MANAS Sosyal Araştırmalar Dergisi 2016 Cilt: 5 Sayı: 5
MANAS Journal of Social Studies 2016 Vol.: 5 No: 5

DETERMINATION OF BEST MILITARY CARGO AIRCRAFT WITH MULTI-CRITERIA DECISION-MAKING TECHNIQUES

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Abstract

The changes that continually occur in the world's economic, military, and diplomatic constraints and strategic targets lead countries to take preventive measures for their defense systems. One of these is that involving military cargo planes. The aim of this study is to determine the best options, by using multi-criteria decision-making approaches, for supplying military cargo aircraft, such as the AHP, SAW, ELECTRE and TOPSIS methods. Firstly, in this study, the military cargo aircraft are examined in order to determine if they meet the needs of and make a contribution to the Air Force in a deterrent capacity. Next, decision theory is studied and related subjects and definitions are explained. Later, all the methodologies are presented individually. All the criteria are defined during the application process. These criteria are operational effectiveness, the country's share in the project, maintainability, maintenance easiness and cost-effectiveness. After this, a hierarchical model is composed and a comparison of criteria is made using the AHP and SAW methods; also the criteria of data related to the AHP method are used in the AHP, TOPSIS and ELECTRE methods. Finally, four different methods are used for three aircraft alternatives (A, B, C) and the best one (C) is determined.

Keywords: Decision making, AHP, SAW, TOPSIS, ELECTRE.

ÇOK KRİTERLİ KARAR VERME TEKNİKLERİ İLE EN İYİ ASKERİ KARGO UÇAĞININ BELİRLENMESİ

Öz

Dünya üzerinde değişen ekonomik, askeri, diplomatik kısıtlar ve stratejik hedefler, ülkelerin savunma sistemleri konusundaki ihtiyaçlarının ve bu ihtiyaç duyulan mal ve hizmetlerin de niteliklerinin artmasına sebep olmaktadır. Bu ihtiyaçların en önemlilerinden biri de askeri kargo uçaklarıdır. Silahlı birlikler içinde hem istenilen sayıda malzeme ve personel nakli yapabilen, hem içinde barındırdığı bütün uçak sistemleri açısından uçuş emniyetini en üst düzeyde tutabilen hem de harekât şartlarında bomba yüklenebilme, maksimum irtifaya çıkabilme, bir çıkışta azami süre havada kalabilme gibi harekât etkinliğini artıran faktörlere sahip olan en iyi alternatif uçağı belirlemek her ülke için önemli bir sorundur. Yukarıda belirtilen kriterlerin haricinde toplam maliyet etkinliği, idame edilebilirliği, hat ve depo seviyesi bakım kolaylıkları ile ülkelerin alım projeleri içindeki payları da, tercih edilecek alternatifte aranan temel başlıklardır. Bu çalışmanın amacı, ordularına askeri kargo uçağı katmak isteyen ülkelerin karar verici birimlerine, tespit edilen en önemli ve uygulanabilir kriterler ışığında, en uygun alternatifi bulmaları için çok kriterli karar verme tekniklerinden AHP, TOPSIS, ELEECTRE ve SAW metodlarının uygulanması suretiyle yol göstermektir.

Anahtar Kelimeler: Karar Verme, AHP, SAW, TOPSIS, ELECTRE.

1. Introduction

One of the most important components of a country’s national power is the power of its armed forces. The air force is one of the means of applying a military deterrent. Transportation aircraft have a significant role in this power. Military transport aircraft have certain capabilities that can fullfill more than one function.

The changes that continually occur in the world’s economic, military, and diplomatic constraints and strategic targets lead countries to take preventive measures for their defense systems. One of these is that involving military cargo planes.

In the armed forces, every country desires to have the best aircraft that can fullfıll all their needs, such as aircraft that can transport personnel and equipment easily, which can perform flight safety systems at the highest levels, maintain bomb loadability in operational situations, can ascend to maximum altitude and stay at maximum altitude in one sortie. Apart from these criteria, cost-effectiveness, maintainability, depot-level maintenance and the share of the countries in the project are other factors to be considered.

The aim of this study is to assist countries who want to supply military cargo aircraft, and to help them to find the best alternatives by using multi-criteria decision-making theories like AHP, TOPSIS, ELECTRE, and SAW.

