furthermore, cargo may be dangerous and damaging to the environment. Thus, loading and unloading must be strictly supervised. Strict time management is required, and seafarers must have high psychological and physical resilience to cope with a fast-paced working environment. Finally, the industry has a culture of safety because of the risks associated with general operations and various cargo.

Considering the contributions of the present study to the literature, HR departments can customize the model through the addition of new criteria, depending on their needs and requirements, or can change the weights of the existing criteria. By enabling the calculation of criterion weights and the creation of seafarer rankings by different companies, the model can help HR departments to identify and hire seafarers best suited to their needs.

Table 4: Explanations of criteria

Personal Competency	
Communication Skill	Lack of communication has been identified as the cause of a large number of incidents or accidents in finance, healthcare, seafaring, and other fields (Jelphs, 2006; Yıldırım et al., 2019).
Professional Behaviour	Professional behaviour refers to the maintenance of work-life balance, ensuring emotions are kept under control so that one's private life and personal feelings do not affect one's professional life.
Analytical Thinking	Analytical thinking refers, in general terms, to dividing a problem into its constituent parts, making sense of these parts, being able to explain the operation of a system, the causes of things or the steps in resolving a problem, comparing two or more situations, and evaluating and criticizing the attributes of things (Sternberg, 2002; Sternberg, 2006).
Time management	Time management refers to the ability of an individual to prioritize, plan, and manage their responsibilities (Seaward, 2002).
Stress Resistance	The stress level of seafarers may be higher than other occupational groups because of the harsh working conditions (Kınalı vd., 2022). Psychological resilience is viewed as the ability of an individual to deal with and overcome obstacles, uncertainties, and other negative situations (Luthans et al., 2006).
Teamwork	Teamwork refers to an entire work environment in which all members of the team work together toward common goals, for which an atmosphere is created that motivates team members and directs their active efforts (İnce et al., 2004).
Initiative	The initiative is a business behaviour that consists of the dimensions of enterprise, foresight, and overcoming obstacles to achieve an objective.
Work Engagement	In the literature, work engagement is defined in terms of the working roles of first-time employees in an organization. According to Maslach and Leither (2008), work engagement increases the sense of professional competency in an employee and encourages dynamic participation when carrying out personal tasks.
Self- Management	Self-management refers to the ability to make the best use of time and skills to achieve specific objectives (Timm, 1993).
Professional Competence	
Period of Service	The period of service is a key seafarer competency (Regulation for Seafarers and Marine Pilots, 2018) and one of the main elements sought in job applications (Winchester, 2005).
Tonnage Experience	The interviews conducted with HR managers showed that tonnage experience is generally paid attention to, but it is especially critical in the appointments of the masters and chief officers.
Vessel Type Experience & Experience at Every Rank Level	INTERTANKO launched an officer matrix system in 2008 to meet the demands of major oil companies (Lloyd's List, 2008). Matrix calculations mainly account for years with the operator and the time at rank, as well as the time aboard a specific tanker type, the time aboard tankers in general, and the time before re-joining the ship.

Inspection Experience	Inspection experience and performance values of seafarers are important qualities that are highly sought after by tanker operators (Fışkın and Zorba, 2015).
References	A reference check is an information-gathering process that human resources managers of maritime companies utilize frequently during personnel selection (Interview with HR Departments, 2020).
Retention	Retention refers to the ability of a company to retain its employees, or the work return rate of seafarers employed by the company.
Commitment to contract time	Non-commitment to contract time results in losses of time and money for the HR organization and creates labour shortages.
Physical Competence	
Personal Image	Personal image refers to attempts to control or influence the opinions of others or one's impressions of oneself through acquired skills, messages given, differences made, and value added in one's self, work, and relationships (Zaidman and Dory, 2001).
Health	During a voyage, the work and living space of seafarers are disconnected and isolated from the shore, therefore overall health is important in carrying out their duties.
Physical Resilience	STCW Code Section A-I/9 on health standards requires seafarers to have the physical capacity to meet the relevant basic training requirements, and avoid health conditions that could worsen as a result of working at sea (STCW Code, 2010).
Technical Competence	
English skills	A lack of English skills may result in miscommunication, which is a major cause of marine accidents and endangers life and safety at sea (Ahmmed et al., 2020).
Safety Culture	A culture of safety refers to the shared attitudes, values, beliefs, and practices related to safety (Glendon and Stanton, 2000).
Knowledge Level of Maritime	Seafarers must have comprehensive knowledge related to technical definitions, maritime transportation rules, regulations, and standards (Yıldırım et al., 2017).
Information Technology Knowledge	Information and communication technology literacy can be defined as the ability to use digital technologies and communication tools and networks to access, manage, integrate, and evaluate existing information and create new information that allows one to function (serve, perform tasks, work) in the information age (Panel, 2002). Encouraging seafarers to adapt and utilize advanced technological equipment is important (Uğurlu et al., 2015).

