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The Practice of Selection at Operation Personnel in Cargo Companies

Kargo Firmalarının Operasyon Personeli Seçim Uygulaması

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ABSTRACT

Delivering products to the consumer, the last member of the supply chain, with the highest level of customer service, is an important issue today. In this process, the harmony of logistics activities with each other is effective. Cargo companies carry out the shipment and delivery of the product to the consumer. One of the main activities of cargo companies is operation. Operation is the systematic process of loading and unloading cargo until its delivery to the customer. For this reason, personnel working in operation processes play an important role in logistics and supply chain. This study proposes a decision model for cargo companies to determine the most suitable operation personnel. The criteria for the selection of the operational staff have been established through a literature review. The suitability of the criteria is evaluated with the branch managers of three companies operating in Yalova and engaged in intensive cargo transportation. A decision team is formed with three branch managers and two academicians from the field of logistics. According to the opinions of the decision team, PSI and ARAS and PSI-ARAS integrated methods are applied. As a result of all three methods, candidate A is determined as the most suitable candidate.

MAKALE BİLGİSİ

Makale Türü
Araştırma Makalesi

Anahtar Kelimeler
Lojistik ve Tedarik Zinciri
Çok Kriterli Karar Verme
PSI Yöntemi
ARAS Yöntemi

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ÖZ

Tedarik zincirinin son üyesi olan tüketiciye ürünlerin en yüksek müşteri hizmet düzeyi ile ulaştırılması günümüzde önemli bir konudur. Bu süreçte lojistik faaliyetlerin birbiri ile uyumu etkili olmaktadır. Sevkiyatı ve tüketiciye ürünün teslimatını kargo firmaları gerçekleştirmektedir. Kargo firmalarının temel faaliyetlerinden birisi operasyondur. Operasyon, kargoların müşteriye teslimatına kadar sistematik bir şekilde yüklenmesi ve boşaltılması sürecidir. Bu nedenle operasyon süreçlerinde çalışan personel lojistik ve tedarik zincirinde önemli rol oynamaktadır. Bu çalışmada kargo firmalarının en uygun operasyon personeli belirlemesine yönelik karar modeli önerilmektedir. Literatür araştırması ile operasyon personelinin seçilmesine yönelik kriterler belirlenmiştir. Kriterlerin uygunluğu Yalova' da faaliyet gösteren ve yoğun kargo taşımacılığı yapan üç firmanın şube sorumlusu ile değerlendirilmiştir. Üç şube sorumlusu ve lojistik alanından iki akademisyen ile karar takımı oluşturulmuştur. Karar takımının görüşlerine göre PSI ve ARAS ile PSI-ARAS bütünleşik yöntemi uygulanmıştır. Üç yöntemin sonucunda da A adayı en uygun aday olarak belirlenmiştir.

1. Introduction

Today, the need or delivery of products to consumers at different points is an important issue for businesses. Especially real or legal persons who make sales by communicating with more consumers thanks to e-commerce application desire to complete the delivery of orders in the most appropriate way. In other words, it is aimed at establishing both cost and quality balance due to intensive delivery to more individual consumers. In the supply chain, the final delivery to the consumer is made by the dealer, retailer or cargo company. However, businesses that receive orders from sellers, deliver them by providing transportation services over a certain distance, and charge a fee in return are cargo companies.

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Cargo companies operate in the service sector. Since they assume the role of transportation and delivery in the supply chain, they sell services, which is an abstract concept. To carry out cargo operations in a coordinated, fast and careful manner, individuals with different personal skills and different trainings are needed (Danışan & Eren, 2024). Since cargo companies have direct contact with the consumer, the competence of the personnel working in their organization is therefore important. personnel to work must have different characteristics compared to other sectors. The features sought vary according to the department they will work in.

In the cargo transportation sector, companies want to make the most efficient use of the skills employed by their staff. Because it is important in meeting the demands and needs of customers (Organ & Kenger, 2018). Indirectly, the level of customer satisfaction will increase and the cargo company in question will provide one of the competitive elements in the sector. However, job and personnel definitions should be compatible with each other. Otherwise, it is likely to affect competition negatively. It has been observed that more than 88% of the accidents in the maritime sector are directly caused by human errors and that human errors have a share in all other reasons that cause accidents to occur (Büyük, 2023). For this reason, the personnel selection process is important for cargo companies. This study presents a model and proposal that enables a cargo company to select operation personnel.

In the first part of the study, the issues of personnel selection and its importance are discussed and the studies contributing to the literature are examined. In the second part, the methods used in the research are explained. In the third part of the study, PSI (Preferences Selection Index) and ARAS (Additive Ratio Assessment) methods are applied in line with the opinions of the decision team on the criteria required by the cargo company in personnel selection. In the conclusion section, the evaluation of the applied methods is made, and suggestions are made.

2. Literature Review

In line with the purpose of the study, the keyword "*Personnel Selection + MCDM"* is searched on the Google Scholar Platform without any time limitation. Many studies contributing to literature are found. However, no study is found on the selection of operation personnel of cargo companies. For this reason, the studies that contributed to the literature are grouped and analysed as the closest studies in terms of method and purpose. The closest studies in terms of purpose are as follows;

Aksakal & Dağdeviren (2010), applied DEMATEL and ANP methods integrally for personnel selection in an international company. The dependent weight values between the criteria are determined by DEMATEL method. The ANP method is used to solve the personnel selection problem. Among 4 criteria, "*foreign language"* is determined as the most important criterion. The 4th candidate is found to be the most suitable candidate.

Zhang & Liu (2011), in their study, he stated that the complexity of personnel selection requires a method that combines both subjective and objective evaluations and proposed a heuristic fuzzy multi-criteria group decision-making method with Gray relational analysis (GRA). He used the intuitionistic fuzzy weighted average (IFWA) method to collect the individual opinions of decision makers. To determine the entropy weights of the criteria, he ranked the alternatives by using the weights determined by intuitionistic fuzzy entropy in the GRI method.

Baležentis et al. (2012), in their study, he aimed to extend the fuzzy MULTIMOORA method for linguistic reasoning in the context of group decision making due to the uncertainty and ambiguity of the personnel selection process. The fuzzy MULTIMOORA (MULTIMOORA-FG) method for group decision making allows the decision team to combine the subjective evaluations of the decision team. To determine the best candidate among four alternatives in personnel selection, he identified the decision team consisting of four people. It proposed the most suitable candidate among the alternatives.

