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Application of AHP Technique for the selection of Military Warehouse: An Empirical Analysis for Turkey

Askeri Depo Yer Seçiminde AHP Tekniğinin Uygulanması: Türkiye İçin Ampirik Bir Analiz

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ÖZET

Askeri lojistiğin sürdürülebilirliği ve devamlılığı için askeri depolar kritik öneme sahiptir. Askeri depolar askeri birliklerin doğrudan ihtiyaçlarının karşılanmasının yanı sıra bakım ve onarım için yedek parça ihtiyaçlarının karşılanmasında da etkin rol oynarlar. Bu araştırmanın temel amacı Türkiye'deki askeri birliklerin ihtiyacı olan askeri depolara ait yer tespitinin yapılmasıdır. Bu amaç doğrultusunda 5 ayrı bölge oluşturulmuştur. Her bir bölge için en iyi askeri depo bölgesi belirlenmiştir. Araştırma'da Analitik hiyerarşi süreç tekniği uygulanmıştır. Problemin çözümünde 9 kriter kullanılmıştır. Kriter ve alternatiflerin ikili karşılaştırılması askeri lojistik alanında uzman 20 karar verici tarafından değerlendirilmiştir. Birinci bölgede 7 alternatif arasından en iyi alternatif noktası İstanbul'dur. İkinci bölgede 10 alternatif arasından en iyi alternatif noktası İzmir'dir. Üçüncü bölgede 14 alternatif arasından en iyi alternatif noktası Ankara'dır. Dördüncü bölgede 9 alternatif arasından en iyi alternatif noktası Erzurum'dur. Beşinci bölgede 13 alternatif arasından en iyi alternatif noktası Malatya'dır. Araştırma sonucunda elde edilen bulgulara dayalı çıkarımlar paylaşılmıştır.

Keywords:

Military Logistics

Military Warehouse Location Selection

Multi Criteria Decision Making

Analytic Hierarchy Process,

ABSTRACT

Military warehouses are of critical importance for the sustainability and continuity of military logistics. Military warehouses also play an active role in responding to the direct needs of military units, as well as spare parts for maintenance and repair. The main purpose of this research is to determine the location of the military warehouses needed by the military units in Turkey. For this purpose, 5 different regions have been created. The best military warehouse location is determined for each region. Analytical hierarchy process (AHP) technique is applied in the research. 9 criteria are used to solve the problem. Pairwise, comparison of criteria and alternatives is evaluated by 20 decision makers who are experts in the field of military logistics. Among the 7 alternatives in the first region, the best alternative location is Istanbul. Among the 10 alternatives in the second region, the best alternative location is İzmir. Among the 14 alternatives in the third region, the best alternative location is Ankara. Among the 9 alternatives in the fourth region, the best alternative location is Erzurum. Among the 13 alternatives in the fifth region, the best alternative location is Malatya. Implications based on the findings obtained are shared.

1. INTRODUCTION

In the decision-making processes, individuals, groups, and institutions try to choose the best alternative for the solution of the problems. This effort sometimes gives successful results, sometimes not. At this point, the question of how successful decision making happens is encountered. There are four key points for successful decision making. These are (i) correct identification of the problem. (ii) determining and weighting the criteria correctly (iii) determining the alternatives and ranking according to the criteria weights (iv) choosing the best among the alternatives (Dağdeviren and Eren, 2001). In the literature, it is seen that multi-criteria decision-making (MCDM) technique are applied to get successful results in the solution of problems (Özkan, 2007; Karakaya, 2009; Yontar, 2014). In MCDM techniques, the focus is on minimizing the cost criteria and maximizing the benefit criteria.

The main factor to be considered in decision-making processes is the scarcity of resources. For this reason, it is necessary to determine the best alternative before making mistakes (Tugay, 2017). The choice of the best alternative depends on the degree to which managers can make rational decisions (Keskinocak, 2012). The establishment of warehouses, which are connection points in supply chain processes, in the right place is of vital importance in the successful realization of procurement activities. At this point, warehouse location selection problems emerge. As with other decision-making problems, the warehouse location problem directly affects the operational performance of companies and institutions. For this reason, based on which criteria the warehouse should be preferred among which alternatives, it should be planned and applied correctly (Baran, 2017).

In military logistics activities, supply points and main warehouses are among the indispensable elements in the success of military activities. Ground operations depends on the correct deployment and determination of warehouse locations in terms of logistics. Considering Turkey's military power and geographical location, military warehouse points should be created correctly. To increase Turkey's military logistics performance, it is aimed to determine the regions where military warehouses should be located. At the same time, it is aimed to set the criteria for determining the location of military warehouses correctly. In addition, it is aimed to choose the best alternatives by considering the opinions of military experts. In the decision-making process, it is decided to apply the Analytical Hierarchy Process (AHP) technique.

In line with the above-mentioned purposes, a literature review on site selection problems is presented in the second part of the research. In the third part, the research method, criteria and AHP technique are explained. In the fourth part, the application of the military warehouse location selection problem is given. In the last part, implications and recommendations based on the findings are presented.