Table 5: Criterion Weights for Expert 1 from the Human Resources Department of a Bulk Carrier

Bulk Carrier Human Resources Department Expert 1							
Main Criteria	**Queue**	**Adjusted Criteria Ranking**	***Sj***	***Kj***	***Qj***	***Wj***	
Personal Competence	1	Personal Competence	-----	1	1	0,33910	
Professional Competence	2	Professional Competence	0,15	1,15	0,86957	0,29487	
Physical Competence	3	Physical Competence	0,45	1,45	0,59970	0,20336	
Technical Competence	4	Technical Competence	0,25	1,25	0,47976	0,16268	
Sub-criteria of Personal Competence	**Queue**	**Adjusted Criteria Ranking**	***Sj***	***Kj***	***Qj***	***Wj***	**Final Weight**
Communication Skill	1	Communication Skill	-	1	1	0,22845	0,07747
Professional Behaviour	2	Professional Behaviour	0,45	1,45	0,68966	0,15755	0,05342
Analytical Thinking	7	Self- Management	0,15	1,15	0,59970	0,13700	0,04646
Time management	8	Team Work	0,25	1,25	0,47976	0,10960	0,03717
Stress Resistance	6	Work Engagement	0,15	1,15	0,41718	0,09530	0,03232
Team Work	4	Stress Resistance	0,15	1,15	0,36277	0,08287	0,02810
Initiative	9	Analytical Thinking	0,15	1,15	0,31545	0,07206	0,02444
Work Engagement	5	Time management	0,15	1,15	0,27430	0,06266	0,02125
Self- Management	3	Initiative	0,15	1,15	0,23853	0,05449	0,01848

Sub-criteria of Professional Competence	Queue	Adjusted Criteria Ranking	*Sj*	*Kj*	*Qj*	*Wj*	Final Weight
Period of Service	4	References	-	1	1	0,32811	0,09675
Tonnage Experience	6	Commitment to contract time	0,75	1,75	0,57143	0,18749	0,05529
Vessel Type Experience	5	Retention	0,25	1,25	0,45714	0,15000	0,04423
Experience at Every Rank Level	7	Period of Service	0,45	1,45	0,31527	0,10344	0,03050
Inspection Experience	8	Vessel Type Experience	0,35	1,35	0,23353	0,07663	0,02259
References	1	Tonnage Experience	0,15	1,15	0,20307	0,06663	0,01965
Retention	3	Experience at Every Rank Level	0,25	1,25	0,16246	0,05330	0,01572
Commitment to contract time	2	Inspection Experience	0,55	1,55	0,10481	0,03439	0,01014
Sub-criteria of Physical Competence	**Queue**	**Adjusted Criteria Ranking**	***Sj***	***Kj***	***Qj***	***Wj***	**Final Weight**
Physical Resilience	2	Health	--	1	1	0,43767	0,08900
Personal Image	3	Physical Resilience	0,25	1,25	0,8	0,35013	0,07120
Health	1	Personal Image	0,65	1,65	0,48485	0,21220	0,04315
Sub-criteria of Technical Competence	**Queue**	**Adjusted Criteria Ranking**	***Sj***	***Kj***	***Qj***	***Wj***	**Final Weight**
Knowledge Level of Maritime	2	Safety Culture	--	1	1	0,41476	0,06748
English skill	3	Knowledge Level of Maritime	0,75	1,75	0,57143	0,23701	0,03856
Information Technology Knowledge	4	English skill	0,15	1,15	0,49689	0,20609	0,03353
Safety Culture	1	Information Technology Knowledge	0,45	1,45	0,34269	0,14213	0,02312

Table 6: Mean Weights of the Criteria

Average Weights of the Criteria	
Main Criteria	**Weights**
Personal Competence	0,319468769
Professional Competence	0,297906163
Physical Competence	0,195952221
Technical Competence	0,180006242
Sub-criteria of Personal Competence	
Communication Skill	0,063689228
Professional Behaviour	0,051200262
Analytical Thinking	0,026098815
Time management	0,021044629
Stress Resistance	0,027826969
Team Work	0,033683858
Initiative	0,019172381
Work Engagement	0,031190311
Self- Management	0,040239134
Sub-criteria of Professional Competence	
Period of Service	0,030485596
Tonnage Experience	0,019259303
Vessel Type Experience	0,022587989
Experience at Every Rank Level	0,016083702

Inspection Experience	0,018250486
References	0,086309048
Retention	0,041128397
Commitment to contract time	0,048995986
Sub-criteria of Physical Competence	
Physical Resilience	0,069146165
Personal Image	0,046220105
Health	0,079029643
Sub-criteria of Technical Competence	
Knowledge Level of Maritime	0,044568188
English skill	0,037910562
Information Technology Knowledge	0,026983655
Safety Culture	0,068735541

