E-Shopping Sites Preference Analysis with Multi-Criteria Decision-Making Methods

Araştırma Makalesi/Research Article

Yıldız ŞAHİN, Deniz Merve SARA

Endüstri Mühendisliği, Kocaeli Üniversitesi, Kocaeli, Türkiye
yildiz.sahin@kocaeli.edu.tr, denizmerveis94@gmail.com
(Geliş/Received:28.07.2018; Kabul/Accepted:04.08.2019)
DOI: 10.17671/gazibtd.448716

***Abstract*—** The increasing usage of the internet all over the world has become an indispensable part of our life. The use of internet in many areas such as health, tourism, education, transportation, shopping, communication, banking is increasing day by day and spreading over a wider area. With the widespread use of the Internet, the use of web sites and the work carried out on this area have also increased. Web sites are the bridge between user and information resources. User-centric design principles make it possible for users to efficiently use web sites. Several methods, standards, and studies have been done to measure accessibility and usability.

In this study, the preference of web sites in the shopping sector was compared using the VIKOR method, which is a multi-criteria decision-making method, and the most preferred website was identified. In this context, the opinions of one hundred and eighty web site users were consulted. In the scope of the study, evaluation criteria were determined first. Using VIKOR method, web sites with similar characteristics have been examined in terms of usability.

***Keywords*—** multi criteria decision making, VIKOR method, usability, web site evaluation.

Çok Kriterli Karar Verme Yöntemleri ile E-Alışveriş Siteleri Tercih Analizi

***Özet*—** Tüm dünyada giderek yaygınlaşan internet kullanımı yaşamımızın vazgeçilmez bir parçası haline gelmiştir. Sağlık, turizm, eğitim, ulaşım, alışveriş, iletişim, bankacılık gibi birçok alanda internet kullanımı gün geçtikçe artmakta daha geniş bir alana yayılmaktadır. İnternetin gelişmesiyle birlikte web sitelerinin kullanımı ve bu alanda yapılan çalışmalar da artış göstermiştir. Web siteleri, kullanıcı ve bilgi kaynakları arasındaki köprüyü oluşturmaktadır. Kullanıcıların web sitelerini verimli bir şekilde kullanabilmesi, kullanıcı merkezli tasarım ilkeleriyle mümkündür. Erişilebilirlik ve kullanılabilirliğin ölçümü için birtakım yöntemler, standartlar ve çalışmalar yapılmıştır.

Bu çalışmada, bir çok kriterli karar verme yöntemi olan VIKOR yöntemi kullanılarak alışveriş sektöründe yer alan web sitelerinin tercih edilebilirliği karşılaştırılmış ve en çok tercih edilen web sitesi belirlenmiştir. Bu bağlamda seksen adet web sitesi kullanıcısının görüşlerine başvurulmuştur. Çalışma kapsamında öncelikle değerlendirme kriterleri belirlenmiştir. VIKOR yöntemi kullanılarak benzer özellik taşıyan web siteleri kullanılabilirlik açısından incelenmiştir.

***Anahtar Kelimeler*—** çok kriterli karar verme, VIKOR yöntemi, kullanılabilirlik, web sitesi değerlendirme.

1. INTRODUCTION

One of the most important phenomena emerging together with technological developments is internet. E-commerce is one of the internet usage areas that is becoming widespread with this phenomenon. The prospect of e-commerce has increased considerably. With this increase, it became one of the livelihood sources. The Internet attracts companies operating in the shopping sector from day to day and does not take advantage of these

developments, revealing the risks of major losses in the future for the remaining businesses. Providing fast access over the internet, the web page downloadable and through any web browser a viewable page is also preferred and practical is a very important issue in terms of use [1]. However, being on the internet alone is not enough to achieve success. With large and growing numbers of web site owners, potential users need to be able to pull their pages and turn them into their own consumers. The most important thing to do in this context is to offer websites with as attractive and rich content as possible to consumers. It depends on the ability of a company to reach the potential customer potential, the user expectations, and how they interact with their websites. At the same time, businesses must design their web sites more easily understandable and easy to use in order to protect existing consumers while adding new consumers to their customer portfolios through the Internet.