2. LITERATURE REVIEW

In the literature, there are many studies on the warehouse location selection problem. Although there are sectoral differences, it is important to determine the best alternative based on appropriate criteria in warehouse location problems. The literature review of the warehouse location problem focused on the criteria, alternatives, techniques, and problems.

Yang and Lee (1999) handled the facility layout problem using the AHP method. In the study, there are 3 alternatives and 16 criteria. Also, the Expert Choice program was used. Badri (1999) addressed the plant location problem for a petrochemical company. 6 alternatives and 4 criteria were used in the research. Alberto (2000) realized the plant location problem for a company that manufactures packaging machines. There are 3 alternatives and 32 criteria. Aydın (2008) used the AHP method to make an investment decision that produces industrial facilities. Expert Choice program was used in the study with 9 alternatives and 7 criteria. Erden (2009) analyzed the emergency room locations using the AHP method. 35 alternatives and 6 criteria were determined. Tüzmen (2010) used the AHP method for gas station location selection. In the study, there were 3 alternatives and 31 criteria and Microsoft Excel, and Expert Choice programs were used.

Şimşek (2011) discussed the problem of hospital location selection in Turkey. 31 criteria and 3 alternatives were determined. Microsoft Excel and Expert Choice programs were used. İmren (2011) discussed the problem of choosing the most suitable warehouse location for the furniture industry. In the study, 19 criteria and 4 alternatives were determined, and Expert Choice program was used. Erdem (2012) dealt with the problem of port location selection for combined transport. In the study, 16 criteria and 4 alternatives are included. In addition, Microsoft Excel program was used. Opasanon and Lertsant (2012) discussed the logistics facility

location problem of a company. 4 criteria and 5 alternatives were used. Ashrafzadeh et al. (2012) used the Fuzzy AHP method for the warehouse location selection of a company in Iran. 27 criteria and 3 alternatives were determined. Yiğitel (2013) examined the location selection problem for cable television network topology using AHP and Geographical Information System methods. Using the Super Decision program, 17 criteria and 3 alternatives were determined. Chakrabort (2013) tried to solve the problem of warehouse location selection with different MCDM methods by determining 6 criteria and 4 alternatives.

Saraçoğlu (2013) dealt with the problem of port location selection for industrial investments. Using the Expert Choice program, 9 criteria and 14 alternatives were used. Akbaş (2014) solved the hotel selection problem in Turkey. Using Matlab and WinQSB programs, the best alternative was selected among 7 alternatives, considering 6 criteria. Ağdaş (2014) dealt with the location selection problem for the logistics facility of a public institution with various MCDM methods. By using SPSS and JSMAA programs, the best alternative was reached among 25 criteria. Bagum and Rashed (2014) identified 10 criteria and 7 alternatives and addressed a drug distribution center location problem in Bangladesh. Koç and Burhan (2015) identified 21 criteria and 3 alternatives and discussed the location problem of a store to be opened for the Carglass company.

Acar et al. (2015) applied 5 criteria and 5 alternatives in the problem of determining the location of regional recycling centers. Güler (2016) discussed 13 criteria and 4 alternatives in the selection of landfills. Üke (2016), who determined 10 criteria and 8 alternatives, solved the shopping mall location problem. In addition, Expert Choice program was used. Boltürk et al. (2016) solved the problem of humanity logistics warehouse location selection with 9 criteria and 5 alternatives. Baran (2017) used AHP and 0-1 Goal Programming methods for warehouse location selection. Kayıran (2018) tried to determine the most valuable point for investment. For this, a total of 70 criteria and 98 alternatives were used. The WEKA program was utilized in the research. Many studies in the literature support that the AHP technique is the appropriate technique for site selection problems. For this reason, it was decided to apply the AHP technique in the selection of military warehouse location.

3. METHODOLOGY

In this research, in which the military warehouse location selection problem is discussed, it is aimed to solve the problem with AHP, one of the MCDM techniques. In the first phase of the research methodology, the problem addressed is defined. Then, criteria and alternatives for the problem addressed are determined. Before proceeding to the application phase, the AHP technique is explained step by step.

3.1. Defining the Problem, Determining the Criteria and Alternatives

The first and most important step of the decision-making problem is to provide the correct definition of the problem. In this research, determining the location of military warehouses, which is the main connection point, has been accepted as a research problem to increase the success of military logistics. With the solution of the identified problem, it is aimed to get better logistics support for ground operations. At this point, the criteria that will play a role in the solution of the problem should be determined correctly. According to the literature review and interviews with decision makers, 9 basic criteria have been determined. These criteria are "*Proximity to maintenance and repair facility (C1), Safety/Security Status (C2), Amount of need (C3), Climatic conditions, (C4), Distance to disaster area (C5), Proximity to industrial area (C6), Proximity to suppliers (C7), Proximity to military units (C8), Proximity to main transportation points (C9)*".