Table 7: Criterion Weights and Rankings for all Industries

Main Criteria Weights			
Main Criteria	**Bulk**	**Container**	**Tanker**
Personal Competence	0,319468769	0,240722689	0,243687541
Professional Competence	0,297906163	0,331850255	0,330618172
Physical Competence	0,195952221	0,173077838	0,180949836
Technical Competence	0,180006242	0,249842262	0,211277312
Ranking of Main Criteria			
Main Criteria	**Bulk**	**Container**	**Tanker**
Personal Competence	1	3	2
Professional Competence	2	1	1
Physical Competence	3	4	4
Technical Competence	4	2	3
Sub-criteria Weights			
Sub-criteria of Personal Competence	**Bulk**	**Container**	**Tanker**
Communication Skill	0,063689228	0,020408677	0,031791238
Professional Behaviour	0,051200262	0,048937534	0,018113929
Analytical Thinking	0,026098815	0,018385512	0,019661097
Time management	0,021044629	0,017631879	0,011323387
Stress Resistance	0,027826969	0,014395369	0,021356406
Teamwork	0,033683858	0,039417566	0,048364965
Initiative	0,019172381	0,025942529	0,013890632
Work Engagement	0,031190311	0,024482219	0,024288606
Self- Management	0,040239134	0,01322125	0,023228469
Ranking of sub-criteria of Personal Competence			
Sub-criteria of Personal Competence	**Bulk**	**Container**	**Tanker**
Communication Skill	1	5	2
Professional Behaviour	2	1	7
Analytical Thinking	7	6	5
Time management	8	7	9
Stress Resistance	6	8	4
Teamwork	4	2	1

Initiative	9	4	8
Work Engagement	5	3	3
Self- Management	3	9	6
Sub-criteria Weights			
Sub-criteria of Professional Competence	**Bulk**	**Container**	**Tanker**
Period of Service	0,030485596	0,032308802	0,043119523
Tonnage Experience	0,019259303	0,023376055	0,015324578
Vessel Type Experience	0,022587989	0,072009092	0,0775431
Experience at Every Rank Level	0,016083702	0,026307586	0,018825453
Inspection Experience	0,018250486	0,032764176	0,031491149
References	0,086309048	0,058000943	0,028539938
Retention	0,041128397	0,024261948	0,046509406
Commitment to contract time	0,048995986	0,032015242	0,032056517
Sub-criteria Ranks			
Ranking of sub criteria of Professional Com.	**Bulk**	**Container**	**Tanker**
Period of Service	4	3	3
Tonnage Experience	7	8	8
Vessel Type Experience	6	1	1
Experience at Every Rank Level	8	6	7
Inspection Experience	5	4	4
References	1	2	5
Retention	3	7	2
Commitment to contract time	2	5	6
Sub-criteria Weights			
Sub-criteria of Physical Competence	**Bulk**	**Container**	**Tanker**
Physical Resilience	0,069146165	0,053059977	0,051561164
Personal Image	0,046220105	0,049132055	0,04662812
Health	0,079029643	0,070110287	0,079733906
Sub-criteria Ranks			
Ranking of sub-criteria of Physical C.	**Bulk**	**Container**	**Tanker**
Physical Resilience	2	2	2
Personal Image	3	3	3
Health	1	1	1
Sub-criteria Weights			
Sub-criteria of Technical Competence	**Bulk**	**Container**	**Tanker**
Knowledge Level of Maritime	0,044568188	0,068707432	0,057295723
English skill	0,037910562	0,05865687	0,052396688
Information Technology Knowledge	0,026983655	0,055863686	0,037145682
Safety Culture	0,068735541	0,064080905	0,060687467
Sub-criteria Ranks			
Ranking of sub-criteria of Technical C.	**Bulk**	**Container**	**Tanker**
Knowledge Level of Maritime	2	1	2
English skill	3	3	3
Information Technology Knowledge	4	4	4
Safety Culture	1	2	1

