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Multi-Criteria Decision Making In The Selection of Electric Sports Utility Vehicles: Integrated Critic–Copras Method

Elektrikli SUV Araç Seçiminde Çok Kriterli Karar Verme: Bütünleşik Critic-Copras Yöntemi

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Abstract: The aim of this study was to assess and determine the most suitable electric sports utility vehicle (e-SUV) alternatives for consumers who are considering buying an e-SUV that is sold in Turkey. Accordingly, 10 different vehicles were selected using specific criteria from the e-SUVs available through distributor sales in Turkey. CRITIC and COPRAS methods were used to rank these vehicles. The results of the CRITIC method for determining the weights of the criteria were the following three: fast charging time, energy consumption, and price. The results of the analyses conducted using the COPRAS method and these weights determined the e-SUV rankings. Based on these results, the top three alternatives were Subaru Solterra, New MG ZS EV, and BMW iX3 eDrive20.

Keywords: Electric vehicles, e-SUV, Multi-criteria decision making, CRITIC, COPRAS

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Öz: Çalışmada Türkiye'de satışı olan elektrikli SUV'lardan, satın almayı planlayan tüketiciler için en uygun e-SUV alternatifi belirlenmeye çalışılmıştır. Bu amaçla, Türkiye'de distribütör satışında olan elektrikli SUV 'lardan 10 farklı araç belirlenmiştir. Belirli kriterler altında seçilen bu 10 farklı aracın sıralamasında Çok Kriterli Karar Verme yöntemlerinden bütünleşik olarak CRITIC ve COPRAS yöntemleri kullanılmıştır. Kriterlerin ağırlıklarının belirlenmesinde CRITIC yöntemiyle yapılan hesaplamalar sonucunda en önemli ilk üç kriter; hızlı şarj süresi, enerji tüketimi ve fiyat kriterleridir. CRITIC yöntemiyle belirlenen ağırlıklar kullanılarak COPRAS yöntemiyle gerçekleştirilen analizler sonucunda e-SUV'lara ilişkin sıralamalar elde edilmiştir. Bu sonuçlara göre ilk üç alternatif Subaru Solterra, New MG ZS EV ve BMW iX3 eDrive20 olarak belirlenmiştir.

Anahtar Kelimeler: Elektrikli araçlar, e-SUV, Çok kriterli karar verme, CRITIC, COPRAS

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1. Introduction

The automobile sector is one of the most important in the progress in world economy. Turkey's interaction with the global automobile sector and market has increased quickly because of the rapid developments in technology since the 1980s. Since 2000, changes in consumer behavior and the rapid increase in the consumption of luxury cars have led to an increase in competition within the automobile sector. Fossil-fuel vehicles that consumers use daily pollute the air with their various gaseous emissions and cause an increase in global warming, the most important of which is the release of greenhouse gases into the atmosphere. Carbon dioxide (CO_2) emission, the most important of these gases, is a byproduct of burning fossil fuels (Karaalp, 2008:90; Uçarol ve Kural,2009:66). Because of the damage caused by fossil fuels to the environment, research has been ongoing to identify different energy sources. As a result, electric vehicles (EVs) have begun to be one alternative preferred in recent years. Although EV technology has been available since the invention of the automobile, there hasn't been much demand for these vehicles because of the high production costs and their having less power than those using fossil fuels.

Today, with the development of battery technology and the increase in the related studies on infrastructure, the number of people using (EVs) has increased. In addition, as countries encourage the use of EVs, these vehicles will be more preferred in the coming years. For example, in 2016, Norway announced that the sale of vehicles using petroleum and diesel fuels would be banned as of 2025. Germany also announced that it would put a similar practice into effect beginning in 2030. By doing so, these countries aim to reduce 95% of CO_2 emissions by 2050. France, England, Scotland, the Netherlands and many other countries in Europe have followed this plan and announced that they would adopt the same policy (Shammut et al.,2019:2), which would bring the production, sale, and use of EVs throughout the world, especially in Europe. After becoming aware of the importance of the production and use of EVs, Turkey launched an EV factory in the Gemlik district of Bursa.