Electronic commerce has emerged as a consequence of technological innovations that have been seen since the early 2000s with the development of liberalization of trade all over the world, making information transfer easy. E-commerce can be used for all kinds of products that can be traded with conventional marketing methods, such as advertising, information and promotion, direct marketing of all kinds of products, transactions that can be realized in electronic environment, transactions and contracts between commercial institutions, joint design / production, and use of commercial sector services. The information, products and services available on the Internet are available throughout the world in the time zones that are needed. It is seen that everybody in our country, women, men, small and large, has more participation in business life and accordingly, there is a time problem. Therefore, people complete their needs in a short time with online sales and service.

By offering shopping and many services in electronic environment, it is aimed to increase service quality by decreasing time and cost. As far as the business is concerned, the internet allows direct sales and service on the channel to lift the commission paid to the process owners through the process and reduce distribution costs. In addition, the advertising of shopping malls is realized more efficiently than the traditional methods thanks to the various picture and sound features provided on the internet. In this case too, the need for research involving the evaluation of websites is increasingly needed [2].

The preference and usability of a website can be explained as a sign of the quality of the web site, including methods that can be used to measure how easily users can access the interfaces and use it in the design process, and to increase ease of use. The statement of usability is defined as a phenomenon that can be achieved in terms of efficiency, effectiveness and satisfaction in achieving the individual objectives of the products in the ISO 9241 standard [3].

If a website does not look professional, how good the product or service is offered will have a negative impact on consumers' perception. Sites that attract consumers' attention, feel secure, and create user loyalty are considered successful. Having a superior design and functional structure of the websites has a big effect on the shopping decisions of the users. In this study, shopping sites covering a large audience, which continues to develop rapidly today, have been evaluated using multi-criteria decision-making methods in terms of preference and usability. Through this evaluation, design problems that negatively affect service utilization have been identified [4]. In this study, multi criteria decision making problem, decision makers' opinions on this problem and the solution processes are discussed [5]. This methods, help experts/decision makers use reasoning knowledge and inference methods [6].

2. LITERATURE REVIEW

The issue being examined in the scope of the study is important for a large number of businesses today, especially in the effort to reach more customers. For this reason, it has been the focus of many researchers and has inspired many studies. In this section, especially the examples that have been introduced in this area in recent years are detailed. Generally, the most suitable solution is chosen by using multi criteria decision making methods according to the preferences of the decision maker [7].

Chiu et.al. (2013) have proposed a new mixed Multi Criteria Decision Making model that uses DANP and VIKOR methods to improve e-store business. The aim of the work is to focus on the evaluation and development of the strategies to reduce the gaps in customer satisfaction arising from the interaction issues between the criteria in order to reach the expectation level. A new hybrid Multi-Attribute Decision Making model combining DEMATEL-based Analytical Network Processor (VIKOR) methods for problem solving is proposed. In the study, the applicability of the proposed new Hybrid Multi Criteria Decision Making (MCDM) model was evaluated in real life. Thanks to the results, e-store managers have been proposed to develop a knowledge-based marketing strategy to meet consumer needs and encourage customers to buy more [8].

Chou and Cheng (2014) have proposed a hybrid fuzzy MCDM approach to evaluate and improve the quality of the website of professional accounting firms. Within the scope of the study, the fuzzy analytical networking process and fuzzy VIKOR approaches were used to evaluate the website quality of the first four professional accounting firms in Taiwan. The results show that the companies included in this study do not use the internet full potentially and need some improvements for their web sites. When the decision criteria considered in the study were examined, wealth, comprehensibility, assurance, level of relevancy and reliability ranked in the top 5 according to their importance [9].

Lin et.al. (2016), have proposed a service selection model that uses Hybrid MCDM approach for digital music service platforms. With this study, customers' expectations and

needs of music service were revealed and selection criteria were determined for customers to evaluate and select digital music service platforms. The study has been developed with a new Multi-Criteria Decision Model integrated with DEMATEL, Basic Component Analysis, Analytical Network Process (ANP) and VIKOR methods, which enumerates and develops digital music service platforms to achieve the best win-win service choice. This study has identified a sequence of service platforms that consider the basic driving characteristics of digital music service platforms using the proposed model [10].

Kang et.al. (2016), have proposed a fuzzy hierarchical TOPSIS based method for evaluating service quality of e-commerce sites. With the empirical case study of B2C e-commerce, the study has been conducted that will enable researchers and practitioners to better understand the evaluation process from a practical point of view [11].