Table 8: Decision Matrix for the Bulk Carriers

Main Criteria	**Personal Competence**								
Weights	0,06369	0,0512	0,0261	0,02104	0,02783	0,03368	0,01917	0,03119	0,04024
Sub-Criteria	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8	SC9
Optimal Values	85,00	88,33	85,00	78,33	75,00	86,67	81,67	86,67	86,67
Candidate 1	85,00	81,67	85,00	78,33	68,33	86,67	81,67	86,67	86,67
Candidate 2	75,00	78,33	71,67	68,33	71,67	65,00	65,00	73,33	68,33
Candidate 3	65,00	65,00	63,33	70,00	65,00	60,00	68,33	78,33	55,00
Candidate 4	81,67	83,33	80,00	78,33	73,33	83,33	81,67	76,67	75,00
Candidate 5	83,33	88,33	76,67	73,33	75,00	76,67	80,00	85,00	80,00
Main Criteria	**Professional Competence**								
Weights	0,030486	0,019259	0,022588	0,016084	0,01825	0,086309	0,041128	0,048996	
Sub-Criteria	SC10	SC11	SC12	SC13	SC14	SC15	SC16	SC17	
Optimal Values	76,67	80,00	81,67	78,33	75,00	81,67	81,67	86,67	
Candidate 1	40,00	55,00	40,00	46,67	65,00	80,00	78,33	68,33	
Candidate 2	76,67	80,00	76,67	78,33	63,33	81,67	76,67	86,67	
Candidate 3	46,67	43,33	53,33	50,00	65,00	56,67	60,00	71,67	
Candidate 4	45,00	61,67	46,67	55,00	68,33	71,67	76,67	75,00	
Candidate 5	71,67	73,33	81,67	75,00	75,00	81,67	81,67	73,33	
Main Criteria	**Physical Competence**								
Weights	0,069146	0,04622	0,07903						
Sub-Criteria	SC18	SC19	SC20						
Optimal Values	65	65	67,5						
Candidate 1	65	65	67,5						
Candidate 2	57,5	55	63,75						
Candidate 3	41,25	47,5	48,75						
Candidate 4	58,75	55	53,75						
Candidate 5	42,5	57,5	51,25						
Main Criteria	**Technical Competence**								
Weights	0,044568	0,037911	0,026984	0,068736					
Sub-Criteria	SC21	SC22	SC23	SC24					
Optimal Values	61,25	67,50	63,75	66,25					
Candidate 1	61,25	67,50	63,75	65,00					
Candidate 2	52,50	52,50	47,50	55,00					
Candidate 3	43,75	52,50	53,75	63,75					
Candidate 4	51,25	53,75	56,25	62,50					
Candidate 5	53,75	60,00	45,00	66,25					

Table 9: Final Rankings of Candidates for Each Companies

Alternatives	Si	Ki	%Ki	Ranks
Bulk Final Ranks				
Alternatives	Si	Ki	%Ki	Ranks
Optimal Values	0,223587	---------	-----------	----------
Candidate 1	0,207881	0,929756	92,9756	1
Candidate 2	0,19923	0,891061	89,10613	3
Candidate 3	0,166648	0,745337	74,53375	5
Candidate 4	0,194139	0,868295	86,82952	4
Candidate 5	0,201942	0,903191	90,31909	2
Container Final Ranks				
Alternatives	Si	Ki	%Ki	Ranks
Optimal Values	0,22896	---------	-----------	----------
Candidate 1	0,21775	0,95105	95,1047	1
Candidate 2	0,13806	0,60298	60,2985	5
Candidate 3	0,17251	0,75347	75,3469	4
Candidate 4	0,20799	0,90843	90,843	2
Candidate 5	0,20717	0,90484	90,4843	3
Tanker Final Ranks				
Alternatives	Si	Ki	%Ki	Ranks
Optimal Values	0,24634	---------	-----------	----------
Candidate 1	0,1858	0,75424	75,4242	2
Candidate 2	0,14248	0,5784	57,8398	5
Candidate 3	0,14885	0,60426	60,4259	4
Candidate 4	0,17477	0,70946	70,9463	3
Candidate 5	0,23897	0,9701	97,01	1

7. CONCLUSION

Business development, sustainability, and customer satisfaction in the maritime sector rely on seafarers to ensure the safe and secure operation of ships. Selecting the right seafarers is critical for the success of several objectives: the on-time delivery of cargo without accidents or damage; carrying out voyages and cargo operations in accordance with good shipping practices and without endangering lives, cargo, or the environment; implementing planned maintenance and care; passing the port state controls and other inspections; and meeting other maritime requirements. From a literature review and expert opinions, the present study identified 24 criteria used for the selection of a ship's personnel, the weights of which vary from company to company. Given the multi-dimensional nature of the identified criteria, personnel selection should be carried out using MCDM techniques. To test the approach, five real candidates with qualifications as an officer of the watch were separately evaluated for employment on bulk carrier, container, and tanker vessels. A hybrid method combining SWARA and ARAS was used to identify the optimal candidates for each type of ship. The applied hybrid model, which involves separate calculations for each sub-sector based on their specific criteria, identified Candidate 1 as the optimal candidate for the bulk carrier and container sub-sectors, and Candidate 5 as the optimal candidate for the tanker sub-sector. The proposed model allows HR departments of maritime businesses to select personnel according to a scientific approach, identifying the appropriate hiring criteria and calculating the relevant criterion weights. Future studies should include more detailed models, as well as criteria based on the competencies for seafarer selection