This study consists of five sections. The first section provides information about electric vehicles. The second section contains a literature review, the third section explains the CRITIC and COPRAS methods. The steps related to the methods are then presented. The fourth section of the study presented the application, ranked the e-SUVs using CRITIC and COPRAS as described, and made recommendations to consumers who are considering buying these vehicles.

2. Literature Review

In the existing literature, it has been observed that only a few studies have addressed the evaluation of the performance of electric vehicles using multi-criteria decision-making methods. Let's briefly summarize the most closely related studies on this topic: Tzeng et al. (2005) devised an MCDM framework incorporating AHP, TOPSIS and VIKOR methods specifically for alternative fuel transit buses such as electricity, fuel cell, and methanol. Through scenario analysis, they determined the hybrid electric bus as the optimal choice. Brey et al. (2007) proposed a multi-criteria assessment model for assessing and comparing alternative fuel options, considering economic, technical, and environmental factors. They utilized data envelopment analysis (DEA) to analyze the options and concluded that fuel cell vehicles exhibit the highest efficiency. Additionally, they employed the PROMETHEE for further analysis. Maimoun et al. (2016) utilized TOPSIS and SAW methods to evaluate alternative vehicles within the US waste collection sector, considering both environmental and economic aspects. Biswas and Das (2019) have proposed a holistic model for selection and ranking of a group of battery EVs using MABAC method. There are five criteria which are combined fuel economy, battery range, top speed, accelerating time and vehicle cost chosen for performance evaluation of seven EVs. It has been found that Hyundai Ioniq electric outperforms over other alternatives based on chosen criteria. Khan et al. (2020) have tried to select the most sustainable HEV in the context of adeveloping country, Pakistan. Using fuzzy TOPSIS, based on ten criteria and seven alternatives, it has been concluded that Toyota Aqua outperforms among all the other alternatives in terms of economic, social, and environmental perspective. Ziemba (2020) has conducted research to provide support to government and local authorities for the creation of EV fleets in Poland using the preference ranking organization method for enrichment evaluation PROMETHEE integrated with Monte Carlo simulation to evaluate different brands and models of EVs within different categories according to different criteria. Gavcar and Kara (2020) have obtained a ranking of 11 different models of EVs for sale in Turkey according to battery capacities, horsepower, aerodynamic coefficients, ranges and sales prices criteria using the ENTROPY and TOPSIS methods. Ecer (2021) has chosen 10 models of EVs as alternatives. These vehicles are then ranked using SECA, MARCOS, MAIRCA, COCOSO, ARAS, and COPRAS methods. Afterward, results from various MCDM techniques are aggregated by applying the Borda count and Copeland ranking methods price, permitted load, energy consumption are determined as the most three significant factors for BEV selection, respectively, whereas Tesla Model S is the best choice. Pradhan and Pradhan (2022) have identified EVs in the Indian market that cost less than 25 Rupees, examined six EVs by considering both technical and customer requirements criteria, and weighted the criteria using the QFD model to determine the most appropriate vehicle model using the COPRAS method. Büyükselçuk and Tozan (2022) have evaluated the efficiency of electric sports utility vehicles (e-SUVs) using multi-criteria decision-making methods. According to their seven input and four output factors, they have evaluated the weights of five different vehicles sold in Turkey using the CRITIC method and evaluated their performance using the efficiency analysis technique with input and output satisficing EATWIOS method. Abdulvahitoğlu (2022) has proposed a model using the standard deviation–based MULTIMOORA integrated Borda method to help consumers select which EVs to purchase. In the study, 10 electric vehicles were evaluated based on criteria including price, range, battery capacity, charging time, efficiency and power. Dwivedi and Sharma (2023) have evaluated fifteen different electric vehicles, according to their different ten criteria such as full charge time, purchasing price, fast charging time, maximum power, range, battery capacity, top speed, cargo volume, acceleration, and unladen weight. They used two methods. The first method, Shannon's entropy, to determine the electric car's criterion weight, while the second method, TOPSIS, was used to rank electric vehicles. The study's findings indicated that the fast charging time, maximum power, range, battery capacity, top speed, and price aspects of electric cars gained popularity. And in the study, the best alternative was determined as BMW iX M60.