Sang et al. (2015), in their study, he proposes an analytical solution to the fuzzy TOPSIS method based on the Karnik-Mendel (KM) algorithm. He suggests that if compared with the existing TOPSIS method in the personnel selection problem, accurate fuzzy relative closeness will be obtained instead of net point or approximate fuzzy relative closeness estimation. By preventing the loss of information, a more efficient calculation will be made and detailed comparisons are made in the personnel selection application.

Sezen Akar & Çakır (2016), the applicant submitted an application for the evaluation of candidates within the framework of 5 criteria for a logistics company. The weights of the criteria are determined with the Fuzzy Analytic Hierarchy Process method and evaluated by ranking the candidates with the MOORA method.

Efe & Kurt (2018), for the selection of a human resources specialist in a port enterprise, the importance levels of the criteria examined in personnel selection are determined with Fuzzy extended AHP and candidate personnel are evaluated with Fuzzy TOPSIS method. In the study, 10 candidates are evaluated based on 8 criteria. The most important criteria are found to be *"self-confidence*" and "*planning and organizational skills".* Among the candidates, alternative 10 is evaluated as the most suitable candidate.

Ilgaz (2018), in the study, he determined the criteria considered for the operation staff to work in the logistics sector. In line with expert opinions, he calculated the importance levels of the determined criteria with the AHP method. The results of the AHP method showed that the main criterion of "professional competence" is the most important criterion. The TOPSIS method is used to select the most suitable candidate for the logistics company to which five candidates applied. As a result of the method he applied, he determined that the most suitable candidate is A5.

Ilgaz Yıldırım et al. (2019), in their study, he made an application for the selection of support personnel in airline businesses, which are grouped into two as line personnel and support personnel. The selection of the most suitable personnel is carried out with the ARAS method, which is a multi-criteria decision-making method. In the study using the ARAS method, it is seen that the most important criterion among the support staff selection criteria is the sectoral "competence" criterion. It is determined that the most suitable candidate among the job applicants is the third candidate.

Kuşakcı et al. (2019), in their study, he proposed the fuzzy MULTIMOORA method as a method considering the uncertainty and subjectivity in personnel selection. In the study, three main criteria and eight sub-criteria are determined. In addition, in order to test the validity of the method, it is also evaluated with the integrated AHS-TOPSIS method. It is observed that the same conclusion is reached in both models. Depending on the evaluation of the criteria, three candidate is determined as the most suitable candidate in both methods.

Acer & İnci (2020), in their study, he used AHP and MOORA methods, which are among the multi-criteria decision-making methods, to select field operation personnel in Trabzon Port, one of the most important ports of Turkey. Criteria weights are determined using AHP method. The determined criteria weights are evaluated using MOORA method.

Öztürk & Keleş (2020), evaluated the selection of the most suitable motorized courier for a pharmaceutical warehouse operating in the pharmaceutical sector using AHP and TOPSIS methods. The weights of the main and sub-criteria are determined by AHP method. As a result of the analysis, it is seen that the most important criterion among the motor courier selection criteria is the "*technical competence"* criterion and the least important criterion is the "*social competence"* criterion, and as a result of both methods, it is determined that "Courier 3" is the most suitable candidate.

Özcan et al. (2020), in the study, AHP, Gray Relational Analysis and TOPSIS methods are used together for the selection of personnel to work as strollers in a metropolitan municipality. 5

main criteria and 13 sub-criteria are determined as evaluation criteria. The AHP method is used to determine the criteria weights and Gray Relational Analysis and TOPSIS methods are used for personnel selection evaluation. The consistency of the two different methods applied is analyzed and evaluated. In both methods, it is determined that the most suitable candidate is candidate 1.

Ayçin (2020), in the study, he used CRITIC and MAIRCA methods together to select the personnel to work in the information systems department of a company operating in the logistics sector. The weights of the criteria are calculated by CRITIC method. The most important criteria are "*ability to use ERP software"* and "*industry experience and communication skills".* Among 5 candidates, MAIRCA method is applied to evaluate A1 alternative as the most suitable personnel.

Merdivenci & Oğuz (2020), in their study, he used Entropy and Edas methods for the logistics personnel selection problem. He calculated the weights of four criteria with the Entropy method. He determined that the most important criterion among the criteria is the "Experience" criterion. Then, he ranked the candidates by using the calculated criteria weights in Edas method. He determined that A4 is the most suitable candidate among the alternatives.

Elmas (2022), used the Fuzzy TOPSIS method for personnel selection and applied it in the maritime department of a freight forwarder company. Nine criteria are evaluated by five managers and five candidates are selected among five candidates for the sales representative of the maritime department. In the developed personnel selection method, it is determined that the 3rd candidate is the most suitable candidate.

Solunoğlu (2022), determined the criteria for hot air balloon pilot selection in his study and made the most appropriate personnel selection with CRITIC and MAIRCA methods. The weights of the criteria are calculated with the CRITIC method. Accordingly, the most important criterion is found to be "*foreign language skills*". As a result of the MAIRCA method, it is determined that the candidate coded A1 is the most suitable candidate among the twelve personnel alternatives.

Research on the methods used in the study are as follows;

Ulutaş & Yürüyen (2019,) in their study, he emphasised the importance of transport operations in logistics activities and mentioned the importance of vehicle selection. Accordingly, he stated that factors such as price, performance and torque of the vehicle should be taken into consideration. 4 truck alternatives are identified. He therefore compared the ranking results using the PSI, ARAS, OCRA and MOORA methods. According to the results, the ranking of the alternatives is the same in the PSI, ARAS, OCRA and MOORA methods. The results of the evaluation are Truck 2, Truck 4, Truck 3 and Truck 1 respectively.

Akbulut (2020), in the study, he has evaluated the performance of 10 large deposit banks operating in Turkey in 2018 by using gray entropy, PSI and ARAS methods together. In the evaluation of the criterion weights obtained with the Gray entropy method, it is considered that the most important criterion affecting the performance is the age of the bank. The weights obtained by the Gray entropy method are subsequently included in the PSI and ARAS methods, and the results are compared. As a result of the study, Ziraat Bank is recognized as the most successful bank for investments in the period under consideration.