7. REFERENCES

1. AGHDAIE, M. H., ZOLFANI, S. H. and ZAVADSKAS, E. K. (2013). *Decision making in machine tool selection: An integrated approach with SWARA and COPRAS-G methods*, Engineering Economics, Vol. 24, No. 1, pp. 5-17. [Journal publication]
2. AHMMED R., SINHA B. S., KHAN R. and ISLAM D. M. (2020). *A Need Analysis of Maritime English Language Skills for Bangladeshi Seafarers to Work Onboard Ships*, Marine Policy, Vol. 119, DOI: 10.1016/j.marpol.2020.104041 [Journal publication]

3. ARVEY, R.D. and CAMPION, J. E. (1982). *The employment interview: A summary and review of recent research*, Personnel Psychology, Vol. 35, No. 1, pp. 281-322.
[Journal publication]
4. BALEZENTIS, A., BALEZENTIS, T. and BRAUERS, W. K. (2012*). Personnel Selection Based on Computing with Words and Fuzzy MULTIMOORA*, Expert Systems with Applications, Vol. 39, No. 9, pp. 7961-7967.
[Journal publication]
5. BALKI, M K., ERDOĞAN, S., AYDIN, S. and SAYIN C. (2020). *The optimization of engine operating parameters via SWARA and ARAS hybrid method in a small SI engine using alternative fuels*, Journal of Cleaner Production, Vol. 258, pp. 1-12.
[Journal publication]
6. CAPALDO, G. and ZOLLO, G. (2001). *Applying Fuzzy Logic to Personnel Assessment: A Case Study*, The International Journal of Management Science, 29, pp. 585-597.
[Journal publication]
7. CHANG, KL. (2015). *The Use of a Hybrid MCDM Model for Public Relations Personnel Selection*, Informatica, Vol 26, No 3, pp. 389-406.
[Journal publication]
8. CHEN, C. T., HWANG, Y. C., HUNG, W. Z., (2009).*Applying multiple linguistic PROMETHEE method for personnel evaluation and selection*, EEM 2009 – IEEE International Conference on Industrial Engineering and Engineering Management. 10.1109/IEEM.2009.5373021.
[Journal publication]
9. CORADDU, A., ONETO, L., BALDI, F., CIPOLLINI, F., ATLAR, M. and SAVIO, S. (2019). *Data-Driven Ship Digital Twin for Estimating the Speed Loss Caused by The Marine Fouling*, Ocean Engineering, Vol. 186, https://doi.org/10.1016/j.oceaneng.2019.05.045
[Journal publication]
10. ÇELIK, B. (2014). *Human resource planning in maritime industry: A study on Turkish seafarers*. Published Master's Thesis, Dokuz Eylül University, İzmir, Turkey.
[Thesis]
11. ÇELIK, M., ER, I. D. and TOPCU, I. Y. (2009). *Computer-based systematic execution model on human resources management in maritime transportation industry: The case of master selection for embarking on board merchant ships*, Expert Systems with Applications, Vol. 36, No. 2, pp. 1048-1060.
[Journal publication]
12. DAGDEVIREN, M. (2007). *Personnel Selection with Fuzzy Analytical Hierarchy Process and an Application*, Journal of the Faculty of Engineering and Architecture of Gazi University, Vol 22, No 4, pp. 791-799.
[Journal publication]
13. DAVY, J. G. and NOH, C. K. (2011). *A Study on Educations Role in Establishing Strategies for Improving Safety at Sea*, The Asian Journal of Shipping and Logistics, Vol. 7, No. 3, pp. 483-499.
[Journal publication]
14. DEHNAVI, A., AGHDAM, I. N., PRADHAN, B. and VARZANDEH, M. H. (2015). *A new Hybrid Model Using Step-Wise Weight Assessment Ratio Analysis (SWARA) Technique and Adaptive Neuro-Fuzzy Inference System (ANFIS) for Regional Landslide Hazard Assessment in Iran*, Catena, Vol. 135, pp. 122–148.
[Journal publication]
15. DODANGEH, J., SOROOSHIAN, S. and AFSHARI, A.R. (2014). *Linguistic Extension for Group Multicriteria Project Manager Selection*, Journal of Applied Mathematics, Vol 8, No 10, pp. 1-8.
[Journal publication]
16. ELIDOLU, G., UYANIK T. and ARSLANOĞLU, Y. (2020). *Seafarer personnel selection with Fuzzy AHP*, 5th International Mediterranean Science and Engineering Congress (IMSEC 2020), 21-23 October 2020 – Antalya, Türkiye.
[Conference proceeding]
17. FIŞKIN, R. and ZORBA, Y. (2015). *An Analysis of the Effects of Major Oil Companies on Crew Selection Criteria for Tanker Operating Ship Management Companies*, Dokuz Eylül University Maritime Faculty Journal, Vol. 7, No. 2, pp. 154-170.
[Journal publication]
18. GLENDON, A. and STANTON, N. (2000). *Perspectives on Safety Culture*, Safety Science, Vol. 34, pp. 193-214.
[Journal publication]
19. DAHOOIE, J. H., ABADI B. J., VANAKI, A. S. and FIROOZFAR, H. R. (2018). *Competency-based IT personnel selection using a hybrid SWARA and ARAS-G methodology,* Human factors and Ergonomics in Manufacturing and Service Industries, Vol. 28, No. 1, pp. 5–16.
[Journal publication]
20. İNCE M., BEDÜK, A. and AYDOĞAN, E. (2004). Örgütlerde Takım Çalışmasına Yönelik Etkin Liderlik Nitelikleri (In English Effective Leadership Qualities for Teamwork in Organizations), Journal of the Social Sciences Institute, Vol. 11, pp. 423-446.
[Journal publication]
21. Interview with HR Departments, 2020. (Aruna – Aslan – Devbulk – Er – İnce – Susesea – Arkas – Bayraktar – Boden – Turkon – Armona – Borealis – Ditaş – Düzgit – Swan Shipping Companies).