The literature reviews also showed that there were many studies in which CRITIC and COPRAS methods were separately applied. No other study in which these methods were used in an integrated manner in the selection of the best e-SUV was found. This study aimed to determine the most suitable e-SUVs for consumers who are thinking of buying an e-SUV that is currently sold in Turkey. Based on this purpose, CRITIC and COPRAS, which are among other MCDMs, were decided to use together. The originality of the present study stems from the fact that CRITIC and COPRAS methods were used together for the selection of EVs. In addition, TOGG EVs, which entered the market in 2023 as a Turkish brand, was among the alternatives. It is believed that the results of the present study will contribute to the literature.

3.Research Methods

CRITIC method and COPRAS method are introduced in this part.

3.1. Critic Method

CRITIC, which was introduced to the literature by Diakoulaki et al. (1995), was proposed to objectively weigh the criteria in the decision phase of MCDM assessment. This objective weighting method uses the standard deviations of the criteria together with the correlation among the criteria.

The calculation steps of the CRITIC method are carried out in the following steps: (Diakoulaki, 1995: 764-765):

Step 1: Creating the Decision Matrix: The decision matrix X is formed and is shown in Equation (1)

$$X = \begin{bmatrix} x_{01} & x_{02} & \cdots & x_{0n} \\ x_{11} & x_{12} & \cdots & x_{1n} \\ . & . & \cdots & . \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \qquad i = 0,1,2\ldots m \quad j = 1,2\ldots n \tag{1}$$

Step 2: Creating the Normalized Decision Matrix: Normalization of original decision matrix using the following Equations(2) and Equations(3).

$$r_{ij} = \frac{x_{ij} - x_j^{min}}{x_j^{max} - x_j^{min}} \qquad j = 1,2\ldots n \text{ for benefit criterion} \tag{2}$$

$$r_{ij} = \frac{x_j^{max} - x_{ij}}{x_j^{max} - x_j^{min}} \qquad j = 1,2\ldots n \text{ for cost criterion} \tag{3}$$

r_{ij}, i.and j. show the correlation coefficients between criteria.

Step 3: Creating a Symmetric Linear Correlation Matrix: In this step Equation (4) with its help, the correlation between pairs of criteria is calculated.

$$\rho_{jk} = \frac{\sum_{i=1}^{m}(r_{ij} - \overline{r_j}).(r_{ik} - \overline{r_k})}{\sqrt{\sum_{i=1}^{m}(r_{ij} - \overline{r_j})^2 . \sum_{i=1}^{m}(r_{ik} - \overline{r_k})^2}} \qquad j=1,2\ldots n \ , k=1,2\ldots n \tag{4}$$

Step 4: Calculation of Objective Criterion Weight Coefficients: In this last step objective criterion weight coefficients are calculated with the help of Equations (5), (6) and (7).

$$\sigma_j = \sqrt{\sum_{i=1}^{m}\left(r_{ij} - \overline{r_j}\right)^2 / m - 1} \tag{5}$$

$$C_j = \sigma_j \sum_{k=1}^{n}\left(1 - \rho_{jk}\right) \qquad j=1,2\ldots n \tag{6}$$

$$W_j = \frac{C_J}{\sum_{k=1}^{n} C_k} \qquad j=1,2\ldots n \ |, k=1,2\ldots n \tag{7}$$

3.2.Copras Method

In 1996, researchers Zavadskas and Kaklauskas from the Vilnius Gediminas Technical University developed the COPRAS method, which is applied to rank and evaluate alternatives in terms of priority and utility of the criteria. Specific values are used to maximize the high utility criteria and minimize low utility criteria (Aksoy et al., 2015:11). The superiority of COPRAS over other multi-criteria decision-making methods is that it rates the alternatives by degree of utility and indicates as a percentage how good or bad each alternative is when compared with the others(Ayçin,2020:64).