In the second part, a literature survey is made of military transportation aircraft. Studies related to decision theory are mentioned. In the third part, multi-criteria decision-making techniques are explained. Finally, in the last section all the methods are applied and analyses are made through the results of application. The results are shown in diagram form.

2. Literature Review

“Decision” is defined as a person’s choice made from different alternatives. Another definition for decision is “a problem related to a real life situation that lasts permanently in insufficient sources’’ (Baykoç, 2001). Many definitions of “decision” have been made by researchers. Some of these are listed here.

To make a decision is to make achoice from among many other incidents and the situation of them (Özkan, 1992:51). To make a decision is try to choose the best alternatives to satisfy certain goals (Filiz, 2004:4). To come to a decision is try to choose the most suitable choice from many alternatives (Tekin, 1996: 16).

Multiple attribute decision-making is to choose the finite alternatives, to be enumerated, classified, or eliminated and to use many criteria that have qualitative values and discrepancy (Hwang and Yoon, 1981).

Performance parameters, components, factors, characterisitics and peculiarities are used as synonyms for the word criterion. Each alternative is characterized by some criteria that the decision-maker decides on (Lio and Hwang,1994). It is a problem of selection rather than conception. It may not need mathematical optimization tools. Grading models, AHP, ANP, TOPSIS, ELECTRE are methods that can be used in this group (Gregory, 1988: 67).

Multiple criteria decision-making (Multiple attribute decision making); finite number of option selection, sorting, classification, prioritization, or for the purpose of elimination is usually weighted with each other, conflicting, and some of them even use the same unit of measurement criteria to a large number of qualitative evaluation of the process values).

Performance parameters, components, factors, the terms criteria and features are used synonymously. For each of the alternatives, the decision maker is characterized by a set of criteria determined as a criterion (Lio and Hwang, 1994). Much of the choice problems of a design problem require mathematical optimization tools. Scoring models, such as the AHP (Analytic Hierarchy Process), ANP (Analytic Network Process), TOPSIS (Technique for Ordered Preference by Similarities to Ideal Solution), and ELECTRE (Elimination Et Choix Traduisant la Reality) methods, can be considered in this group (Gregory, 1988: 67).

This study proposes a multi-criteria decision-making (MCDM) approach to evaluate the military transportation aircraft options in respect to the users' preferences by means of the AHP, SAW, ELECTRE and TOPSIS methods. Below, some of the studies, conducted on multi-criteria decision-making.

In their study, Korkmaz et al. (2008) proposed an analytic hierarchy process (AHP) and two sided matching based Decision Support System to assist detailers. The DSS is programmed to generate positions’ preferences from position requirement profiles and personnel competence profiles by using the analytic hierarchy process, and matches personnel to positions by using two-sided matching. The use of the proposed DSS is demonstrated with an example.

Sherali et al. (2003, 2006), presented a large-scale, airspace planning and collaborative decision-making model (APCDM) to enhance the management of the U.S. National Airspace System (NAS).

Gürbüz and Yalçın (2013), used Fuzzy AHP with the SWOT analysis to expose the existing state in transportation department of a textile firm in Kayseri, Turkey. According to the results of the analysis, the most appropriate strategy to be selected for the numerical data has been obtained.

Simanaviciene and Ustinovichius (2010) analyzed the quantitative multiple criteria decision-making methods and sensitivity analysis methods usage in decision support systems in their study.

Şenyiğit and Gölec¸ (2010) proposed a new heuristic for the supplier selection and purchase problem for MDSC systems with stochastic demand in their study. They compared the performance of the new heuristic according to four cases.

The Weapon System Capability Assessment (WSCA) problem is modeled as an MCDM problem with both quantitative and qualitative information under an uncertain environment in Jiang et al. (2011). The belief structure model and evidential reasoning approach are used to deal with the WSCA problem. A case study of real Main Battle Tank capability assessment is explored to show the proposed process for WSCA.

Senyigit and Soylemez (2012) considered the multi-echelon multi-product defective supply chain network (MMDSCN) of firm X in Kayseri, Turkey which produces chairs under uncertain demand.

Senyigit (2012) proposed a new problem called the lot-sizing with supplier selection problem in the multi-product multi-echelon defective supply chain network. Senyigit (2013) considered the purchasing costs of raw materials, production costs, fixed operation costs, transportation costs and lost sales costs in his study similar to his earlier study with Göleç.

3. Methods

3.1. AHP

The AHP method builds on the pair-wise comparison model for determining the weights for every unique criterion. Saaty (1980) developed steps for applying the AHP.