Liang et al. (2017) proposed a model that allows evaluation of e-commerce sites through an integrated approach under a single-valued trapezoidal neutrophilic environment. In the study, the data were evaluated by an integrated decision system consisting of three modules. The first phase of study is the acquisition of knowledge. In the second step, a single-valued trapezoidal neutrophilic DEMATEL module was used to analyze the causal relationships between the criteria. The third stage provides integration. The validity of the model has been proven through a case study [12].

Pamučar et al. (2018), used the integration of interval rough AHP and interval rough MABAC methods to evaluate university websites. In the group decision-making process, modified IR-AHP method was used to determine the weights of the criteria. The proposed model is adapted to the group decision-making process to help eliminate uncertainties using interval rough numbers (IRN). The results of the IR-AHP model were compared with the results of the traditional AHP method and the fuzzy AHP approach. In addition, the proposed integrated model is compared with the results obtained from Fuzzy TOPSIS, Fuzzy VIKOR, Fuzzy MAIRCA and Fuzzy TODIM methods for evaluating validity and it is seen that it gives satisfactory results [13].

3. METHODOLOGY

3.1. Multiple Criteria Decision-Making Methods

We make decisions almost every day. Every decision taken, or decision made is also an abandoned alternative. According to these alternatives, the right decisions are beneficial to people, while the wrong decisions result in a cost or loss. In this context, the main problem during the decision-making process is; determine the best of the options evaluated according to the measures inconsistent with each other [14]. One of the main objectives of decision-making multi-criteria approach is to help organize and assemble such information that makes decision-makers feel comfortable and confident about the decision they make, to increase satisfaction with considering all evaluation criteria, and to minimize possible regret after decision making [15]. In order to fully evaluate the effectiveness of multiple decision making problems are options (alternatives) [1]. One of the main objectives here is to give the decision maker better control and information and analytics to guide people's decision processes support [16].

Evaluation by decision maker using a minimum of two different criteria within the set in which the final choice is included can be defined as multi-criteria decision making. One of the problems that can be encountered in the solution phase is the choice of the most appropriate method to use. When determining the most appropriate method for a decision-making solution, it is necessary to look at the nature of the problem and the characteristics of the process.

There are various evaluation methods; however as in this study multi criteria decision making methods provide effective results for these decision processes [17]. Today, a variety of methods have been developed for making multi-criteria decision-making. AHP, ANP, ELECTRE, PROMETHEE, TOPSIS, VIKOR methods can be used to make multi-criteria decision-making [18].

3.2. Analytic Hierarchy Process (AHP)

The Analytic Hierarchy Process (AHP) was introduced by Myers and Alpert in 1968 and developed by Saaty in 1977 as a model for problem solving. The method aims to reach a conclusion by creating a complex model of pairwise comparison matrices composed of multiple alternatives and criteria. By making comparisons by decision makers, one matrix is created for criterion and alternatives, and then consistency check is performed to obtain average scores. The highest score among the alternatives is considered the most appropriate [14, 19]. In the AHP method, the pre-defined comparison scale is used. This measurement scale consisting of numbers from 1 to 9, suggested by Saaty. Pairwise comparisons constitute the basic building blocks of the AHP method. Intermediate values in the table are used for cases where the decision maker is conflicting [14].

The most important feature of the method is that it is able to include the thoughts of the decision makers both objectively and subjectively in the decision process [20]. In other words, it tests the consistency of evaluations made after the process of objective and subjective thoughts. At the same time, the AHP method enables decision-makers to implement important decisions as well as which alternatives should be given priority, especially among the alternatives that need to be evaluated according to numerous criteria [21].

The first step of the decision making method is to divide the problem components into a hierarchical structure. At the top of this decision hierarchy is the main objective, below the criteria and below the criteria are alternatives. AHP decision hierarchy scheme is given Figure 1 [22]. The

use of multi-criteria decision making methods, which are analytical methods, is important in terms of consistency and impartiality of decisions [17]. The AHP method is a subjective weighting method while the Entropy weighting method, which takes entropy weights into account, is an objective method [23].

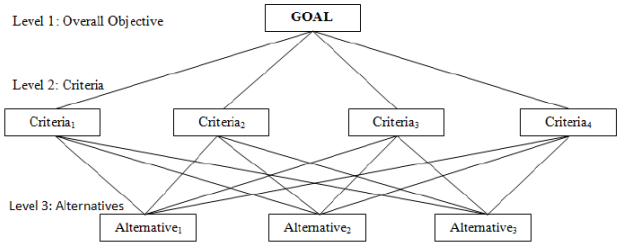

Figure 1. AHP hierarchical decision model

The implementation steps of AHP method were classified as 3 steps in total. Explanations of the implementation steps are indicated respectively [22].