22. JELPHS, K. (2006). *Communication: Soft skill, hard impact?* Clinician in Management, Vol. 14, pp. 33-37.
[Journal publication]

23. JUODAGALVIENĖ, B., TURSKIS, Z., ŠAPARAUSKAS, J. and ENDRIUKAITYTĖ, A. (2017). *Integrated multi-criteria evaluation of house's plan shape based on the EDAS and SWARA methods*, Engineering Structures and Technologies, Vol. 9, No. 3, pp. 117–125.
[Journal publication]

24. KAMBLE, P.N. and PARVEEN N. (2018) *An Application of Integrated Fuzzy AHP and Fuzzy TOPSIS Method for Staff Selection,* Journal of Computer and Mathematical Sciences, Vol.9, No 9, pp. 1161-1169.
[Journal publication]

25. KARABASEVIC, D., STANUJKIC, D., UROSEVIC, S. and MAKSIMOVIC, M. (2015). *Selection of Candidates in the Mining Industry Based on The Application of the SWARA and the MULTIMOORA methods*, Acta Montanistica Slovaca, Vol. 20, No. 2, pp. 116–124.
[Journal publication]

26. KARABASEVIC, D., ZAVADSKAS, E. K., TURSKIS, Z. and STANUJKIC, D. (2016a). *The Framework for the Selection of Personnel Based on the SWARA and ARAS Methods Under Uncertainties*, Informatica, Vol. 27, No. 1, pp. 49-65.
[Journal publication]

27. KARABASEVIC, D., STANUJKIC, D., UROSEVIC, S. and MAKSIMOVIC, M. (2016b). *An Approach to Personnel Selection Based on SWARA and WASPAS Methods*, Journal of Economics, Management and Informatics, Vol. 7, No. 1, pp. 1–11.
[Journal publication]

28. KARABASEVIC, D., PAUNKOVIC, H. and STANUJKIC, D. (2016c). *Ranking of Companies According to the Indicators of Corporate Social Responsibility Based on SWARA and ARAS Methods*, Serbian Journal of Management, Vol. 11, No. 1, pp. 43–53.
[Journal publication]

29. KELEMENIS, A. and ASKOUNIS, D. (2010). A new TOPSIS-based multi criteria approach to personnel selection, Expert Systems with Applications, Vol 37, No 7, pp. 4999-5008.
[Journal publication]

30. KERŠULIENĖ, V. and TURSKIS, Z. (2011). *Integrated fuzzy multiple criteria decision making model for architect selection*, Technological and Economic Development of Economy, Vol. 17, No. 4, pp. 645–666.
[Journal publication]

31. KERŠULIENĖ, V., ZAVADSKAS, E. K. and TURSKIS, Z. (2010). *Selection of rational dispute resolution method by applying new step-wise weight assessment ratio analysis (SWARA),* Journal of Business Economics and Management, Vol. 11, No. 2, pp. 243–258.
[Journal publication]

32. KINALI, H., YILDIRIM, U. and TOYGAR, A. (2022). *A Quantitative Study on the Mental Health of Turkish Seafarers.* International Journal of Occupational Safety and Ergonomics, Vol. 28, No. 4, pp. 2657-2667.
[Journal publication]

33. KOUTRA, G., BARBOUNAKI, S., KARDARAS, D. and STALIDIS, G. (2017). *A Multicriteria Model for Personnel Selection in Maritime Industry in Greece*, Paper Presented at the IEEE 19th Conference on Business Informatics (CBI), 24-26 July 2017, Thessaloniki, Greece.
[Conference proceeding]

34. LIANG, G. S. and WANG, M. J. J. (1994). *Personnel Selection Using Fuzzy MCDM Algorithm*, European Journal of Operational Research, Vol. 78, No. 1, pp. 22-23.
[Journal publication]