Military main warehouses are basically planned to meet the needs of military units. To provide a sustainable competitive advantage in military unit operations, regular maintenance and repair of materials and equipment is needed. The element that plays an active role in maintenance and repairs is the supply of spare parts. For the maintenance and repair activities to be carried out on time, the supply of spare parts from the military warehouses must be carried out quickly. For this reason, the military storage location should be as close to the current and repair facility as possible. At this point, "*proximity to maintenance and repair facility*" has been determined as the first criterion for the solution of the problem.

In military operations, logistics bases are among the primary target points of enemy forces. Military warehouses are among these targets. In addition, considering the critical importance of the materials stored in military warehouses, it highlights the necessity of establishing them in safe areas. For this reason, our second criterion has been determined as "*Safety/Security Status*". Military units are deployed according to the need in ground operations. Although this situation of need sometimes changes, it is deployed in accordance with general

military doctrines. Thus, the amount of need is determined according to the density of the military unit. The reason for the existence of military warehouses is to meet these needs. At this point, "*amount of need*" has been evaluated as the third criterion.

Climate conditions are among the important factors affecting military operations. Climatic conditions are also one of the factors that determine the equipment of military units. To ensure the continuity of logistics activities in all climatic conditions, military warehouses are expected to be accessible. For this reason, the climatic conditions of the military warehouse installation point must be favorable. For this reason, "*climatic conditions*" has been accepted as the fourth criterion. It is vital to consider disaster situations in facility installation planning. This is also true for military warehouses. It is important for the military warehouse to be as far away from disaster areas as possible for minimum damage. Therefore, "*distance to the disaster area*" was considered as the fifth criterion. The defense industry is industrial formations that support the technological development of military units. For this reason, it is important that military logistics points and industrial zones are close and act in cooperation. In addition, material supply to military warehouses is carried out from industrial zones. For this reason, "*proximity to the industrial area*" has been evaluated as the sixth criterion.

Military equipment suppliers play an important role in the procurement of military equipment. The distance between the supply points and the material delivery points determines the speed of the logistics service in domestic and international supplies. For this reason, "*closeness to suppliers*" has been determined as the seventh criterion. The distance between the location of the military units involved in ground operations and the location of military warehouses directly affects the logistical success of procurement and procurement activities. For this reason, "*proximity to military units*" has been accepted as the eighth criterion in solving the problem. "*Proximity to main transportation points*" was evaluated as the last criterion in determining the location of military warehouses. The main reason for this is the necessity of convenient transportation between military units, maintenance facilities, suppliers and other elements interacting with military warehouses.

As a result of the evaluations made with the decision makers in Turkey, it has been decided that 5 main warehouses should be established by grouping the existing units. For the establishment of 5 military warehouses, alternative zones have been determined for each military warehouse. Considering the confidentiality of military information, regions are described as regions, not geographical points. For the establishment of 5 military warehouse, alternative zones have been determined for each military warehouse. Considering the confidentiality of military information, regions are described as regions, not geographical points. 7 alternative regions have been determined for the first military warehouse. 10 alternative areas have been determined for the second military warehouse. For the third military warehouse, 14 alternative regions have been determined. For the fourth military warehouse, 9 alternative regions have been determined. 13 alternative sites have been identified for the fifth military warehouse. The criteria and alternatives used in the study are presented in Table 1.

Table 1. Criteria and Alternatives

Criteria	**Alternatives**	
Proximity to maintenance and repair facility (C1), Safety/Security Status (C2), Amount of need (C3), Climatic conditions, (C4), Distance to disaster area (C5), Proximity to industrial area (C6), Proximity to suppliers (C7), Proximity to military units (C8), Proximity to main transportation points (C9)	1st Military Warehouse	Edirne (1A), Kırklareli (1B), Tekirdağ (1C), İstanbul (1D), Kocaeli (1E), Sakarya (1F), Bursa (1G).
	2nd Military Warehouse	İzmir (2A), Çanakkale (2B), Balıkesir (2C), Manisa (2D), Afyon (2E), Isparta (2F), Aydın (2G), Denizli (2H), Burdur (2I), Antalya (2J).
	3rd Military Warehouse	Ankara (3A), Bolu (3B), Çankırı (3C), Kırıkkale (3D), Konya (3E), Niğde (3F), Amasya (3G), Samsun (3H), Sivas (3I), Kayseri (3J), Adana (3K), Mersin (3L), Gaziantep (3M), Hatay (3N).
	4th Military Warehouse	Erzurum (4A), Erzincan (4B), Bayburt (4C), Trabzon (4D), Artvin (4E), Ardahan (4F), Kars (4G), Iğdır (4H), Ağrı (4I).
	5th Military Warehouse	Diyarbakır (5A), Malatya (5B), Tunceli (5C), Elazığ (5D), Bingöl (5E), Muş (5F), Bitlis (5G), Siirt (5H), Van (5I), Şırnak (5J), Hakkari (5K), Mardin (5L), Şanlıurfa (5M)

3.2. Analytic Hierarchy Process Technique

The decision-making process is defined as the selection of the most appropriate alternative among the available alternatives to reach the goal (Sarıçalı and Kundakcı, 2016). In problem solving, decision makers are always directed to choose the best among the alternatives. A decision should be made to choose one of these alternatives (Tugay, 2017). Decision making can simply be defined as determining the importance of alternatives and performing a elimination process as a result. The success of this elimination process is the accurate determination of the needs and the high accuracy of the pairwise comparisons (Baran, 2017).