Taşcı (2024), the PSI-MEREC-ARAS decision model is used to evaluate the performance of the National Reinsurance Company between 2015 and 2022. The PSI and MEREC methods are used to determine the objective weighting coefficients for evaluating the company's performance. The financial performance of the company is then assessed using the ARAS method. According to the PSI-MEREC-ARAS results, the most important and influential criterion for financial performance is the retention ratio, while the technical profitability ratio is the least influential criterion. According to the results of the ARAS method, the company showed the best performance in 2016 and the worst performance in 2015.

Bektaş & Çimen (2024), Multi-Criteria Decision Making (MCDM) methods have been used to analyze the performance of savings finance companies in the period 2021-2023. The criteria are weighted using the PSI method. The MABAC method has been used to rank the alternatives. The results for 2023 obtained using the MABAC method are compared with the results obtained using ARAS, MAIRCA, COCOSO and PSI methods. It has been found that the results for the year 2023 are exactly the same as the MABAC results.

Öztaş (2024), in the study, he used Preference Selection Index (PSI) and Additive Ratio Assessment (ARAS), which belong to the Multi-Criteria Decision Making (MCDM) methods, to select Big Data Analytics (BVA) software. There are 8 alternatives and 7 criteria in the model. The PSI method has been used to determine the weights of the criteria, and the ARAS method has been used to rank the alternatives. According to the results of the analysis, "*ease of use*" is determined as the criterion with the highest importance weight and "*data workflow*" is determined as the criterion with the lowest importance weight. Among the alternatives, the fifth alternative has been chosen as the most suitable big data analytics software.

3. Operation Personnel Selection Practice

Previous studies close to this study and contributing to literature have been examined. However, this study is different because the evaluation of cargo company operation personnel will be based on criteria for the first time, and two different MCDM methods will be used in an integrated way. In this section of the study, the purpose, constraints and assumptions of the study are explained, and the methods are applied.

3.1. Purpose of the Study

In the branches of cargo companies, not only candidates who have an associate or bachelor's degree in their field, but also candidates who have graduated from associate or bachelor's degree programs in different fields apply to work as operations personnel. In addition, it is seen that the applicants have different characteristics other than the characteristics required for the operation personnel. For this reason, to increase the efficiency of cargo companies and to provide competitive advantage, it is aimed to select the most suitable personnel among the candidates who apply to work in the position of operation personnel in the branches.

3.2. Limitations and Assumptions of the Study

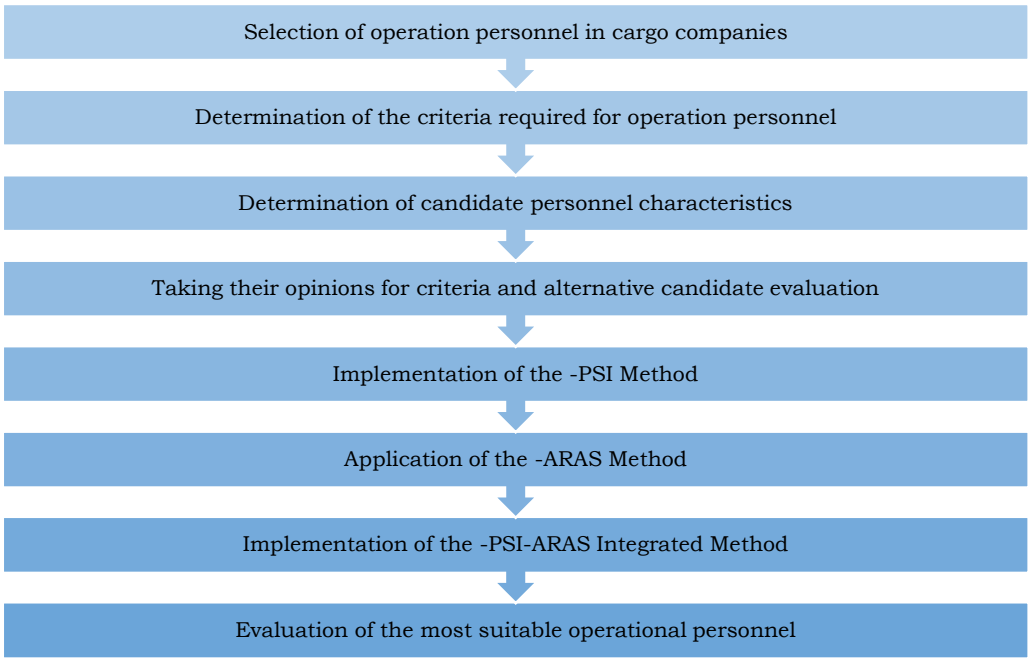
Three branches of cargo companies operating in Yalova are included in this study. Due to the high cargo mobility, it is applied in cargo companies and branches that need operation personnel intensively. However, their names are not pronounced in the study in order not to have a positive or negative impact on the image of the cargo companies in the sector and the opinions of their stakeholders. Likewise other information about the candidates whose characteristics are determined to make an evaluation is not shared. In addition, it is accepted that the branch managers and academicians participating in the study supported the study with their free will depending on their knowledge and experience

3.3. Methodology of the Study

The selection criteria, which are closely related to the freight transport sector, have been identified through literature review. A modified Delphi method is used to make the final decision on the selection criteria and the interview form. Initially, two academics working in the field of logistics and supply chain management and three company officials involved in freight distribution in Yalova and with a significant share in the sector joined the study. The selection criteria are presented verbally to the academicians. According to the opinion of the academics, the criteria are sufficient, but the opinion of the authorities operating in the sector should be taken into consideration. In this direction, the branch officials of the companies determined in this direction have been asked about the process of selection of personnel, and they have been clarified how the process works. According

to the general explanations given by the branch officials, it is found that the operational personnel selection process is carried out as follows:(1) The information of the candidates who apply to the cargo branch is examined in detail. (2) The candidate who meets the criteria for operation personnel is determined. (3) The selected candidate is recommended to the central management of the cargo company. (4) Finally, after the legal procedures are completed, the candidate starts work. Thus, assuming that this study will clarify (2), a second round of interviews was conducted with academics and branch officials to clarify the personnel selection criteria obtained through literature research. All the branch officials and academics agreed with the selection criteria that have been presented to them verbally. However, at the end of the interview, one branch official suggested "being able to work for a long time" as an additional criterion. Two other branch officials and two academics also agreed, emphasising the importance of this criterion. At the end of the second round, an opinion form has been produced with the accepted criteria. The methodology of the study is shown in Figure 1.