The alternative with the highest weight coefficient value should be taken as the best alternative. One of the major advantages of AHP is that it calculates the inconsistency index as a ratio of the decision-maker's inconsistency and randomly generated index. This index is important for the decision-maker to assure him that his judgments are consistent and that the final decision is made well (Pohekar and Ramachadran, 2004; Gurmeric et al, 2013; Yıldıztekin et al. 2011).

3.2. SAW

With regard to this method, the expert decision-makers' assigning scores to both criteria and alternatives and reaching a decision in line with these scores are known as SAW multi-criteria decision making techniques. Although choices of scoring is very few in criteria, experts' accumulated knowledge about the alternatives plays the most important role in reaching the most efficient (or right) decision. The steps of SAW are as in Afshari et al. (2010) and Gurmeric et al. (2013).

3.3. ELECTRE

This method is capable of handling discrete criteria which are both quantitative and qualitative in nature and provides complete ordering of the alternatives. The problem is to be so formulated that it chooses alternatives that are preferred over most of the criteria and that do not cause an unacceptable level of discontent for any of the criteria. The concordance discordance indices and threshold values are used in this technique. Based on these indices, graphs for strong and weak relationships are developed (Pohekar and Ramachadran 2004). The steps of this method are as in Triantaphyllou et al. (1998) and Gurmeric et al. (2013).

Finally, the ELECTRE method yields a whole system of binary outranking relations between the alternatives. Because the system is not necessarily complete, the ELECTRE method is sometimes unable to identify the preferred alternative. It only produces a core of leading alternatives. This method has a clearer view of alternatives by eliminating less favorable ones; this is especially convenient when encountering a few criteria with a large number of alternatives in a decision-making problem (Pohekar and Ramachadran 2004; Gurmeric et al, 2013).

3.4. TOPSIS

This method was developed by Huang and Yoon as an alternative to ELECTRE. The basic concept of this method is that the selected alternative should have the shortest distance from the negative ideal solution in a geometrical sense. The method assumes that each attribute has a monotonically increasing or decreasing utility. This makes it easy to locate the ideal and negative ideal solutions. Thus, the preference order of alternatives is yielded by comparing the Euclidean distances (Pohekar and Ramachadran 2004; Sadeghzadeh, K., Salehi, M. B., 2011).

The steps of this method are as in Triantaphyllou et al. (1998), Sadeghzadeh and Salehi (2011) and Gurmeric et al. (2013).

4. Case Study

In this study, criteria are defined in order to reach the goals. These criteria are the important parameters to reach the aim.

A military cargo aircraft has many tasks, both inland and outland. Some of its tasks are as follows: education, personnel transportation, courier, operations and personal assistance.

Choosing this kind of aircraft requires foresighted working groups. Listed below are some of the criteria considered in order to supply these aircrafts.

1- The country's share in the Project (CS)

2- Maintainability of Aircraft (MA)

3- Maintenance easiness (ME)

4- Cost- effectiveness (CE)

5- Operational effectiveness (OE)

Here, only the cost-effectiveness criterion is a cost criterian, others are benefit criteria.

4.1. The Country's Share in the Project

In many countries, it is government policy to contribute some amount of money to the aviation industry. Many companies are eager to work in the designing, production, integration and software systems of many countries.

4.2. Maintainability of Aircraft

This item indicates whether or not the information on the technical order and the data in the logistic system are compatible which each other. It deals with the accordance between all the technical imperatives (craft maintenance, component catalog) and available data of the logistic system. For example, accordance must be present between a technical part belonging to the logistic system store and the label of the part; otherwise these numbers must be defined with similar labels. Moreover, when buying a new aircraft, the appropriate storing of materials has a critical importance in the availability of aircraft maintenance.

4.3. Maintenance Easiness

The aircraft dimensions (width, length, tail height) are important in terms of ease of maintenance. Also, as mentioned in the technical orders and technical bullletins, the factories' renovated level of maintenance intervals and scope play an important role in this concept of ease in maintenance.

4.4. Cost Effectiveness

One of the aims in all activities must be minumum cost. Cost must be taken into consideration because all the equipment related to aircraft, such as the propellers, avionics and engine, are very expensive.

4.5. Operational Effectiveness

This aircraft should include all the requirements which are needed for operations. For example, fuel capacity is one of them. If fuel capacity is large, this means that it can fly for many hours without stopping. This is needed especially for foreign duties.