The AHP method, one of the MCDM methods, was introduced by Saaty in the 1970s. The AHP technique, which incorporates subjective criteria into the problem, ensures that the most appropriate choice is made among the alternatives (Gülner, 2016). The basis of the AHP method is the weights of the criteria and alternatives. Here, the knowledge and experience of the decision makers directly affect the decision (Keskinocak, 2012).

The steps of the AHP technique are as follows;

Step-1: *Defining the Problem*: In this step, the decision problem is clearly revealed.

Step-2: *Determination of Criteria and Alternatives*: In this step, criteria for solving the problem are determined. In addition, possible alternatives for the solution of the problem are created.

Step-3: *Creation of the Hierarchical Structure*: In this step, the decision hierarchy model is created.

Step-4: *Making Pairwise Comparisons of the Criteria*: In this step, decision makers are asked to make a pairwise comparison of the criteria. Pairwise comparisons are converted to matrix with the help of Eq. 1.

$$\begin{bmatrix} g_{11} & g_{12} & \cdots & g_{1n} \\ g_{21} & g_{22} & \cdots & g_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ g_{n1} & g_{n2} & \cdots & g_{nn} \end{bmatrix} = \begin{bmatrix} 1 & g_{12} & \cdots & g_{1n} \\ 1/g_{21} & 1 & \cdots & g_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ 1/g_{n1} & 1/g_{n2} & \cdots & 1 \end{bmatrix} \quad (1)$$

$$B = [g_{kl}]_{nxn} \;\; k = 1,2,\dots n \;\; l = 1,2,\dots n$$

$$If \; g_{kl} = y \; then \; g_{lk} = \frac{1}{y}, \; y \neq 0$$

Step-5: *Calculation of Priority Vectors*: With Eq. 2, the pairwise comparison matrix is normalized. Eq. 3 is converted to matrix. Eq. 4 determines the priority vector of the criteria. Eq. 5 is converted to matrix.

$$c_{kl} = \frac{g_{kl}}{\sum_{k=1}^{n} g_{kl}} \quad (2)$$

$$C = \begin{bmatrix} c_{11} & c_{12} & \cdots & c_{1n} \\ c_{21} & c_{22} & \cdots & c_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ c_{n1} & c_{n2} & \cdots & c_{nn} \end{bmatrix} \quad (3)$$

$$w_j = \frac{\sum_{l=1}^{n} c_{kl}}{n} \quad (4)$$

$$W = \begin{bmatrix} w_1 \\ w_2 \\ \cdot \\ \cdot \\ w_n \end{bmatrix} \quad (5)$$

Step-6: *Performing the Consistency Test*: In this step, the consistent index (CI) of the Comparisons is calculated by Equation 8. It is compared to a random consistency index (RI; if N=2 then *RI*=0.0; if N=3 then *RI*=0.52; If N=4 then *RI*=0.89. if N=5 then *RI*=1.11; if N=6 then *RI*=1.25; if N=7 then *RI*=1.35; if N=8 then *RI*=1.40; if N=9 then *RI*=1.45; If N=10 then *RI*=1.49.). The consistency ratio (CR) is calculated by Eq. 7. If CR < 0.10, the consistency ratio is acceptable.

$$CI = (\lambda_{max} - n)/(n-1)\ ,\ \lambda_{max} = \frac{\sum_{i=1}^{n} e_i}{n}\ ,\ e_i = \frac{d_i}{w_i}\ ,\ BxW = \begin{bmatrix} g_{11} & g_{12} & \cdots & g_{1n} \\ g_{21} & g_{22} & \cdots & g_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ g_{n1} & g_{n2} & \cdots & g_{nn} \end{bmatrix} x \begin{bmatrix} w_1 \\ w_2 \\ . \\ . \\ w_n \end{bmatrix} = \begin{bmatrix} d_1 \\ d_2 \\ . \\ . \\ d_n \end{bmatrix} \quad (6)$$

$$CR = CI/RI \quad (7)$$

Step-7: *Making Pairwise Comparisons of the Alternatives for Each Criterion, Calculating the Percent Weights, and Performing the Consistency Analysis*: Step-4, Step-5 and Step-6 are calculated according to the alternatives for each criterion.

Step-8: *Calculating the Weights of the Alternatives and Determining the Best Alternative*: A ranking is made according to the weights and the alternative with the highest weight is preferred.