Figure 1. Methodology of the Study



The decision team consisted of five people, including branch officials and academics with knowledge of the research process. In another study on personnel evaluation, the decision team consisted of three people (Tuş & Sertaç Adalı, 2018). Accordingly, the number of decision makers in the study is considered to be sufficient. The forms indicating the opinions of the members of the decision team, which will contribute to the study, are sent to them via e-mail. The forms containing the opinions of the members who actively participated in the decision-making process received via e-mail or computer printout. Three members of the decision team in the position of branch manager have 5 to 15 years of experience in the field of operations and two academics have more than 10 years of experience in logistics and supply chain management. Therefore, the reliability of their influence on the evaluation result can be considered quite high.

The criteria to be considered in the operation of personnel are shown in table 1.

Table 1. Cargo Operation Personnel Evaluation Criteria

Criteria	Abbreviation	Source
Age	C1	(Öztürk & Keleş, 2020)
Physical Resilience	C2	(Öztürk & Keleş, 2020)
Effective communication skills	C3	(Ilgaz, 2018)
Not Being Introverted	C4	(Acer & Inci, 2020)
Education Status	C5	(Akyurt, 2019) , (Öztürk & Keleş, 2020)
Computer Information	C6	(Acer & Inci, 2020)
Ability to Work for a Long Time	C7	Not encountered.
Professional Experience	C8	(Danışan & Eren, 2024) , (Akyurt, 2019), (Acer & İnci, 2020), (Sezen Akar & Çakır, 2016)
Driving License	C9	(Öztürk & Keleş, 2020)
Reference	C10	(Acer & Inci, 2020)

Among the evaluation criteria identified, the criterion that cargo operations personnel can work for a long time (C7) is not found in the literature research. It is identified at the end of the second round of the modified Delphi method with decision makers. It is included in the study in accordance with the opinions of the decision makers.

In evaluating candidates, the cost of *'introversion'* has been converted into a benefit. Decision makers evaluated it as 'not being introverted' in the opinion form. The *'age'* criterion is considered a cost criterion for all candidates. So, all other criteria are considered benefit criteria, apart from the *'age'* criterion.

Depending on the evaluation criteria in Table 1, the characteristics of the candidates to be evaluated in terms of operational personnel competence are shown in Table 2. It is seen in Table 2 that the candidates have different characteristics other than the field of graduation.

Table 2. Information on Candidates

A STAFF CANDIDATE	
CRITERIA	INFO
Age	24
Physical Resilience	Height weight proportionate and athletic build
Professional Experience	1 year
Education Status	High School
Computer Information	Can use office and package programs sufficiently.
Not Being Introverted	Friendly and problem solving.
Effective Communication Skills	They are friendly and can give adequate explanations.
Ability to Work for a Long Time	High organizational commitment and willing to work in the cargo sector
Driving License	There is
Reference	No
B STAFF CANDIDATE	
CRITERIA	**INFO**
Age	30
Physical Resilience	Height weight proportionate and athletic build
Professional Experience	4 years
Education Status	University (Associate Degree)-Civil Defense and Firefighting
Computer Information	Does not use a computer.
Not Being Introverted	Friendly and problem solving.
Effective Communication Skills	They are friendly and can give adequate explanations.
Ability to Work for a Long Time	He/she is willing to work related to the department he/she graduated from.
Driving License	There is
Reference	No
C STAFF CANDIDATE	
CRITERIA	INFO
Age	35
Physical Resilience	Overweight. He's in poor physical condition.
Professional Experience	7 years
Education Status	University (Associate's degree)-Logistics Management
Computer Information	Can use office and package programs sufficiently.
Not Being Introverted	Teamwork-oriented and mobile
Effective Communication Skills	A little aggressive and focused on getting the job done
Ability to Work for a Long Time	He/she is willing to work related to the department he/she graduated from.
Driving License	No
Reference	Yes. (Logistics company managers)

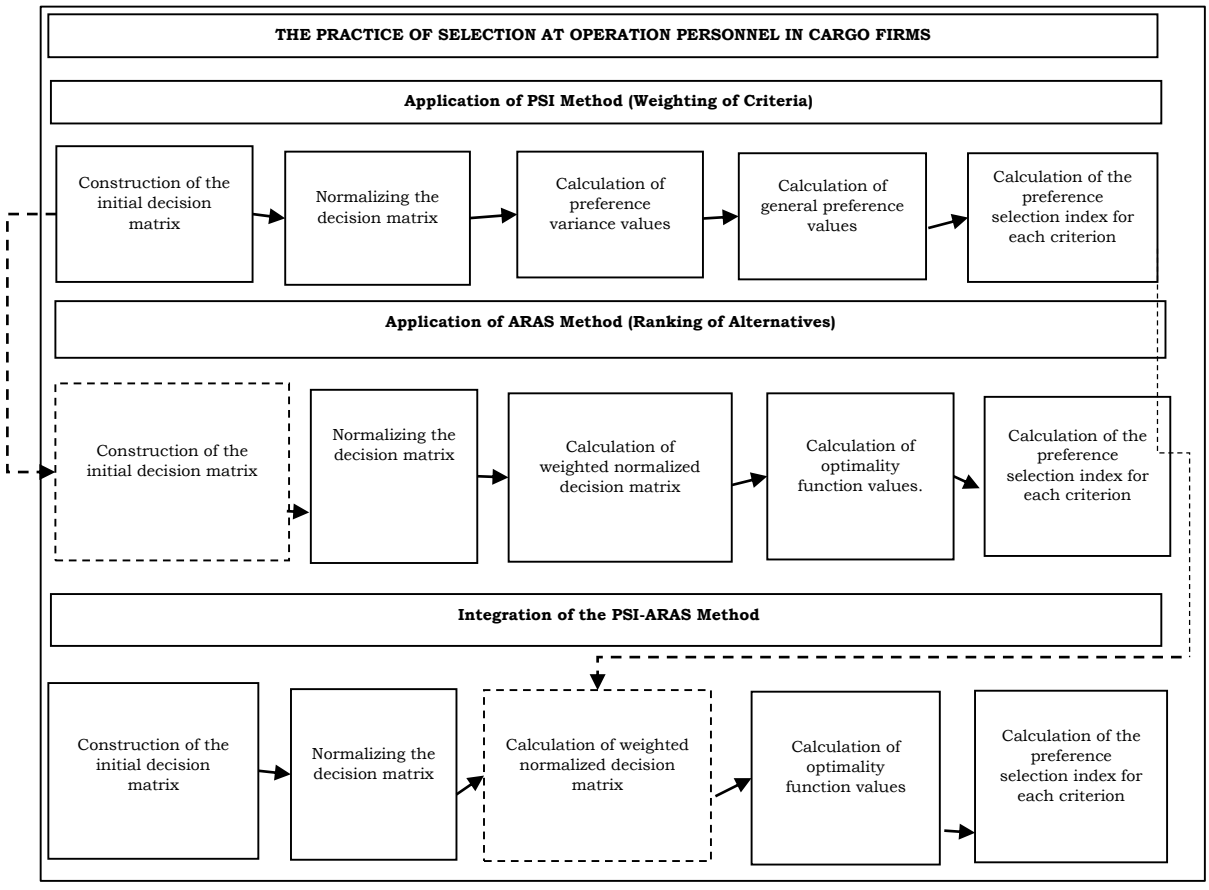
Data for the study is obtained by consulting decision makers. When creating the questionnaire, information about the candidates' characteristics is presented as shown in Table 2. The evaluation has been carried out on a scale of 1 to 9, both according to the candidates and the importance weights of the criteria. The evaluation scale used to obtain the opinions of the decision makers is shown in Table 3.