Step 1: It is the step of defining the decision problem and establishing the model. In this context, the objectives, criteria and alternatives are expressed clearly [24, 25].

Step 2: The second step of the method consists of binary comparisons. All criteria are evaluated by comparisons with each other by decision makers.

Step 3: The third step is normalization and calculation of weights. The binary comparison matrices are normalized. In comparison matrices, the total of each column is obtained and divided by row values. Finally, normalized values are averaged on a per line basis and relative weights are generated [25].

3.3. VIKOR Method

The VIKOR method has been developed for the optimization of multi-criteria complex systems [26]. It involves evaluating alternatives according to contradictory criteria, determining their order, and accordingly determining the best one. This method addresses the multi-criteria ranking index based on the ideal solution approximation. The VIKOR method was first proposed by Tzeng and Opricovic for multi-criteria optimization of complex systems. Tzeng and Opricovic used SAW, TOPSİS, VIKOR methods in their studies. Although the results of the three methods are similar to each other, TOPSIS and VIKOR methods have been observed to be able to evaluate the results more clearly. The distinguishing feature of VIKOR and TOPSIS methods is that they utilize vector normalization in the VIKOR method.

VIKOR method has been used in different field applications such as selection of materials and equipment, bank performance evaluations, information systems/ information technologies, land use, airway service quality improvement studies, renewable energy projects evaluation. The method is based on the Lp variable, which is calculated as the total function in the compromised modeling approach in the decision-making process. According to the assumption that each criterion is evaluated according to the comprehension order, the best solution is obtained by comparing the values of closeness [27].

VIKOR method starts with L_p criterion form [28].

$$L_{p,j} = \{\sum_{i=1}^{n} [\frac{w_i(f_i^* - f_{ij})}{(f_i^* - f_{ij})}]^p\}^{1/p} \quad (1)$$

$$1 \leq p \leq \infty; j = 1,2, \dots\dots\dots\dots, j$$

The w_i value in equation 1 can be obtained by expert opinion or any of the multiple criteria decision-making methods that allow the weights of the criteria to be calculated. When the weights are determined, it must be checked that the sum of all weight values is equal to 1. The implementation steps of the VIKOR method are described in 5 steps.

Step 1: The best f_i^* and worst f_i^- values are determined for each criterion. When the criterion i is accepted as a benefit criterion $f_i^* = max_j f_{ij}$ and $f_i^- = min_j f_{ij}$ are calculated.

Step 2: In this step, the average utility and maximum regret of the group are calculated. Equation 2 is used when calculating the average benefit value of the group, and equation 3 is used in calculating the regret value.

$$s_j = \sum_{i=1}^{n} w_i(f_i^* - f_{ij})/(f_i^* - f_{ij}) \quad (2)$$

$$R_j = max_i [\frac{w_i(f_i^* - f_{ij})}{f_i^* - f_{ij}}] \quad (3)$$

Step 3: The index values are calculated. Equation 4 is used to implement this step.

$$Q_j = \frac{v(s_j - s^*)}{(s^- - s^*)} + (1 - v)(R_j - R^*)/(R^- - R^*) \quad (4)$$

In this method, $s^- = max_j s_j$, $s^* = min_j s_j$ and $R^* = min_j R_j R^- = max_j R_j$ are defined. As seen in Eq (4), while the variable v expresses the weight for the strategy that maximizing group benefit, the minimum regret of the opposite decision makers is defined by $(1 - v)$. In general, v=0,5 is used.

Step 4: In this step, the alternatives will be sorted in order to obtain the compromise solution. In the fourth stage S_j, R_j, and Q_j, which must be computed separately for each of the alternatives, must be arranged independently from small to large.

Step 5: By specifying the conditions, a' will be offered as a compromise solution if the following constraints are satisfied in the sequence that was made in the previous step according to $Q\ min$.

Condition 1; C_1 Acceptable advantage,

$$Q(a'') - Q(a') \geq DQ$$

$$DQ = 1/1(j-1)$$

The first alternative in the sequence according to the Q value results is defined as a' and the second alternative is defined as a''.