4. APPLICATION

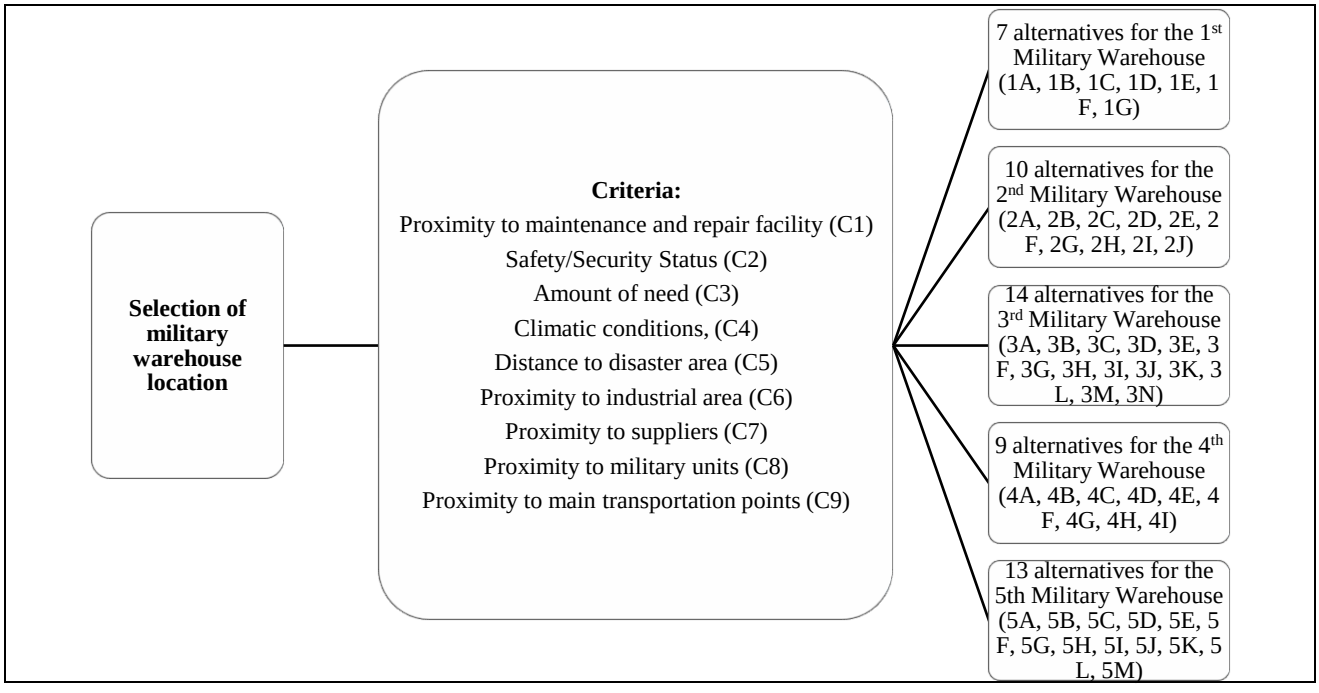
In this application, it is aimed to determine the military warehouses points in Turkey. The criteria and alternatives for the determination of military warehouse location are explained in the methodology section. Pairwise comparison matrices of the research were collected from 20 decision makers who are experts in the field of military logistics. The AHP technique was deemed appropriate for the application. The application steps of the AHP technique are also presented in the Methodology section. In this section, the 5 best military storage locations have been determined by applying the AHP step by step.

Step-1: *Defining the Problem*: The problem is to determine the best alternative regions for the 5 military warehouses proposed to be established in Turkey.

Step-2: *Determination of Criteria and Alternatives*: 9 criteria have been determined. 7 alternatives for the first military warehouse, 10 alternatives for the second military warehouse, 14 alternatives for the third military warehouse, 9 alternatives for the fourth military warehouse, and 13 alternatives for the fifth alternative were determined. The criteria and alternatives are presented in Table 1.

Step-3: *Creation of the Hierarchical Structure*: The decision hierarchical structure of the problem is shown in the Figure 1.

Figure 1. The Decision Hierarchical Structure



Step-4: *Making Pairwise Comparisons of the Criteria*: With Eq. 1, the pairwise comparison matrix of the criteria was obtained (Appendix-1).

Step-5: *Calculation of Priority Vectors*: The priority vector of the criteria (w) is calculated by Eq. 2-5. The resulting priority vector is shown in Table 2.

Table 2. Priority Weights of Criteria

	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**
W	0,05367	0,30549	0,10413	0,02754	0,01688	0,10515	0,05031	0,21042	0,12641

Step-6: *Performing the Consistency Test*: Consistency rate was determined by Equation 6-7 and determined as *CR=0,09063*. It is mentioned that the comparison of the criteria is consistent because it is less than 0,10.

Step-7: *Making Pairwise Comparisons of the Alternatives for Each Criterion, Calculating the Percent Weights, and Performing the Consistency Analysis*: For each military warehouse, it was requested from the decision makers to compare the alternatives for each criterion. Matrices were formed by taking the geometric mean of the pairwise comparisons of the decision makers. The calculations in Step-4, Step-5 and Step-6 were made for each military warehouse and the importance weight of each alternative was determined.

The criteria weights for each alternative for the 1st military warehouse are presented in Table 3.