Table 3. Evaluation Scale

KRİTER	1	2	3	4	5	6	7	8	9
Age	☐	☐	☐	☐	☐	☐	☐	☐	☐
Physical Resilience	☐	☐	☐	☐	☐	☐	☐	☐	☐
Professional Experience	☐	☐	☐	☐	☐	☐	☐	☐	☐
Education Status	☐	☐	☐	☐	☐	☐	☐	☐	☐
Computer Information	☐	☐	☐	☐	☐	☐	☐	☐	☐
Not Being Introverted	☐	☐	☐	☐	☐	☐	☐	☐	☐
Effective Communication Skills	☐	☐	☐	☐	☐	☐	☐	☐	☐
Ability to Work for a Long Time	☐	☐	☐	☐	☐	☐	☐	☐	☐
Driving License	☐	☐	☐	☐	☐	☐	☐	☐	☐
Reference	☐	☐	☐	☐	☐	☐	☐	☐	☐

Figure 2 shows the steps detailing the stages of the methods used in the study and their integration processes. In the PSI-ARAS integrated method, the criterion weights obtained from the PSI method are incorporated into the weighted matrix created using the ARAS method.

Figure 2. Implementation Steps and Integration of Methods



The same initial matrix is used in both the PSI method and the ARAS method. The criterion weights calculated using the PSI method are integrated into the ARAS method and the alternatives are re-ranked. In this way, similarities and differences in the results of the PSI, ARAS, and PSI-ARAS methods are evaluated. Then the evaluations make at the end of the applied methods are compared.

3.4. PSI Method

The PSI method is a multi-criteria decision making (MCDM) method, which is formed from the words Preferences Selection Index and stands for Preference Selection Index. This method is applied to solve the material selection problem (Maniya & Bhatt, 2010). This method has been applied to solve the material selection problem. The important stage in the PSI method is that it offers a solution with a different approach, unlike the criteria weighing methods used in MCDM methods. In other words, the model determines the weights of the criteria within itself (Attri & Grover, 2015); (Maniya & Bhatt, 2010); (Akbulut, 2020). In the PSI method, the preference index ($İ_i$) value is calculated for each alternative determined using the criteria values and the alternatives are ranked according to these values.

The literature has found that the PSI method is applied in different fields. Kalpesh Maniya & M.G. Bhatt b. (2010) is used the PSI method to select a suitable material to meet the needs of design engineers. In the study where three different materials are selected, different multi-criteria decision making methods and PSI method are compared. It is stated that the PSI method produced reliable results. Rajesh Attri & Sandeep Grover (2015) examined five examples from the literature to determine the potential, applicability and accuracy of the PSI method in the design phase of the life cycle of a manufacturing system, which is a multi-criteria decision making problem, and compared it with the results of studies conducted by past researchers. Christian Zamiela et al. (2022) conducted a case study on the supply chain of medical equipment. They validated the results of the "cluster analysis" machine learning technique is used in the case study with the PSI method. Wardana & Putri (2024) are used the PSI method to identify the business partner that meets the needs and expectations of a company. According to the evaluation results, Andreanto Wijaya is identified as the best alternative with the highest score. Sharma & Kumar (2024) are used the PSI method to identify a composite material as the most suitable composite material for a large number of components in the construction, automobile, marine and aerospace industries.

The steps of the PSI method, which consists of six stages, are as follows.

Step 1: It is the problem definition stage. The alternatives and evaluation criteria to be used in the method are determined.

Step 2: In the decision matrix the rows represent the job applicants A=[A_i, i=1, 2, ... , n] the columns represent the criteria to be used in the evaluation C=[C_j, j=1, 2, ... , m] and the decision matrix is constructed as in equation (1) so that Ai_i represents the performance value X_{ij} of the staff candidate.

$$X = [X_{ij}]_{mxn} = \begin{bmatrix} X_{11} & X_{12} & X_{13} & X_{1n} \\ \dots & \dots & \dots & \dots \\ X_{31} & X_{32} & X_{33} & X_{3n} \\ X_{m1} & X_{m2} & X_{m3} & X_{mn} \end{bmatrix} \quad (1)$$

Step 3: Normalization is applied to the decision matrix to perform standard operations on all matrix elements. Equation (2) applies if the personnel evaluation criterion has a benefit value, and Equation (3) applies if it has a cost value.

$$R_{ij} = \frac{X_{ij}}{makX_j} \forall;\ i,\ j \quad (2)$$

In Equation (2) $X_{j,max} = \max\{X_{ij}\}$; ∀ i, j the value of,

$$R_{ij} = \frac{\min X_{ij}}{X_j} \forall;\ i,\ j \quad (3)$$

In Equation (3) $X_{j,min} = \min\{X_{ij}\}$; ∀ i, j refers to the shaped value.