Condition 2; C_2 Acceptable stability in decision making, a' alternative, when evaluated in terms of *S* and/or *R*, should be obtained as the best alternative in the sequence. The alternative that can provide these conditions is considered stable throughout the solution process. If one of the conditions is not met, it is suggested that the solution set be applied as follows,

When C_2 condition is satisfied, between alternatives a' and a''. In case C_1 is satisfied, the maximum value of M. alternatives is considered among the alternatives of the sorted $a', a'', \dots\dots\dots\dots, a^{(M)}$ when determining $Q\left(a^{(M)}\right) - Q(a') < DQ$.

The best of the alternatives ordered by the obtained Q values is one with the minimum Q value. This method is suitable for use when the decision maker does not have enough information about the reasons that affect his / her preferences. The compromise solution obtained is a solution that can be accepted by the decision maker with the ability to maximize the utility of the group and to minimize the individual regret [14].

Integrate multi-criteria decision making methods many functions were introduced in the literature.In general, AHP is weighted by the critical importance. TOPSIS, VIKOR, etc. there are alternatives to a multi-criteria decision-making method such as analysis [29].

4. E-SHOPPING SITE PREFERENCE ANALYSIS

In this study, the existing shopping sites were classified as having the most number of visitors and the first 5 alternative web sites were selected. The websites that were evaluated within the scope of the study were not shared in order not to create any negative conditions. The AHP method was used to weight the criteria determined within the scope of the study. This evaluation form was applied to one hundred and eighty web site users and the data collection phase was carried out. Users rated the web site by using 1-9 measurement scale. In this study, 11 evaluation criteria were determined by using the alternative sites and web site usability studies in the literature. These evaluation criteria and explanations are given below.

Accessibility (EC_1): This criterion evaluates the ability of the websites to meet the main accessibility needs.

Home page (EC_2): The well-designed home page has an impact on the users positively.

Page Structure (EC_3): The layout of the elements in the website is evaluated.

Text View (EC_4): The appropriate color combinations are checked to ensure that the text size in the website is compatible with the font used and the visibility of the text.

Search Box (EC_5): Measures how effectively the web site search function is being used. The search option is controlled both in a simple and detailed way.

Detailed Filtering (EC_6): In the roughly prepared data of web sites, the searches that can be done to limit the data type are evaluated.

Reliability (EC_7): How secure the website is and how privacy policy is being assessed. It also looks at how web sites inform users about this issue.

Brand and Product Diversity (EC_8): In this section, the brand and product range of websites are evaluated to meet user expectations.

Navigation (EC_9): The navigation structure of a well-designed page allows websites to be used effectively.

Updatability (EC_{10}): It is evaluated that the web sites are updatable and can provide product change in a short time.

Communication (EC_{11}): In this section, it is evaluated that the users can easily communicate with the web sites.

Scores were made on the evaluation form in the direction of the given measurement scale. Forms filled by one hundred and eighty evaluators were collected and average scores were calculated for each criterion. The weight of each criterion is taken as equal. Table 1 lists the alternative list for the decision problem.

Table 1. List of alternatives

List of Alternatives	**Definition of alternatives**	
	Number	***Alternative***
	A_1	Alternative-1
	A_2	Alternative-2
	A_3	Alternative-3
	A_4	Alternative-4
	A_5	Alternative-5

4.1. Determination of Criteria Weights by Analytic Hierarchy Process

The AHP method was used to determine the weight of the criteria used in evaluating the performance of Web sites. The generated comparison matrices were evaluated by one hundred and eighty users.

1-9 measurement scale recommended by Saaty was used in the evaluation [8]. The arithmatic mean results of the criterion evaluations made in the direction of this measurement scale are given in Table 2.

Table 2. Scoring for the evaluation criteria

Scoring For the Evaluation Criteria	**Average scores for each criterion**	
	Criterion	***Average scores***
	EC_1	4
	EC_2	6,5
	EC_3	6,5
	EC_4	5,5
	EC_5	6
	EC_6	8
	EC_7	9
	EC_8	6,5
	EC_9	9
	EC_{10}	7
	EC_{11}	4,5

According to criterion evaluations, Table 3 include normalized criteria datas. Also table include criterion shortening column sections. For example, HP is Home Page criterion.