Table 3. Criteria Weights for Each Alternative for the 1st Military Warehouse

Alternatives	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**
1A	0,03184	0,21319	0,10641	0,03703	**0,26778**	0,03177	0,02440	0,02732	0,03055
1B	0,03480	**0,26439**	0,18492	0,02321	0,19446	0,04407	0,02946	0,03990	0,02322
1C	0,17264	0,24340	**0,41715**	0,05551	0,19446	0,05335	0,11455	0,13273	0,04820
1D	**0,36817**	0,03815	0,18492	**0,46491**	0,21323	**0,43494**	**0,57053**	**0,42578**	**0,47280**
1E	0,19071	0,07224	0,03381	0,13265	0,03927	0,15799	0,14327	0,24827	0,15387
1F	0,16784	0,09195	0,04191	0,08317	0,04815	0,10447	0,09554	0,10395	0,07198
1G	0,03399	0,07668	0,03087	0,20351	0,04265	0,17342	0,02225	0,02205	0,19938
Consistency rate (CR)	0,01032	0,03804	0,01660	0,09059	0,01600	0,08539	0,09564	0,06986	0,07976

The criteria weights for each alternative for the 2nd military warehouse are presented in Table 4.

Table 4. Criteria Weights for Each Alternative for the 2nd Military Warehouse

Alternatives	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**
2A	0,18250	0,03734	0,21769	**0,18033**	0,12791	0,22383	**0,47819**	0,11734	**0,26991**
2B	0,08459	0,08872	**0,37457**	0,09002	0,11074	0,05318	0,02875	0,01535	0,17266
2C	**0,22128**	0,08340	0,10448	0,14047	0,11703	0,07578	0,07670	0,05676	0,09992
2D	0,20200	0,07269	0,02970	0,06323	0,02558	0,09522	0,16281	**0,21709**	0,06439
2E	0,07533	0,11330	0,02970	0,02444	0,02215	0,03461	0,02922	0,08663	0,01939
2F	0,02837	**0,14161**	0,04979	0,04929	0,12725	0,05396	0,02240	0,06345	0,02314
2G	0,08180	0,09875	0,05361	0,15576	0,10399	0,06746	0,10091	0,16029	0,04799
2H	0,07533	0,13859	0,05361	0,02715	**0,13808**	0,08105	0,05952	0,18328	0,03966
2I	0,03185	0,13859	0,02970	0,03239	0,11024	0,05262	0,02476	0,07652	0,03710
2J	0,01694	0,13859	0,03216	0,03239	0,11703	**0,26227**	0,01674	0,03328	0,22585
Consistency rate (CR)	0,01246	0,02630	0,01107	0,05337	0,01316	0,09887	0,06122	0,01920	0,06021

The criteria weights for each alternative for the 3rd military warehouse are presented in Table 5.

Table 5. Criteria Weights for Each Alternative for the 3rd Military Warehouse

Alternatives	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**
3A	0,08319	0,03685	**0,25702**	0,02464	0,01121	**0,26990**	**0,13756**	0,09776	0,10678
3B	0,01585	0,08067	0,08708	0,05580	0,14131	0,04282	0,02408	0,01506	0,04829
3C	0,04042	0,12896	0,02607	0,02496	0,12777	0,01494	0,06557	0,06887	0,04829
3D	0,09463	0,09696	0,02469	0,02432	**0,14976**	0,01618	0,11234	0,15819	0,01565
3E	0,11977	0,06350	0,04429	0,02613	0,12577	0,13422	0,09375	0,06422	0,03123
3F	**0,17268**	0,12825	0,02553	0,03399	0,13259	0,13422	0,11234	0,14487	0,02976
3G	0,02626	0,12825	0,02607	0,04028	0,03564	0,02858	0,02564	0,05748	0,03019
3H	0,01274	0,05626	0,02607	0,13890	0,03642	0,06781	0,01095	**0,16790**	0,17787
3I	0,03989	**0,13463**	0,02607	0,01864	0,01134	0,02943	0,02531	0,06276	0,17787
3J	0,16293	0,07344	0,03087	0,02583	0,01195	0,08641	0,08831	0,16502	0,03081
3K	0,09071	0,01265	0,02607	0,12221	0,01081	0,10979	**0,13756**	0,05996	0,08948
3L	0,07524	0,02180	0,02839	**0,19482**	0,03642	0,06519	0,11044	0,05437	**0,19038**
3M	0,02995	0,01633	0,16913	0,08515	0,13259	0,07292	0,02742	0,02198	0,06611
3N	0,03571	0,02632	0,20265	0,18432	0,03642	0,03313	0,02872	0,01268	0,13523
Consistency rate (CR)	0,01214	0,03885	0,00845	0,02113	0,03171	0,07238	0,01801	0,02201	0,06714

The criteria weights for each alternative for the 4th military warehouse are presented in Table 6.