The steps in COPRAS are listed below (Zavadskas et al., 2008:241–247). The variables in the model are shown as follows:

A_i = i alternatives   I = 1,2,…m
K_j = j evaluation criteria   j = 1,2,…n
W_j = weight of the j evaluation criteria   j = 1,2,…n
X_{ij} = the value of i alternative in terms of j evaluation criteria

Step 1: Construct the decision matrix as seen in Eq. (8).

$$D = \begin{matrix} A_1 \\ A_2 \\ A_3 \\ . \\ . \\ A_m \end{matrix} \begin{bmatrix} x_{11} & x_{12} & x_{13} & . & x_{1n} \\ x_{21} & x_{22} & x_{23} & . & x_{2n} \\ x_{31} & x_{32} & x_{33} & . & x_{3n} \\ . & . & . & . & . \\ . & . & . & . & . \\ x_{m1} & x_{m2} & x_{m3} & . & x_{mn} \end{bmatrix} \quad (8)$$

Step 2: Transform the decision matrix into a normalized decision matrix using Eq. (9).

$$x_{ij}^{*} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}} \qquad \forall_j = 1,2,...n \quad (9)$$

Step 3: Construct a weighted normalized decision matrix using Eq. (10).

$$D^{'} = d_{ij} = x_{ij}^{*}.w_j \quad (10)$$

Step 4: Determine the criteria with high and low utility using Eqs. (10) and (11). For high-utility criteria, the sum of the values in the weighted normalized decision matrix is shown as $Si+$, and for low-utility criteria, the sum of the values in the weighted normalized decision matrix is shown as $Si-$.

$$S_{i+} = \sum_{j=1}^{k} d_{ij} \quad \text{j= 1,2,…k high-utility criteria} \quad (11)$$

$$S_{i-} = \sum_{j=k+1}^{n} d_{ij} \quad \text{j=k+1, k+2,… n low-utility criteria}$$

Step 5: Calculate the relative priority value, symbolized as Qi for each alternative, using Eq.(12).

$$Q_i = S_{i+} + \frac{\sum_{i=1}^{m} S_{i-}}{S_{i-} \sum_{i=1}^{m} \frac{1}{S_{i-}}} \quad (12)$$

Step 6: Use Eq. (13) to find the highest relative priority value.

$$Q_{\max} = Max\{Q_i\} \qquad \forall_i = 1,2,...m \quad (13)$$

Step 7. Use Eq. (14) to calculate the performance index symbolized as P_i for each alternative and rank the alternatives from largest to smallest.

$$P_i = \frac{Q_i}{Q_{max}}.100\% \tag{14}$$

4.Application

Due to the damages to the environment from fossil fuels, manufacturers have begun to accelerate the production of EVs by diversifying their products. The use of clean energy in EVs and reducing the dependence on fossil fuel use helps to reduce greenhouse gas emissions; however, clean energy sources also play an important role in combating environmental and climate change. The use of these energy sources is an important step toward a sustainable future. The production of EVs with zero CO_2 emissions is likely to reduce air pollution; therefore, many countries have announced that they would ban the sale of vehicles using petroleum and diesel fuels. The demand for EVs increases as countries encourage their use and the related infrastructure.

The aim of the present study was to determine the most appropriate ranking for consumers who are considering purchasing e-SUVs that are available for sale in Turkey. Accordingly, 10 different vehicles were selected under specific criteria for the study from the e-SUVs available in distributor sales in Turkey. CRITIC and COPRAS from MCDM were then used together to rank these vehicles. Criteria weights were determined using CRITIC, which was chosen because of its objective weighting. Alternatives were ranked using COPRAS, which was chosen because of its being a simple method in terms of use and it not requiring excessive calculations and long periods of time. In addition, in this method, alternatives could be compared, and how better or how worse they were in percentage terms than other alternatives could be revealed.