Another important subject for operational effectiveness is passenger and inner capacity. Personnel transportation from inland to outland, and that of equipment and machines, which do not fit into other aircraft, without using highways is an important capability for military cargo aircraft. The wideness capacity of these aircraft increases the number of passengers and flight safety is another essential topic for operational effectiveness.

The main aim of the criteria and choosable alternatives are presented in the below (Figure 1). In this manner, there are three alternatives which are evaluated according to the criteria.

4.6. AHP

In this method, all the criteria which are explained in Figure 1 are compared with each other. A criterion which is more important than another is assigned to the place shown in the diagram. We can see the evaluation of comparison in Figure 1.

The criteria which are more important than the others are shown in Table 1. For example, the operational effectiveness criterion is two times more important than the country's share (in the Project) criterion and three times more important than maintainability. In continuation of the method, the normalizing matrix is used to find the weight of the criterion. We can see the normalizing matrix and the averages of lines in Table 2.

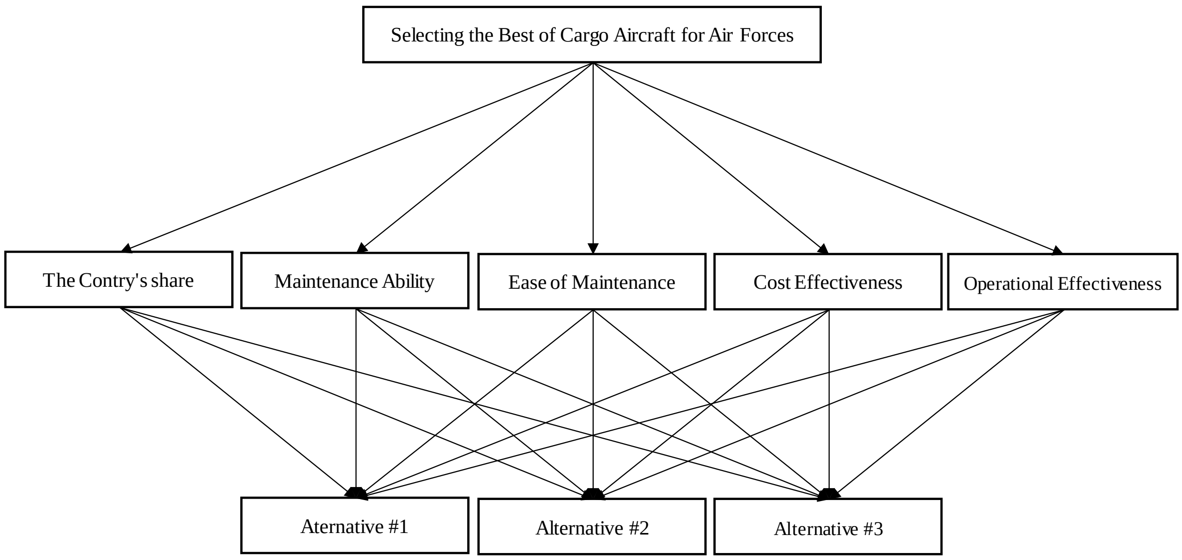

Figure 1. Hierarchical Model

Table 1. Pair-wise comparisons

Criteria	CS	MA	ME	CE	OE
CS	1	2	4	2	1/2
MA	1/2	1	3	1	1/3
ME	1/4	1/3	1	1/2	1/7
CE	1/2	1	2	1	1/3
OE	2	3	7	3	1
Total	4.250	7.333	17.000	7.500	2.310

Table 2. Normalization Matrix

Criteria	1	2	3	4	5	Weights
CS	0.235	0.273	0.235	0.267	0.216	0.245
MA	0.118	0.136	0.176	0.133	0.144	0.142
ME	0.059	0.045	0.059	0.067	0.062	0.058
CE	0.118	0.136	0.118	0.133	0.144	0.130
OE	0.471	0.409	0.412	0.400	0.433	0.425
Total	1	1	1	1	1	1

(CI = 0.06, CR = 0.005)

To determine the alternative weight and consistency of all criteria, we apply the same method that we used for the comparison of criteria in Table I. For example, we can easily see how to determine the alternative weight for " the country's share'' criterion. As shown in Table II, each of the weight criteria is given in the rows, so the average is for five values. For example, in the AHP method the weight of the "Operational Effectiveness" criterion is "1" over 0.425.