Step 4: Calculate the preference variance value (PV_j) as in Equation (5). $\overline{R_j}$ values are the meaning of the values in the normalized decision matrix and are calculated by Equation (4).

$$\overline{R_j} = \frac{1}{N}\sum_{i=1}^{N} R_{ij} \quad (4)$$

$$PV_j = \sum_{i=1}^{N}[R_{ij} - \overline{R_j}]^2 \quad (5)$$

Step 5: Calculating the overall preference value (Ψj) based on the deviation in the preference value (Φj). Equation (6) calculates the deviation (Φj) and Equation (7) calculates the overall preference value (Ψj).

$$\Phi_{i=[1-PV_j]} \quad (6)$$

$$\Psi_{i=\frac{\Phi_j}{\sum_{j=1}^{M}\Phi_j}} \quad (7)$$

Step 6: The preference index (i_i) of each staff candidate is calculated using equation (8).

$$i_i = \sum_{j=1}^{M}(R_{ij}.\Psi_j) \quad (8)$$

Preference Index (i_i) shows the performance values of the staff candidates. The preference index allows performance comparison starting from the candidate with the highest preference index to the candidate with the lowest preference index. The candidate with the highest index can be characterized as the most suitable candidate. However, since the preference index values obtained with this method will be used as coefficients in the ARAS method, the candidate with the highest value is not considered as the most suitable candidate.

3.5. ARAS Method

The ARAS method, which is one of the multi-criteria decision-making methods, consists of the initials of Additive Ratio Assessment (Koçak, 2024) and stands for Additive Ratio Assessment or Additive Ratio Assessment. The ARAS method is first proposed for evaluating the microclimate in office rooms (Zavadskas & Turskis, 2010). The method is based on the ranking of the alternatives according to the utility function within the framework of the evaluation criteria, and the most important feature that distinguishes it from other MCDM methods is that the utility values of the alternatives can be compared with the utility value of the optimal alternative (Akbulut, 2020). The method is applied in five steps.

The literature indicates that the ARAS method has been applied in several areas. Paul et al. (2016) used ARAS method to evaluate and rank Indian cities according to their performance in minimising criminal activities. According to the evaluation results, Chandigarh is the best performing region among 35 alternatives while West Bengal is the lowest performing region. Koc & Uysal (2017) have conducted an evaluation of the textile, retail and automotive sectors by applying the ARAS method using logistics critical success factors determined from the literature. It has been found that the automotive sector ranked first, the retail sector ranked second and the textile sector ranked third in terms of reverse logistics practices. Sihombing et al. (2021) dealing with the problem of selecting a location for an English course to open a new branch. The ARAS method has been applied using 5 criteria: population density, access to locations, number of people, rent, and income. It is found that the most suitable location is Patuan Anggi Street. Syahputra et al. (2022) designed the Reward Decision Support System process using ARAS method to encourage drivers by removing some barriers in the process of rewarding them. According to the application results, the value of the best employee is 0.90 and the lowest value is 0.81.Sivaji et al. (2024) using the ARAS method

in food science in his study, found that Nanotechnologies Fresher Longer TM has the highest ranking value while Nano tea has the lowest value. Junior et al. (2024) used the ARAS method in their study with the aim of providing suitable housing recommendations to potential buyers. A ranking has been made between 5 criteria and 5 alternatives. Kota Cakra has the highest preference and Kota Batara has the lowest.

Step 1: By adding alternatives in rows and evaluation criteria in columns, decision matrix X is formed as in equation (9).

$$X = [X_{ij}]_{mxn} = \begin{bmatrix} x_{11} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{bmatrix} (i = 1,2,\dots,m; j = 1,2,\dots,n) \quad (9)$$

If the optimal value of criterion j is unknown, it is determined using equation (10).

$$x_0 = \begin{cases} If\ mak\ x_{ij}\ is\ x_{0j} = mak\ x_{ij} \\ If\ min\ x_{ij}\ is\ x_{0j} = min\ x_{ij} \end{cases} \quad (10)$$

Step 2: If the evaluation criteria in the created decision matrix provide a utility effect, normalization is applied with equation (11).

$$\overline{X_{ij}} = \frac{X_{ij}}{\sum_{i=1}^{m} X_{ij}} \quad (11)$$

If the evaluation criteria in the $\overline{X_{ij}}$ matrix have a cost effect, normalization is performed using equation (12).

$$\overline{X_{ij}} = \frac{\frac{1}{X_{ij}}}{\sum_{i=1}^{m} \frac{1}{X_{ij}}} \quad (12)$$

Step 3: Based on the normalized decision matrix, the calculation steps of w_i criteria weights are as follows (Ecer, 2016);

Step 3.1: Calculating the ranking sum

$$t_j = \sum_{k=1}^{r=i} t_{jk} \quad (13)$$

Here t_j , denotes the sum of the evaluations of the decision makers for each criterion.

Step 3.2: Calculating ranking averages

$$\overline{t_j} = \frac{t_j}{r} \quad (14)$$

$\overline{t_j}$, the sum of each ranking is divided by the number of decision makers.

Step 3.3: Calculation of criteria weights

$$w_j = \frac{\overline{t_j}}{\sum_{j=1}^{m} \overline{t_j}} \quad (15)$$

Step 4: At this stage, the weight coefficients for the evaluation criteria in the PSI method are also included in the ARAS method as an integrated method and the Weighted Normalized Decision Matrix is calculated using Equation (16).

$$X_{ij} = \overline{X_{ij}}\ x\ w_j \quad (16)$$

Step 5: Calculate the Optimality Function Values for the alternatives using Equation (17).

$$S_i = \sum_{i=1}^{n} X_{ij} \quad (17)$$

S_i in the above equation denotes the optimality value of the i. alternative. S_i the with the highest value is determined as the best alternative

Step 6: Equation (18) is used to calculate the degree of utility of the best alternative according to its optimality value.

$$K_i = \frac{S_i}{S_0} \tag{18}$$

Each alternative is evaluated by ranking the K_i values from high to low.

3.6. Application of the PSI Method

Depending on the decision maker opinion forms, an initial decision matrix is formed as shown in Table 4. In the decision matrix, criteria are scored between 1-9 depending on the evaluation of the decision makers and entered into the decision matrix. The matrices of all decision makers are prepared, and the geometric mean is taken. Then, using Equation (2) and (3), the normalized decision matrix in Table 5 is obtained.