The data for August 2023 published by the automobile companies on their own websites were used in the present study. The criteria considered in the study were determined by first examining their websites of brands that sell e-SUVs, and then by interviewing 3 sales representatives with 1-5 years of experience to determine the criteria to be considered when purchasing an electric vehicle. According to these determined criteria as follows: price, fast charging time, 0-100 km/h acceleration time, energy consumption, range (WLTP procedure average user), usable battery and total torque. And these criteria are provided in Table 1. As a result of discussions with sales representatives of brands offering e-SUV sales in Turkey, the most preferred e-SUV brands have been determined. Accordingly, determined alternatives were as follows: Dacia Spring, Togg T10X, Seres 3, Skywell ET5, Mercedes Benz EQA 250+, Mercedes Benz EQB 250+, Volvo XC40 Recharge, BMW iX3 eDrive20, New MG ZS EV, and Subaru Solterra.

Table 1: Selected Criteria, Unit and Description

Criterion Code	Criteria	Unit	Description
C1	Price	TL	The criteria indicated the stated price of EV
C2	Fast Charging Time	Minute	This indicates charging of EVs from 10% to 80%
C3	Accelaration Time	Second	This indicates the accelerated time from 0 to 100 km
C4	Energy Consumption	KiloWatt hour	This indicates the energy consumption for EVs
C5	Range	Kilometer	This parameter indicates the distance the EVs can cover on a single charge.
C6	Usable Battery	KiloWatt hour	This indicates the ability of a battery to deliver a specified power output over a certain period of time.
C7	Total Torque	Newton meter	This criterion is a parameter that enables the vehicle to reach higher speeds rapidly during acceleration and also ensures strong traction for the vehicle.

To analyze using the CRITIC method, a decision matrix must first be created. In the decision matrix created with the data taken from the websites of automobile companies, as presented in Table 2.

Table 2: Decision Matrix

	C1	C2	C3	C4	C5	C6	C7
Dacia Spring	969.000	38	13,7	11,9	225	25	125
Togg T10X	1.227.500	28	7,6	16,9	310	52,4	350
Seres 3	920.000	30	9	15,8	405	52,5	380
Skywell ET5	1.499.000	63	7,9	15,9	480	85,97	320
Mercedes Benz EQA	2.360.000	32	6	15,3	506	70,5	375
Mercedes Benz EQB	2.450.000	32	8,9	18,1	481	70,5	385
Volvo XC40 Recharge	2.417.368	28	7,3	20	405	79	420
BMW iX3 eDrive20	4.432.400	32	10,1	18,5	460	80	400
New MG ZS EV	1.379.000	40	8,6	17,8	440	72,6	280
Subaru Solterra	2.358.959	56	6,9	16,1	465	71,4	336

Source: Dacia Spring (2023), Togg (2023), Seres (2023), Skywell (2023), Mercedes Benz (2023), Volvo (2023), BMW (2023,) New MG (2023), Subaru Solterra (2023)

After that, the importance weights of the evaluation criteria were calculated using CRITIC. Utility criteria were range, usable battery, and total torque. Cost criteria were price, fast charging time, acceleration time, and energy consumption. The decision matrix was normalized using Eq (2) for the benefit criteria and Eq (3) for the cost criteria. The normalized decision matrix is given in Table 3.

Table 3: Normalized Decision Matrix

	C1	C2	C3	C4	C5	C6	C7
Dacia Spring	0,986	0,714	0,000	1,000	0,000	0,000	0,000
Togg T10X	0,912	1,000	0,792	0,383	0,302	0,449	0,763
Seres 3	1,000	0,943	0,610	0,519	0,641	0,451	0,864
Skywell ET5	0,835	0,000	0,753	0,506	0,907	1,000	0,661
Mercedes Benz EQA 250+	0,590	0,886	1,000	0,580	1,000	0,746	0,847
Mercedes Benz EQB 250+	0,564	0,886	0,623	0,235	0,911	0,746	0,881
Volvo XC40 Recharge	0,574	1,000	0,831	0,000	0,641	0,886	1,000
BMW iX3 eDrive20	0,000	0,886	0,468	0,185	0,836	0,902	0,932
New MG ZS EV	0,869	0,657	0,662	0,272	0,765	0,781	0,525
Subaru Solterra	0,590	0,200	0,883	0,481	0,854	0,761	0,715

After determining the normalized matrix, the relationship coefficient matrix was calculated using Eq (4). The relationship coefficient matrix is shown in Table 4.