Table 3. Normalized criterion datas

Normalized Datas	**A**	**HP**	**PS**	**TV**	**SB**	**DF**
Accessibility	0,06	0,06	0,06	0,06	0,06	0,06
Home page	0,09	0,09	0,09	0,09	0,09	0,09
Page Structure	0,09	0,09	0,09	0,09	0,09	0,09
Text View	0,08	0,08	0,08	0,08	0,08	0,08
Search Box	0,08	0,08	0,08	0,08	0,08	0,08
Detailed Filtering	0,11	0,11	0,11	0,11	0,11	0,11
Reliability	0,12	0,12	0,12	0,12	0,12	0,12
Brand and Product Diversity	0,09	0,09	0,09	0,09	0,09	0,09
Navigation	0,12	0,12	0,12	0,12	0,12	0,12
Updatability	0,10	0,10	0,10	0,10	0,10	0,10
Communication	0,06	0,06	0,06	0,06	0,06	0,06

Table 3. (Continuation) Normalized criterion datas

Normalized Datas	**R**	**BPD**	**N**	**U**	**C**
Accessibility	0,06	0,06	0,06	0,06	0,06
Home page	0,09	0,09	0,09	0,09	0,09
Page Structure	0,09	0,09	0,09	0,09	0,09
Text View	0,08	0,08	0,08	0,08	0,08
Search Box	0,08	0,08	0,08	0,08	0,08
Detailed Filtering	0,11	0,11	0,11	0,11	0,11
Reliability	0,12	0,12	0,12	0,12	0,12
Brand and Product Diversity	0,09	0,09	0,09	0,09	0,09
Navigation	0,12	0,12	0,12	0,12	0,12
Updatability	0,10	0,10	0,10	0,10	0,10
Communication	0,06	0,06	0,06	0,06	0,06

After normalized values, the criteria weights determined using the AHP method are given in Table 4. As a result of calculating the consistency ratios of the pairwise comparison matrices, it is seen that they are found consistent. The dual comparison questionnaire template which was created to collect the evaluation data is given in Appendix 1.

Table 4. Weights of the evaluation criteria

Weights of The Evaluation Criteria	**Average scores for each criterion**	
	Criterion	***Average scores***
	EC_1	0,055
	EC_2	0,090
	EC_3	0,090
	EC_4	0,076
	EC_5	0,083
	EC_6	0,110
	EC_7	0,124
	EC_8	0,090
	EC_9	0,124
	EC_{10}	0,097
	EC_{11}	0,062

The consistency check of the criterion assesment was performed and the consistency ratio was calculated as 0,045. This result shows that less then 0,1 and that means assessment was done clearly and correctly.

4.2. Problem Solution with VIKOR Method

The initial data to be used in the VIKOR Method solution has been provided by one hundred and eighty users as mentioned before. The initial data obtained as a result of the questionnaire survey is as shown in Table 5.

Table 5. Evaluation of alternatives based on criteria

Evaluation of Alternatives based on criteria	**Evaluation Results Provided by Users**					
	Evaluation Criteria	***Alternatives (A_i)***				
		A_1	A_2	A_3	A_4	A_5
	EC_1	6,25	6,00	6,00	5,00	6,75
	EC_2	6,00	4,50	6,25	6,00	7,25

Evaluation of Alternatives based on criteria	Evaluation Results Provided by Users					
	Evaluation Criteria	*Alternatives (A_i)*				
		A_1	A_2	A_3	A_4	A_5
	EC_3	5,50	4,00	5,50	5,50	6,25
	EC_4	5,75	4,50	4,75	6,25	5,75
	EC_5	3,75	4,50	5,75	5,50	6,75
	EC_6	4,50	4,75	5,25	5,50	7,00
	EC_7	6,67	4,00	6,67	7,33	9,00
	EC_8	7,67	4,33	7,00	6,67	8,67
	EC_9	6,67	6,00	7,33	8,00	8,67
	EC_{10}	6,33	4,33	5,00	7,00	8,33
	EC_{11}	6,33	5,00	6,67	6,00	6,67

After completing the criterion assessment, the following VICOR method solution steps are as follows.

Step 1: Using the evaluation results in Table 5, the best and worst values of each evaluation criterion were determined.