Table 6. Criteria Weights for Each Alternative for the 4th Military Warehouse

	5	**9**	**8**	**7**	**6**	**2**	**4**	**1**	**3**
Alternatives	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**
4A	**0,25645**	0,04198	0,23156	0,05432	0,01638	**0,38203**	**0,51504**	**0,29566**	0,16998
4B	**0,25645**	**0,36575**	0,05550	0,13485	0,03751	0,10716	0,06940	0,02948	0,10940
4C	0,22805	0,07642	0,04504	0,14237	0,23723	0,08796	0,13968	0,13958	0,03794
4D	0,05700	0,12453	0,03803	0,07753	0,23723	0,22559	0,02212	0,03570	**0,37171**
4E	0,04727	0,10421	0,04294	0,07355	0,03670	0,05995	0,04947	0,13958	0,08636
4F	0,03972	0,04205	0,02728	0,07355	**0,24105**	0,02055	0,04947	0,15812	0,02678
4G	0,04727	0,04401	0,13934	0,07337	0,09214	0,04381	0,05954	0,14771	0,06047
4H	0,02054	0,03666	0,05550	**0,29935**	0,23166	0,04075	0,02432	0,02470	0,04576
4I	0,04727	0,03563	**0,36481**	**0,29935**	0,09096	0,03220	0,07462	0,02948	0,09159
Consistency rate (CR)	0,01064	0,03887	0,04198	0,04125	0,09096	0,08347	0,04088	0,00806	0,08627

The criteria weights for each alternative for the 5th military warehouse are presented in Table 7.

Table 7. Criteria Weights for Each Alternative for the 5th Military Warehouse

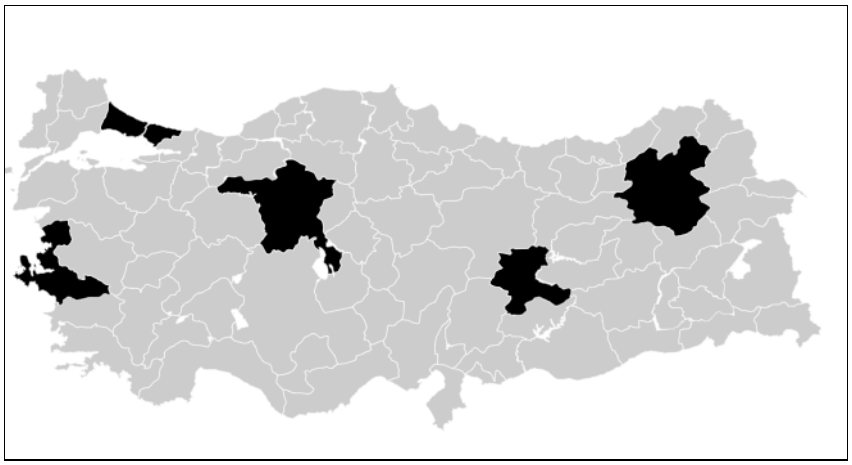
Alternatives	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**
5A	**0,16427**	0,04496	0,09412	0,15283	0,06495	0,19015	**0,41473**	**0,13960**	0,16051
5B	0,08778	**0,30943**	0,02893	**0,26999**	0,01810	**0,27032**	0,03497	0,02873	**0,19804**
5C	0,08575	0,03476	0,03702	0,01145	0,02019	0,02261	0,03028	0,04086	0,04070
5D	**0,16427**	0,19555	0,04578	0,03046	0,01885	0,12728	0,07288	0,08266	0,10933
5E	0,08942	0,03820	0,03544	0,02163	0,01267	0,02861	0,08027	0,12631	0,03591
5F	0,07344	0,03226	0,02740	0,19710	0,01810	0,02906	0,03409	0,13520	0,03942
5G	0,06094	0,03695	0,03303	0,08286	0,02019	0,02633	0,05009	0,12906	0,04426
5H	0,06094	0,06602	0,04289	0,08443	0,16061	0,02469	0,06012	0,11212	0,04139
5I	0,02029	0,11094	0,04828	0,03163	**0,18850**	0,11011	0,01629	0,02927	0,04139
5J	0,02763	0,01568	0,16236	0,03408	0,15421	0,01917	0,03107	0,04103	0,02204
5K	0,01188	0,01568	**0,32738**	0,04256	0,17207	0,01158	0,01087	0,01972	0,02204
5L	0,08778	0,04926	0,07666	0,07627	0,16061	0,03489	0,10421	0,08081	0,09863
5M	0,06560	0,05030	0,04071	0,14209	0,16061	0,10521	0,06012	0,03463	0,09863
Consistency rate (CR)	0,03150	0,06173	0,01365	0,09699	0,02434	0,05670	0,03745	0,08231	0,05315

Step-8: *Calculating the Weights of the Alternatives and Determining the Best Alternative*: Alternatives are listed by calculating the total weights of the alternatives. Weights of alternatives and their ranking are presented in Table 8. The map showing the location of the alternatives is presented in Figure 2.