Table 4: Inter-Criteria Correlation Matrix

	C1	C2	C3	C4	C5	C6	C7
C1	1,000	-0,126	-0,141	0,531	-0,511	-0,574	-0,531
C2	-0,126	1,000	-0,100	-0,278	-0,271	-0,297	0,297
C3	-0,141	-0,100	1,000	-0,492	0,671	0,662	0,708
C4	0,531	-0,278	-0,492	1,000	-0,492	-0,730	-0,787
C5	-0,511	-0,271	0,671	-0,492	1,000	0,864	0,663
C6	-0,574	-0,297	0,662	-0,730	0,864	1,000	0,693
C7	-0,531	0,297	0,708	-0,787	0,663	0,693	1,000

Objective criterion weight coefficients were calculated using Eqs (5) and (6) and as shown in Table 5.

Table 5: C_j Values

	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
Cj	2,21	2,35	1,31	2,25	1,58	1,59	1,43

In the last step, importance weights were calculated for all criteria using Eq (7) and the results obtained are shown in Table 6.

Table 6: The CRITIC Criteria Weights

	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
Wj	0,174	0,185	0,103	0,177	0,125	0,125	0,112

As seen in Table 5, the fast charging time criterion was weighted highest (C2) with 0.185 and had the highest level of importance. This criterion was followed by energy consumption (C4) and price (C1). Range (C5) and usable battery (C6) criteria followed and were assessed to be of equal importance, followed by total torque (C7) and acceleration time (C3) criteria.

After calculating the weights of the criteria that were effective in selecting the e-SUVs using CRITIC, the e-SUV alternatives were ranked using COPRAS. With this method, useful criteria were those in which higher values indicated a better situation for achieving the objective. Range, usable battery, and total torque were the useful criteria in the present study. The higher values of these criteria had a positive effect on an alternative selection. On the other hand, the criteria that positively affected the selection of alternatives when their values were low were termed "useless criteria". In the present study, price, fast charging time, acceleration time, and energy consumption were among the useless criteria.

The first step of COPRAS was the creation of the decision matrix, after which the normalized decision matrix was obtained using the formula given in Eq (9). The weighted normalized decision matrix shown in Table 7 was then created using Eq (10) and the criteria weights obtained using CRITIC.

Table 7: Weighted Normalized Decision Matrix

	C1	C2	C3	C4	C5	C6	C7
Dacia Spring	0,008	0,019	0,016	0,013	0,007	0,005	0,004
Togg T10X	0,011	0,014	0,009	0,018	0,009	0,010	0,012
Seres 3	0,008	0,015	0,011	0,017	0,012	0,010	0,013
Skywell ET5	0,013	0,031	0,009	0,017	0,014	0,016	0,011
Mercedes Benz EQA 250+	0,021	0,016	0,007	0,016	0,015	0,013	0,012
Mercedes Benz EQB 250+	0,021	0,016	0,011	0,019	0,014	0,013	0,013
Volvo XC40 Recharge	0,021	0,014	0,009	0,021	0,012	0,015	0,014
BMW iX3 eDrive20	0,039	0,016	0,012	0,020	0,014	0,015	0,013
New MG ZS EV	0,012	0,020	0,010	0,019	0,013	0,014	0,009
Subaru Solterra	0,021	0,027	0,008	0,017	0,014	0,014	0,011

Following the construction of the weighted normalized decision matrix, Si+ values for the beneficial criteria and Si- values for the useless criteria were calculated using Eq (11), as shown in Table 8.