35. LIN, H. (2010). *Personnel Selection Using Analytic Network Process and Fuzzy Data Envelopment Analysis Approaches*, Computers and Industrial Engineering, Vol. 59, pp. 937-944.
[Journal publication]

36. Llyod List. (2021). *Intertanko to roll out new tanker officer matrix project*, https://lloydslist.maritimeintelligence.informa.com/LL074467/Intertanko-to-roll-out-new-tanker-officer-matrix-project (Accessed 12 October 2021).
[Website]

37. LUTHANS, F., AVEY, J. B., AVOLIO, B. J., NORMAN, S. and COMBS, G. (2006). *Psychological Capital Development: Toward a Micro-intervention*, Journal of Organizational Behaviour, Vol. 27, pp. 387–393.
[Journal publication]

38. MASLACH, C. and LEITER, M. P. (2008). *Early Predictors of Job Burnout and Engagement*, Journal of Applied Psychology, Vol. 93, No. 3, pp. 498–512.
[Journal publication]

39. MORGESON, F. P., CAMPION, M. A., DIPBOYE, R. L., HOLLENBECK, J. R., MURPHY, K. and SCHMITT, N. (2007). *Reconsidering the use of personality tests in personnel selection contexts*, Personnel Psychology, Vol. 60, No. 3, pp. 683-729.
[Journal publication]

40. MUSLU, A. (2008). *Human Resources Management and Working Principles in Maritime*, Published Master's Thesis, Marmara University, Istanbul, Turkey.
[Thesis]

41. OAKLAND, J.S. (1993). *Total Quality Management: The Road to Improving Performance*, Butterworth – Heinemann Ltd., Oxford
[book]

42. OPRICOVIC, S. and TZENG, G. H. (2004). *The Compromise Solution by MCDM Methods: A Comparative Analysis of VIKOR and TOPSIS*, European Journal of Operational Research, Vol. 156, No. 2, pp. 445-455.
[Journal publication]

43. PANEL, I. L. (2002). *Digital transformation: a framework for ICT literacy*, A Report of the International ICT Literacy Panel, 34328-010796 CL42M10.
[book]

44. QIN, J., LIU, X. and PEDRYCZ, W. (2016). *Frank aggregation operators and their application to hesitant fuzzy multiple attribute decision making*, Applied Soft Computing, Vol. 41, pp. 428-452.
[Journal publication]

45. SANG, X., LIU, X. and QIN, J. (2015). *An analytical solution to fuzzy TOPSIS and its application in personnel selection for knowledge-intensive enterprise*, Applied Soft Computing, Vol. 30, pp. 190-204.
[Journal publication]

46. Regulation for Seafarers and Marine Pilots, (2018). Official Gazette Number: 30328, https://www.resmigazete.gov.tr/eskiler/2018/02/20180210-9.htm (Accessed 12 September 2021).
[Website]

47. SEAWARD, B.L. (2002). *Managing stress: Principles and strategies for health and wellbeing* (3rd Ed.). John and Bartlett Publishers, Sudbury, Massachusetts, USA.
[book]

48. SLIOGERIENE, J., TURSKIS, Z. and STREIMIKIENE, D. (2013). *Analysis and Choice of Energy Generation Technologies: The Multiple Criteria Assessment on the Case Study of Lithuania*, Energy Procedia, Vol. 32, pp. 11-20.
[Journal publication]

49. STANUJKIC, D., KARABASEVIC, D. and ZAVADSKAS, E. K. (2015). *A Framework for the Selection of a Packaging Design Based on the SWARA method,* Engineering Economics', Vol. 26, No. 2, pp. 181–187.
[Journal publication]

50. STERNBERG, R. J. (2002). *Raising the achievement of all students: Teaching for successful intelligence*, Educational Psychology Review, Vol. 14, No. 4, pp. 383–393.
[Journal publication]

51. STERNBERG. R. J. (2006). *The rainbow project: Enhancing the SAT through assessments of analytical, practical, and creative skills*, Intelligence, Vol. 34, 321–350.
[Journal publication]

52. STCW Code (2010). *International Convention on Standards of Training, Certification and Watchkeeping for Seafarers: Including 2010 Manila Amendments*, STCW Convention and STCW Code, IMO Publications, London.
[book]

53. TIMM, P. R. (1993). *Successful self-management*. California, Crisp Publishing.
[book]

54. TOYGAR, A., YILDIRIM, U. and İNEGÖL, G. M. (2022). *Investigation of Empty Container Shortage Based on SWARA-ARAS Methods in the COVID-19 Era*. European Transport Research Review, Vol. 14, No. 8, pp. 1-17.
[Journal publication]

55. TURSKIS, Z. and ZAVADSKAS, E. K. (2010). *A New Additive Ratio Assessment (ARAS) Method in Multicriteria Decision-Making*, Technological and Economic Development of Economy, Vol. 2, pp. 159-172.
[Journal publication]