Table 4. Initial Decision Matrix

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Candidate A	8.139	7.432	6.871	8.002	4.644	6.382	8.586	4.690	8.002	1.974
Candidate B	7.017	8.360	8.559	8.002	8.360	1.888	2.930	5.036	8.002	2.268
Candidate C	5.462	2.825	3.471	5.753	8.586	7.765	3.519	6.554	1.380	4.829

Table 5. Normalized Decision Matrix

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Candidate A	0.671	0.889	0.803	1.000	0.541	0.822	1.000	0.715	1.000	0.409
Candidate B	0.778	1.000	1.000	1.000	0.974	0.243	0.341	0.768	1.000	0.470
Candidate C	1.000	0.338	0.406	0.719	1.000	1.000	0.410	1.000	0.172	1.000

Equation (4) is used to average the weights of the criteria in the normalized decision matrix. To calculate the variance values of the criteria, Table 6 is created using Equation (5).

Table 6. Variance Values Table

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Candidate A	0.021	0.022	0.004	0.009	0.088	0.018	0.173	0.013	0.076	0.047
Candidate B	0.001	0.066	0.070	0.009	0.018	0.198	0.059	0.004	0.076	0.024
Candidate C	0.034	0.164	0.109	0.035	0.026	0.097	0.030	0.030	0.304	0.140

Table 7 shows the deviation values (Φ_i) of the criteria calculated with Equation (6). In the same table, Equation (7) is used depending on the deviation values and the general preference values of the candidates depending on the criteria (Ψ_i) is calculated.

Table 7. Deviation and General Preference Values of Criteria

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Φ_i	0.944	0.749	0.817	0.947	0.867	0.687	0.738	0.954	0.543	0.789
Ψ_i	0.117	0.093	0.102	0.118	0.108	0.085	0.092	0.119	0.068	0.098

Equation (8) is used to calculate the index values of the candidates as a result of the PSI method. Accordingly, candidate A with the highest preference index (0.774) in Table 8 is seen as the most suitable candidate in the evaluation.

Table 8. Preference Ranking by PSI Method

	$İ_i$	Preference Ranking
Candidate A	0.774	1
Candidate B	0.766	2
Candidate C	0.735	3

Candidate B with a preference index of (0.766) and candidate C with a preference index of (0.735) are identified as the second and third suitable candidates, respectively.

3.7. Application of the ARAS Method

The method has been applied using the initial matrix obtained by the PSI method. The optimal values x_0 are calculated using Equation (10) and the optimal decision weights (ODW) are calculated using Equations (13), (14) and (15). The optimal values and optimal decision weights are included in the decision matrix and the initial decision matrix shown in Table 9 is obtained.

Table 9. Initial Decision Matrix

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
ODW	0.118	0.106	0.108	0.124	0.123	0.091	0.086	0.093	0.099	0.052
x_0 (Optimal)	8.139	8.360	8.559	8.002	8.586	7.765	8.586	6.554	8.002	4.829
Candidate A	8.139	7.432	6.871	8.002	4.644	6.382	8.586	4.690	8.002	1.974
Candidate B	7.017	8.360	8.559	8.002	8.360	1.888	2.930	5.036	8.002	2.268
Candidate C	5.462	2.825	3.471	5.753	8.586	7.765	3.519	6.554	1.380	4.829

Equations (11) and (12) are used to normalize the initial decision matrix according to the classification of the criteria into cost and benefit criteria. All criteria have been evaluated as benefit criteria. The normalized matrix obtained is also shown in Table 10.

Table 10. Normalized Decision Matrix

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
ODW	0.118	0.106	0.108	0.124	0.123	0.091	0.086	0.093	0.099	0.052
x_0 (Optimal)	0.283	0.310	0.312	0.269	0.285	0.326	0.363	0.287	0.315	0.347
Candidate A	0.283	0.276	0.250	0.269	0.154	0.268	0.363	0.205	0.315	0.142
Candidate B	0.244	0.310	0.312	0.269	0.277	0.079	0.124	0.221	0.315	0.163
Candidate C	0.190	0.105	0.126	0.193	0.285	0.326	0.149	0.287	0.054	0.347

The criteria weights in the normalized decision matrix are multiplied by the optimal decision weight values as in Equation (16) and the weighted normalized decision matrix is obtained as shown in Table 11.

Table 11. Weighted Normalized Decision Matrix

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
ODW	0.118	0.106	0.108	0.124	0.123	0.091	0.086	0.093	0.099	0.052
x_0 (Optimal)	0.033	0.033	0.034	0.033	0.035	0.030	0.031	0.027	0.031	0.018
Candidate A	0.033	0.029	0.027	0.033	0.019	0.025	0.031	0.019	0.031	0.007
Candidate B	0.029	0.033	0.034	0.033	0.034	0.007	0.011	0.020	0.031	0.008
Candidate C	0.022	0.011	0.014	0.024	0.035	0.030	0.013	0.027	0.005	0.018

The optimality function values (S_i) which indicate the total criteria weight for each candidate are calculated using Equation (17). The degree of benefit (K_i) of each candidate based on the optimal values are calculated using Equation (18). The calculated values are shown in Table 12.

Table 12. Preference Ranking by ARAS Method

	S_i	K_i	Preference Ranking
x_0 (Optimal)	0.305	1.000	Optimal
Candidate A	0.255	0.836	1
Candidate B	0.241	0.789	2
Candidate C	0.199	0.651	3

According to the results of the method shown in Table 12. Candidate A is determined as the most suitable candidate with the highest degree of utility (0.836). Candidate B (0.789) and Candidate C (0.651) are determined as the second and third most suitable candidates, respectively.

3.8. Application of the PSI-ARAS Integrated Method

An integrated application is made by using the general preference values determined in the PSI method (Ψ_i) instead of the optimal decision weight (ODW) calculated in the ARAS method. The weighted normalized decision matrix in Table 13 is obtained by multiplying the general preference values in Table 7 with the normalized criteria weights in Table 10.

Table 13. Weighted Normalized Decision Matrix

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Ψ_i	0.117	0.093	0.102	0.118	0.108	0.085	0.092	0.119	0.068	0.098
x_0 (Optimal)	0.283	0.310	0.312	0.269	0.285	0.326	0.363	0.287	0.315	0.347
Candidate A	0.283	0.276	0.250	0.269	0.154	0.268	0.363	0.205	0.315	0.142
Candidate B	0.244	0.310	0.312	0.269	0.277	0.079	0.124	0.221	0.315	0.163
Candidate C	0.190	0.105	0.126	0.193	0.285	0.326	0.149	0.287	0.054	0.347

Optimality function values (S_i) are calculated using Equation (17) and the utility degree of each candidate (K_i) based on the optimal values is calculated using Equation (18). The calculation results are shown in Table 14.