Table 8: Si^+ and Si^- Values for Each Alternative

Aternatives	Si+	Si-
Dacia Spring	0,016	0,056
Togg T10X	0,031	0,051
Seres 3	0,035	0,050
Skywell ET5	0,041	0,070
Mercedes Benz EQA 250+	0,041	0,060
Mercedes Benz EQB 250+	0,041	0,067
Volvo XC40 Recharge	0,041	0,065
BMW iX3 eDrive20	0,042	0,086
New MG ZS EV	0,036	0,061
Subaru Solterra	0,039	0,073

Then, the relative importance value (Qi) for each alternative was calculated using Eq (12). The calculated Qi values for each alternative are shown in Table 9.

Table 9: Q_i Value for Each Alternative

Aternatives	Qi
Dacia Spring	0,056
Togg T10X	0,080
Seres 3	0,093
Skywell ET5	0,091
Mercedes Benz EQA 250+	0,109
Mercedes Benz EQB 250+	0,116
Volvo XC40 Recharge	0,139
BMW iX3 eDrive20	0,143
New MG ZS EV	0,234
Subaru Solterra	0,401

According to the ranking in Table 10, the best alternative was Subaru Solterra with a performance index value of 100%, and the worst was Dacia Spring with a performance index value of 13.953%.

Table 10: P_i for Each Alternative and Order of Preference of Alternatives

Order of Preference	Alternatives	P_i
1	Subaru Solterra	100
2	New MG ZS EV	58,433
3	BMW iX3 eDrive20	35,723
4	Volvo XC40 Recharge	34,656
5	Mercedes Benz EQB 250+	28,854
6	Mercedes Benz EQA 250+	27,269
7	Seres 3	22,785
8	Skywell ET5	23,272
9	Togg T10X	20,023
10	Dacia Spring	13,953

5. Conclusion and Discussion

The use of clean energy sources is important for a sustainable future. EVs that use clean energy reduce dependence on fossil fuels. Developments in technology, limited fossil fuels sources, the damages caused by fossil fuels to the environment, and the increasing environmental awareness have made EVs a higher priority for consumers.

This study aimed to determine the most appropriate e-SUVs for consumers who are considering buying an e-SUV that is sold in Turkey. For this purpose, 10 e-SUVs were selected. The data used in the analyses were those the companies shared with consumers. The e-SUVs were assessed using CRITIC and COPRAS based on seven criteria. CRITIC method was used to determine the criteria weights and COPRAS was used to rank the e-SUV alternatives. As a result of the weighting made by the CRITIC method, it was determined that the most important criterion was fast charging time with the coefficient of importance (0,185). These criteria were determined as energy consumption (0.177), price (0.174), range (0.125) and usable battery (0.125), total torque (0.112), and acceleration time (0.103), respectively. As it was seen, three most important criteria were: fast charging time, energy consumption and price, while the least important criterion was acceleration time. After calculating the criterion weights with the CRITIC method, the COPRAS method was used to determine the performance of the alternatives. According to these calculations, Subaru Solterra (100) was determined as the best performing vehicle among alternative electric vehicles. This vehicle was followed by New MG ZS EV (58.433), BMW İX3 eDrive20 (35.723), Volvo XC40 Recharge (34.656), Mercedes Benz EQB (28.854), Mercedes Benz EQA (27.269), Seres 3 (22.785), Skywell ET5 (23.272), Togg T10X (20.023) and Dacia Spring (13.953) respectively.

According to the results obtained, the highest performance score belongs to Subaru Solterra. Actually, although Subaru Solterra has a long fast charging time and a high price, it has a long range, long usable battery time and high total torque value, as well as short acceleration time. The last alternative was found to be Dacia Spring. This vehicle has a short fast charging time and a low price, its range and usable battery time are short, its total torque value is low and its acceleration time is also long. Comparing our results with studies in the literature yielded similar findings. Ecer (2021) and Dwivedi and Sharma (2023) have stated that "fast charging time," "energy consumption," and "price" criteria are the most important criteria in electric vehicle selection decisions as reached in our study.

For future studies, it is suggested to expand the scope of the criteria and include qualitive criteria as well. Additionally, while this study focused only on e-SUVs future research could also compare electric passenger cars. Furthermore, comparisons could be analyzed using different MCDM techniques such as AHP, ARAS, EDAS, COCOSO.

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