Table 3. Comparison of alternatives and normalization

Country's Share	A	B	C	Country's Share	1	2	3
A	1	1/2	1/4	A	0.143	0.143	0.143
B	2	1	1/2	B	0.286	0.286	0.286
C	4	2	1	C	0.571	0.571	0.571
TOTAL	7.000	3.500	1.750	**TOTAL**	1	1	1

Table 4. The results table of AHP method

Alternatives	CS	MA	ME	CE	OE	X	Weights
A	0.143	0.250	0.320	0.480	0.110		0.245
B	0.286	0.250	0.557	0.405	0.309		0.142
C	0.571	0.500	0.123	0.115	0.581		0.058
							0.130
							0.425

Table 5. The result table of AHP

Alternatives	Result
A	0.198
B	0.322
C	**0.480**

The alternative weight of the "country's share" criterion is shown in Table 3. According to this, the alternative weight of A is 0.143, that of B is 0.286 and that of C is 0.571. The consistency value for CI is 0. When we apply the same method for each criterion, we can find the matrix weight of each criterion for the three alternatives and also the consistency results of each criterion. According to this, the results are shown in Table 4 below.

4.7. Comparing The Criteria According To The SAW Method

In this method, factor weight is limited. According to this, the highest rate is ''3''and the lowest rate is ''1''. In this problem, three decision–makers give rates to each criterion and, by using these rates, normalizing decision matrixes are formed in Table 6. We can see the decision-makers evaluation of factor weightiness. In this table, DM (1-2-3) abbreviation indicates the three decision-makers' grading: ''H'' means high, ''VH'' means very high and "MH" expresses medium high point.

Table 6. Decision–makers evaluation on criterion weight

	Criteria	DM1	DM2	DM3
CS	C1	VH	H	H
MA	C2	H	H	H
ME	C3	MH	H	MH
CE	C4	H	H	H
OE	C5	VH	VH	VH

Table 7. The average and normalization of criterion weight

Criteria	DM1	DM2	DM3	Average	Weights
CS	3	2	2	2.333	0.219
MA	2	2	2	2	0.188
ME	1	2	1	1.333	0.125
CE	2	2	2	2	0.188
OE	3	3	3	3	0.281
TOTAL				10.667	1

Above, we can see all the rates that are given by the decision–makers. These rates are graded into numerical forms.

In Table 7, the weight of each criterion is determined. In the AHP method, this application is used as a comparison between the criteria but here it is made by the decision-makers. Below, we can see the grades that are given by each decision-maker to each alternative.

In Table 8, the averages in the right column, the decision-makers evaluations, are changed into a decision matrix and, after this, the normalizing decision matrix is made and the results are shown in Table 9.

Table 8. Result table of each alternative

Criteria	Alternatives	DM1	DM2	DM3	K_{mean}
	A	7	5	5	5.667
CS	B	5	7	7	6.333
	C	9	7	9	8.333
	A	9	7	9	8.333
MA	B	7	5	7	6.333
	C	5	5	7	5.667
	A	7	7	7	7.000
ME	B	5	7	7	6.333
	C	5	5	7	5.667
	A	7	9	7	7.667
CE	B	7	5	9	7.000
	C	5	9	7	7.000
	A	5	7	3	5.000
OE	B	7	5	9	7.000
	C	9	9	9	9.000

Table 9. Normalizing decision matrix

Alternatives	CS	MA	ME	CE	OE
A	0.279	0.410	0.368	0.354	0.238
B	0.311	0.311	0.333	0.323	0.333
C	0.410	0.279	0.298	0.323	0.429
W_i	0.219	0.188	0.125	0.188	0.281

Table 10. The results of SAW method (Weighted Normalized Decision Matrix)

Alternatives	CS	MA	ME	CE	OE	Sum	Ranking
A	0.061	0.077	0.046	0.066	0.067	0.317	Third
B	0.068	0.058	0.042	0.061	0.094	0.323	Second
C	0.090	0.052	0.037	0.061	0.121	0.360	First

When the values of the normalized determination matrix in Table 9 are multiplied with the values in the bottom line, we reach the result with the weighted normalized determination matrix that is shown in Table 10. The alternative C is also found as the best alternative in the SAW method.

4.8. Electre

In this method, the weight of the alternatives is determined differently comparing to criterion. In Table 11, we can see the numbers taken from AHP.