Table 14. Preference Ranking by ARAS-PSI Method

	S_i	K_i	Preference Ranking
x_0 (Optimal)	0.31	1.000	Optimal
Candidate A	0.25	0.810	1
Candidate B	0.23	0.757	2
Candidate C	0.21	0.690	3

According to the results of the PSI-ARAS method in Table 14, candidate A with the highest degree of utility (0.810) is determined as the most suitable candidate. Then, candidate B with (0.757) and candidate C with (0.690) are determined as the second and third most suitable candidates, respectively.

Table 15. Comparison of Applied Methods

	PSI Method		ARAS Method		PSI-ARAS Method	
	$\dot{I}_i$	Ranking	K_i	Ranking	K_i	Ranking
Candidate A	0.774	1	0.836	1	0.810	1
Candidate B	0.766	2	0.789	2	0.757	2
Candidate C	0.735	3	0.651	3	0.690	3

The ranking results of the alternatives are shown in Table 15, using the PSI, ARAS, and PSI-ARAS methods. A is the most suitable candidate of three methods.

4. Sensitivity Analysis

A sensitivity analysis has been conducted to ascertain the impact of the model's criteria on the evaluation of the alternatives. The reason for this is the definite effect of changes in the opinions of decision makers on the ranking of the alternatives. In the sensitivity analysis, different scenarios are created based on changes to the criteria weights, as determined by the PSI method. The PSI-ARAS method applied the modified criterion weights that have been created. Table 16 shows the five different scenarios.

Table 16. Test Scenarios

Criteria	1. Scenario	2. Scenario	3. Scenario	4. Scenario	5. Scenario
Age (C1)	+0.20	-0.05	-0.05	-0.05	-0.05
Physical Resilience (C2)	+0.20	-0.05	-0.05	-0.05	-0.05
Effective communication skills (C3)	-0.05	+0.20	-0.05	-0.05	-0.05
Not Being Introverted (C4)	-0.05	+0.20	-0.05	-0.05	-0.05
Education Status (C5)	-0.05	-0.05	+0.20	-0.05	-0.05
Computer Information (C6)	-0.05	-0.05	+0.20	-0.05	-0.05
Ability to Work for a Long Time (C7)	-0.05	-0.05	-0.05	+0.20	-0.05
Professional Experience (C8)	-0.05	-0.05	-0.05	+0.20	-0.05
Driving License (C9)	-0.05	-0.05	-0.05	-0.05	+0.20
Reference (C10)	-0.05	-0.05	-0.05	-0.05	+0.20

In the first scenario, the weighting of the "Age" and "Physical Resilience" criteria from the PSI method is increased by 20%, while the other main criteria's weights are reduced by 5%. The changes in the alternatives in the PSI-ARAS method are shown in Table 17.

Table 17. Test Scenario Results of the PSI-ARAS Model

Alternatives	1. Scenario	2. Scenario	3. Scenario	4. Scenario	5. Scenario
Candidate A	0.817	0.815	0.803	0.812	0.802
Candidate B	0.766	0.770	0.751	0.746	0.754
Candidate C	0.681	0.684	0.705	0.691	0.690

When looking at the results of the five different scenarios in Table 17, it can be seen that there is no change in the ranking of the candidates. In general, the results of the PSI-ARAS method have been around 0.800 for candidate A, 0.700 for candidate B, and 0.600 for candidate C. Proceeding from this, it can be clearly seen that there is a difference in the scores of only the 3rd scenario for candidate C. However, there has been no change in the ranking of the candidates. The fact that there is no change in the results of the five different scenarios in the sensitivity analysis indicates that the model is adequate.

5. Conclusions and Recommendations

One of the core activities of cargo shipping companies is their operational processes. The efficiency of these processes largely depends on the competence of their personnel. In this regard, the selection of operational personnel in cargo companies is a critical process. The reason for this is that not all of the numerous criteria required of operational personnel can be found in a single candidate at a sufficient level. Due to the large number of criteria required in candidates and the varying levels of influence, this study has been conducted using multi-criteria decision-making methods to guide personnel selection in cargo companies. Furthermore, when reviewing studies on

personnel selection practices, it has been determined that multi-criteria decision-making methods are used. However, no research has been found in which the methods used in the study have been applied separately or together. Therefore, this study proposes an integrated model of two multi-criteria decision-making methods for personnel selection.

In this study, ten criteria and three candidates are evaluated based on the opinions of decision-makers. The PSI, ARAS and PSI-ARAS integrated methods have been employed for this evaluation. The results of all three methods are shown in Table 16.

In Table 7, which shows the criterion weights in the PSI method, it can be seen that 'age (C1)', 'not being introverted (C4)' and 'professional experience (C8)' are the most important criteria, 0.117, 0.118 and 0.119, respectively. In other words, the criteria are the most influential criteria in personnel selection decisions. Also, the driving license (C9) criterion is seen as the least important, with a value of 0.068. In other words, according to the PSI method, this criterion has the least influence on the decision-making process. When the results of the method are ranked in order of suitability, the candidates are ranked as follows: A (0.774), B (0.766) and C (0.735).

When the optimal decision weights (ODW) values in the application of the ARAS method were analysed, it was determined that the criterion of not being an introvert (C4) with a value of 0.124 and the educational status (C5) with a value of 0.123 were the most important criteria among the criteria determined. The criterion with the lowest ODW value was the reference (C10) criterion, with a value of 0.052. According to the ARAS method, the criteria with the greatest impact on the decision-making process are introversion (C4) and educational level (C5). The criterion with the lowest impact is the reference criterion (C10). When the results of the method are ranked by score, the order is A (0.836), B (0.789) and C (0.651). In other words, candidate A is deemed the most suitable according to the ARAS method.

The PSI-ARAS method was used as an integrated approach in this study. The criterion weights from the PSI method were used. Then, the normalized matrix calculated using the ARAS method was employed. According to the calculation results, candidate A has been determined to be the most suitable with a score of 0.810. Candidates B and C ranked second and third with values of 0.757 and 0.690, respectively.

When the methods applied in the study are evaluated, it is also seen that the scores of the candidates determined by the PSI-ARAS integrated method produced a clearer result compared to the PSI and ARAS evaluation scores. In order to obtain more positive and clearer results, it is possible to differentiate the applied methods with fuzzy logic by adding or removing different criteria to the evaluation criteria. Finally, this study is thought to be a guide for other studies to be conducted in similar or different fields.

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