Table 8. Weights and Ranking of Alternatives

1st Mil. Warhouse		**Rank**	**2nd Mil. Warhouse**		**Rank**	**3rd Mil. Warhouse**		**Rank**	**4tf Mil. Warhouse**		**Rank**	**5th Mil. Warhouse**		**Rank**
1A	0,09764	5	**2A**	**0,15740**	**1**	**3A**	**0,11272**	**1**	**4A**	**0,24159**	**1**	5A	0,12818	2
1B	0,12326	4	2B	0,10709	4	3B	0,05347	13	4B	0,17041	2	**5B**	**0,17125**	**1**
1C	0,17727	2	2C	0,09048	7	3C	0,06685	8	4C	0,09864	4	5C	0,03738	13
1D	**0,29087**	**1**	2D	0,11034	2	3D	0,08309	4	4D	0,12681	3	5D	0,12274	3
1E	0,13565	3	2E	0,06858	10	3E	0,06957	5	4E	0,09057	5	5E	0,05914	8
1F	0,09133	6	2F	0,07655	9	3F	0,09719	2	4F	0,06503	8	5F	0,05570	10
1G	0,08398	7	2G	0,09815	5	3G	0,06544	9	4G	0,08039	6	5G	0,05866	9
			2H	0,10803	3	3H	0,05872	11	4H	0,04673	9	5H	0,06739	6
			2I	0,09536	6	3I	0,06829	6	4I	0,07983	7	5I	0,06984	5
			2J	0,08802	8	3J	0,08745	3				5J	0,04172	12
						3K	0,05739	12				5K	0,05229	11
						3L	0,06755	7				5L	0,07094	4
						3M	0,05082	14				5M	0,06478	7
						3N	0,06144	10						

Figure 2. The Best Alternatives Locations for Military Warehouses



5. CONCLUSION

Military warehouses have strategic importance in both peacetime and military operations. For this reason, it is necessary to create military warehouses in accordance with the general military doctrine structure. In addition to the qualitative importance of military warehouses, it is vital to accurately determine the area where the warehouse is located. With this research, the installation points of five military warehouses were determined according to the criteria and alternatives. Firstly, the weights of the criteria were calculated with the AHP technique. The criterion with the highest weight is "*Safety/Security Status (30.549%)*". The criterion with the lowest weight is "*Distance to disaster area (1.688%)*". Weights of other criteria are respectively "*Proximity to military units (21.042%)", "Proximity to main transportation points (12.641%)", "Proximity to industrial area (10.515%)", "Amount of need (10.413%)", "Proximity to maintenance and repair facility (% 5.367)", "Proximity to suppliers (5.031%)", "Climatic conditions (2.754%)*". According to the importance of the criteria, the decision makers should consider the safety and security situations in determining the military warehouse location. Since military facilities are accepted as the first target by the enemy forces, this criterion supports the first importance level. In addition, the establishment of a military warehouse in a region close to the military units is of great importance for the duration of logistics services. The fact that the "*Proximity to military units*" criterion ranks second in the criterion weight supports the high level of consideration of logistics speed.

Although natural disasters negatively affect facilities, the fact that they are less likely to occur explains the "*Distance to disaster area*" criterion being at the lowest level of importance.

Turkey's geographical structure directly affects the availability of transportation opportunities. In addition, Turkey's geopolitical position directly affects the deployment of military units. For these reasons, it is considered that it would be appropriate to establish five separate warehouses in five different regions. The best alternative regions should be determined by considering the military units in each region and the determined criteria. Istanbul (1D) is the region where the 1st military warehouse should be established as a result of the application of the AHP technique. The high number of military units in Istanbul and its critical importance support the presence of the first military warehouse in this region. The 2nd military warehouse location is İzmir (2A). The location of the military units in the western part of Turkey and the high industrialization in this region support İzmir to be the best alternative. The 3rd military warehouse location is Ankara (3A). Ankara, the capital of Turkey, has a politically active role and being the center of the troops in Central Anatolia supports the establishment of a military warehouse in this region. Erzurum (4A) was identified as the 4th military warehouse location. Erzurum has a transitional position between Eastern Anatolia and Black Sea regions. The fact that military warehouses are connection points supports this determination. The 5th military warehouse location is Malatya (5B). It supports the result that Malatya is in a critical position in terms of supporting the military units in the Southeastern Anatolia region.

In this research, AHP technique was performed to solve the military warehouse location selection problem. However, solving the same problem with various MCDM techniques and comparing the results is important to support the findings. At this point, researchers are advised to apply different MCDM techniques in the military warehouse location problem. In addition, the limitations of the research are as follows: (i) It is assumed that Turkey should be divided into five military zones and five military warehouses should be established. (ii) The criteria are weighted by considering the deployment of existing military units. (iii) 9 basic criteria were taken into consideration for the solution of the problem. (vi) Turkey's provinces have been accepted as alternative regions instead of specific military points, considering military secrecy.

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APPENDICES

Appendix-1. The Pairwise Comparison Matrix of the Criteria

Criteria	C1	C2	C3	C4	C5	C6	C7	C8	C9
C1	1	4	3	4	4	8	7	2	1/2
C2	1/4	1	1/4	4	4	5	6	2	1/4
C3	1/3	4	1	3	3	7	4	1/2	1/5
C4	1/4	¼	1/3	1	1	4	4	1/2	1/6
C5	1/4	¼	1/3	1	1	6	4	1/2	1/6
C6	1/8	1/5	1/7	1/4	1/6	1	1/4	1/5	1/8
C7	1/7	1/6	1/4	1/4	1/4	4	1	1/5	1/8
C8	½	½	2	2	2	5	5	1	1/3
C9	2	4	5	6	6	8	8	3	1