The countrys' share criterion is determined as a percentage. For example, if A company is chosen to be the supplier it means that the country will get a benefit of 16% (percentage) for help in production, design and engineering activities.

In maintainability criteria, line-replaceable unit in the aircraft, military depot stocks, mean time between failure, and revision time are considered as the main criteria and because of this the criteria is rated 20 points on the table.

Table 11. Criterion Weights

Weights	0.245	0.142	0.058	0.130	0.425
Alternatives	**CS**	**MA**	**ME**	**CE**	**OE**
A	12	12	8	7	8
B	12	15	14	10	6
C	10	20	18	12	5

Table 12. Normalized matrix

Alternatives	CS	MA	ME	CE	OE
A	0.609	0.432	0.331	0.739	0.715
B	0.609	0.5409	0.579	0.517	0.536
C	0.507	0.721	0.744	0.431	0.447

Table 13. Weighted normalized matrix

Alternatives	CS	MA	ME	CE	OE
A	0.149	0.061	0.019	0.095	0.304
B	0.149	0.076	0.033	0.067	0.228
C	0.124	0.102	0.043	0.055	0.190

In the maintenance easiness criteria, suitable hangars for the aircraft, long maintenance time, readable TO'S, and a comfortable avionics room are the main considerations for these criteria and for this reason, the criteria are rated out of 20 points in the table.

In the cost–effectiveness criteria, the cost of aircraft supply, initial supply price, engineering support service, and the repair and modification operations of aircraft are evaluated. In the normalizing procedures, the rates cannot be changed, for this reason the cost of each alternative is decreased ten times.

Operational effectiveness includes the following: the maximum altitude of the aircraft, how far the aircraft can fly without fuel transport, the effectiveness of the chaf flare system, the cabin armor, how many personnel it can carry, flight safety and armament system loading.

4.8.1. Normalizing Matrix and Normalizing Decision Matrix

In every cell of the matrix the normalization procedure is performed according to formula 4. The matrix which resulted after normalization is shown in Table 12 and Table 13.

4.8.2. Harmony-Disharmony Matrixes

The Harmony-Disharmony Matrices were calculated as per given formula and are given in Table 14.

Table 14. Harmony-Disharmony matrices

C (A, B)	(1, 4, 5)	0.8	Yes	D (A, B)	(2, 3)	0.369	Yes
C (A, C)	(1, 4, 5)	0.8	Yes	D (A, C)	(2, 3)	0.266	Yes
C (B, A)	(1, 2, 3)	0.445	No	D (B, A)	(4, 5)	0.779	No
C (B, C)	(1, 4, 5)	0.8	Yes	D (B, C)	(2, 3)	0.322	Yes
C (C, A)	(2, 5)	0.567	No	D (C, A)	(1, 3, 4)	0.36505	Yes
C (C, B)	(2, 3)	0.2	Yes	D (C, B)	(1, 4, 5)	0.678	No
Total		3.612				2.779	
Average		0.60198				0.46312	

Alternatives were compared according to the weighted normalized decision matrix and calculated by criteria grade for "c" and by the formula given in the table for "d". When we choose "YES" rows for both values, we will find the harmony-disharmony matrix result in Figure 2.

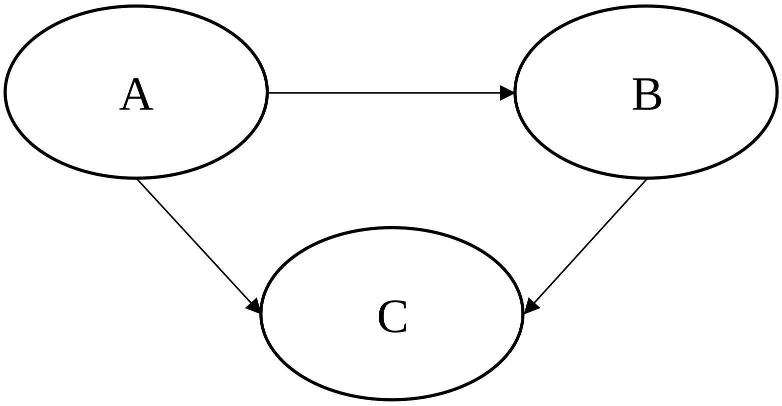

Fig. 2. Harmony Matrix Result

4.8.3 The Result of Electre

In the ELECTRE method it is expected that value "c" will be high while value "d" will be low. This is the best fit by the first alternative. The formulas (9, 10, 11) and result table used to reach these results are in shown in Table 15.