56. TURSKIS, Z., KERSULIENE, V. and VINOGRADOVA, I. (2017). *A New Fuzzy Hybrid Multi Criteria Decision Making Approach to Solve Personnel Assessment Problems Case Study: Director Selection for Estates and Economy Office*, Economic Computation and Economic Cybernetics Studies and Research, Vol. 51, No. 3, pp. 211-229.
[Journal publication]

57. UĞURLU, Ö., YILDIRIM, U. and BAŞAR, E. (2015). *Analysis of Grounding Accidents Caused by Human Error*, Journal of Marine Science and Technology-Taiwan, Vol. 23, No 5, pp. 748-760.
[Journal publication]

58. UNCTAD, (2018). *Review of Maritime Transport Report*, UNCTAD Secretariat, 978-92-1-112928-1.
[book]

59. VAFAEIPOUR, M., ZOLFANI, S. H., VARZANDEH, M. H. M., DERAKHTI, A. and KESHAVARZ, M. E. (2014). *Assessment of Regions Priority for Implementation of Solar Projects in Iran: New Application of a Hybrid Multi-Criteria Decision Making Approach*, Energy Conversion and Management, Vol. 86, pp. 653–663.
[Journal publication]

60. WINCHESTER, N. (2005). *Global Regulation of Seafarer Certification, Seafarers International Research Centre's,* Fourth International Symposium, July 2005, Cardiff, England.
[book]

61. YALCIN, N. and YAPICI, N. P. (2019). *Application of the Fuzzy CODAS Method Based on Fuzzy Envelopes for Hesitant Fuzzy Linguistic Term Sets: A Case Study on a Personnel Selection Problem*, Symmetry, Vol. 11, No. 4, pp. 493.
[Journal publication]

62. YILDIRIM, B. F. (2014). *Gri İlişkisel Analiz, Çok Kriterli Karar Verme Yöntemleri (Book in English: Gray Relational Analysis*, Multi-Criteria Decision Making Methods), Dora Publishing, Bursa.
[book]
63. YILDIRIM, U., UĞURLU, Ö., BAŞAR, E. and YÜKSEKYILDIZ, E. (2017). *Human Factor Analysis of Container Vessel's Grounding Accidents*, International Journal of Maritime Engineering, Vol. 159, No. 89-98.
[Journal publication]
64. YILDIRIM, U., BAŞAR, E. and UĞURLU, Ö. (2019). *Assessment of collisions and grounding accidents with human factors analysis and classification system (HFACS) and statistical methods*, Safety Sciences, Vol. 119, pp. 412-425.
[Journal publication]
65. YILDIRIM, U., TOYGAR, A. and ÇOLAKOĞLU, C. (2022). *Compensation Effect of Wages on Decent Work: A Study on Seafarers Attitudes.* Marine Policy, Vol. 143, 105155.
[Journal publication]
66. YU, D., ZHANG, W. and XU, Y. (2013). *Group decision making under hesitant fuzzy environment with application to personnel evaluation*, Knowledge-Based Systems, Vol. 52, No. 1-10.
[Journal publication]
67. ZAIDMAN, N. and DRORY, A. (2011). *Upward Impression Management in the Work Place Cross Cultural Analysis*, International Journal of Intercultural Relations, Vol. 25, No. 6, pp. 671-690.
[Journal publication]
68. ZHANG, S. F. and LIU, S. Y. (2011). *A GRA-based intuitionistic fuzzy multi-criteria group decision making method for personnel selection*, Expert Systems with Applications, Vol. 38, No. 9, pp. 11401–11405.
[Journal publication]
69. ZOLFANI, S. H. and SAPARAUSKAS, J. (2013). *New Application of SWARA Method in Prioritizing Sustainability Assessment Indicators of Energy System,* Engineering Economics, Vol. 24, No. 5, pp. 408–414.
[Journal publication]
70. ZOLFANI, S. H., ESFAHANI, M. H., BITARAFAN, M., ZAVADSKAS, E. K. and AREFI, S. L. (2013). *Developing a New Hybrid MCDM Method for Selection of the Optimal Alternative of Mechanical Longitudinal Ventilation of Tunnel Pollutants during Automobile Accidents*, Transport, Vol. 28, No. 1, pp.89–96.
[Journal publication]
71. ZOLFANI, S. H. and BANIHASHEMI, S. S. A. (2014). *Personnel Selection Based on a Novel Model of Game Theory and MCDM approaches*. 8th International Scientific Conference - Business and Management, Vilnius, Lithuania, pp. 191–198.
[Conference proceeding]
72. ZOLFANI, S. H., SALIMI, J., MAKNOON, R. and KILDIENĖ, S. (2015). *Technology Foresight about R&D Projects Selection: application of SWARA method at the policy making level*, Engineering Economics, Vol. 26, No. 5, pp. 571-580.
[Journal publication]