Table 15. Result of the ELECTRE Method

Alternatives	c	d	Ranking
A	0.588	-0.509	First
B	0.245	0.054	Second
C	-0.834	0.455	Third

Table 16. Finding the ideal and negative ideal solutions

Alternatives	S_{i+}	S_{i-}
A	0.123	0.047
B	0.051	0.085
C	0.047	0.123

4.9. Topsis

The criteria weights obtained with the AHP method are also used in this method. In this method, whose decision matrix is the same as the weighted normalized decision matrix used in "ELECTRE".

The distinguishing measurements as per the formula above enable us to see the closest results to the ideal solution. According to it, the following result is reached. The minimum and maximum values in the weighted normalized decision matrix column are marked. These are used to find the S_i (+, -) values in the following Table 16.

After finding the ideal and negative ideal solutions, the data given in Table 10 are again used to calculate the proximity values as per the TOPSIS method. The relative proximity values, which are the results of the TOPSIS method, and the formula used for reaching these results are given in Table 11. Finally, with the solution of formula 14, the values of Table 10 are used and the proximity values are found for each alternative.

As a result, in the TOPSIS method, the best alternative is selection "C", as in the ELECTRE method (Table 17).

Table 17. TOPSIS application results (The ideal relative proximity values)

Alternatives	C_i	Ranking
A	0.27780853	Third
B	0.625538312	Second
C	0.72219147	First

4.10 Results

The problem of selecting military transportation aircraft is one of the basic issues in military management. The AHP, SAW, TOPSIS and ELECTRE methods applied to the same problem under the same condition and the basic characteristics of these methods were shown in this study. An AHP hierarchy can have as many levels as needed to fully characterize a particular decision situation. A number of functional characteristics make AHP a useful methodology. These include the ability to handle decision situations involving subjective judgments, multiple decision makers, and the ability to provide measures of consistency of preference.

TOPSIS thus gives a solution that is not only closest to the hypothetically best, that is also the farthest from the hypothetically worst. ELECTRE method is used for choosing best actions from a given set of actions, but it was applied to three main problems: choosing, ranking and sorting. Multi-Criteria Decision Making is a useful tool in many economical, manufacturing, material selection, military, constructional, etc. problems specifically plays an important role in fields of investment decision, project evaluation, economic benefit evaluation, Staff appraisal and so on (Gavade, 2014). The results obtained from AHP, SAW, TOPSIS and ELECTRE are presented in Table 18. The scores in the table show the preference ranking of aircraft alternatives depending on the method. The most suitable military cargo aircraft was found as alternative C, according to the results, except ELECTRE. This is because the values of this alternative for all criteria are superior to the other alternatives. Both methods can be successfully used for any aircraft type selection problems. The great advantage of the methodologies is that both can use quantitative as well as qualitative data.

Table 18. Results of all whole methods

Methods	Alternatives	Ranking
AHP	A	Third
	B	Second
	C	First
SAW	A	Third
	B	Second
	C	First
ELECTRE	A	First
	B	Second
	C	Third
TOPSIS	A	Third
	B	Second
	C	First

5. Conclusion and Future Works

The cargo aircraft, the indispensable instrument of airforces, which are the deterrent forces of every country, are of great importance to every country for the tasks required of them. Multi-citeria decision-Making techniques are also applicable to branches of the defense industry as in numerous other areas. Determining the right criteria reach to the solution is important here. Selection "C" was found as the best alternative according to the 5 criteria used in this study and according to the formulization processes of the methods in the 2nd part. The process was found to be consistent with the conducted consistency tests. To deepen the methods up to future requirements of operational and logistic activities criteria parameters, to establish a sub-criteria division in the body is inevitable. The factors affecting military transportation aircraft could be qualitative or quantitative. There are many qualitative concerns when assessing the factors critical to military transportation aircraft selection. Some of the factors included in our study were difficult to quantify for maintainability, maintenance easiness. Different hybrid techniques such as fuzzy ELECTRE, fuzzy SAW, fuzzy AHP, fuzzy TOPSIS, ANP, PROMETHEE can be used to address this problem. Also in future, different military sectors can be considered and a thorough comparison can be made highlighting the challenges in military transportation aircraft selection for these different sectors.

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