Table 6. Best and worst values of evaluation criteria

Best and Worst Values of Evaluation Criteria	Evaluation Results Provided by Users			
	Criterion Number	*Alternatives (A_i)*		
		Definition of criteria	f_j^*	f_j^-
	EC_1	Accessibility	6,75	5,00
	EC_2	Home page	7,25	4,50
	EC_3	Page Structure	6,25	4,00
	EC_4	Text View	6,25	4,50
	EC_5	Search Box	6,75	3,75
	EC_6	Detailed Filtering	7,00	4,50
	EC_7	Reliability	9,00	4,00
	EC_8	Brand and Product Diversity	8,67	4,33
	EC_9	Navigation	8,67	6,00
	EC_{10}	Updatability	8,33	4,33
	EC_{11}	Communication	6,67	5,00

Step 2: In the second step of the method, the average utility and maximal regret of the group for each of the alternatives are calculated.

Eq. 2 and 3 are used in the calculation of these data. The values obtained after the completion of the calculations are given in Table 7.

Table 7. Calculation results of S_j and Q_j values

Calculation Results of S_j and Q_j Values	S_j and Q_j values for alternatives		
	Alternatives	S_j	Q_j
	Alternative-1	0,534	0,712
	Alternative-2	0,937	1,000
	Alternative-3	0,491	0,543
	Alternative-4	0,397	0,423
	Alternative-5	0,022	0,000

Step 3: Index values are calculated for each of the alternatives.

Equation 4 is used in the calculation of the index values. In order to see the decision results at different risk levels that the decision maker may prefer, the value of "v", which provides the maximum group benefit in equation 4, is taken as 0,5 and the R value is calculated.

When the risk level values (v) vary from 0 to 1, the alternative list to be sorted according to the R_j values to be obtained can be changed.

For this reason, the investigation of the effect of the "v" values on the solution results is very important in order to be able to make a right decision in different decision environments.

The values calculated at this stage are given in Table 8.

Table 8. S_j, R_j and Q_j values for v=5

Calculation results of S_j and Q_j values	S_j, R_j and Q_j values			
	Alternatives	S_j	R_j	Q_j
	Alternative-1	0,534	0,110	0,712
	Alternative-2	0,937	0,124	1,000
	Alternative-3	0,491	0,080	0,543
	Alternative-4	0,397	0,066	0,423
	Alternative-5	0,022	0,022	0,000

Step 4: S_j, R_j and Q_j ranking results are given in Table 9

Table 9. Ascending sequence for S_j, R_j and Q_j values

Ascending Sequence for S_j, R_j and Q_j Values	S_j, R_j and Q_j values			
	Alternatives	S_j	R_j	Q_j
	Alternative-1	A5	A5	A5
	Alternative-2	A4	A4	A4
	Alternative-3	A1	A3	A3
	Alternative-4	A3	A1	A1
	Alternative-5	A2	A2	A2

Step 5: To test the accuracy of the sorting performed, it is checked whether the alternative with the minimum R value provides the following two conditions.

Condition 1; C_1 Acceptable advantage,

$Q(a'') - Q(a') \geq DQ$
$DQ = 1/1(j-1)$; j represents the number of alternatives.

In this study, because the alternative number $j = 5$, $DQ = 0{,}25$ was found by using the DQ equation. For v=0,5 the second alternative is A_4 and the first alternative is A_5. In this case $Q(a'')$=0,524 and $Q(a')$=0,000. As a result of the

values calculated with $Q(a'') - Q(a') \geq DQ$ Eq., it is seen that $0,524 - 0,000 \geq 0,25 \rightarrow 0,524 \geq 0,25$ is achieved. Condition 1 is provided for the problem.
Condition 2; C_2 Acceptable stability in decision making

For *v*=0,5, the best score was obtained in at least one of the *S* and *R* values, as seen in Table 8. In this case Condition 2 is provided. The evaluation results of all alternatives are shown in Table 8. All alternatives provide at least one of the S and R values. The best website alternative for usability is A5. Other alternatives are A4, A3, A1 and A2, respectively.

5. CONCLUSION AND DISCUSSION

In today's increasingly widespread e-commerce business, competitiveness has become more and more difficult every day. Due to the cost-reducing effect, the companies are aiming to realize their marketing and sales activities via the internet. The availability of web sites, which have a significant share in the e-commerce sector, is very important in terms of acquiring customers and retaining existing customers.

Especially the increase in the number of web sites marketed by similar products makes this competition more difficult. Being a preferred website for customers is almost the most critical issue in terms of competitive advantage.

The purpose of this study is to evaluate the preference analysis of E-shopping sites using the VIKOR method, one of the most critically-based decision-making methods. Within the scope of the study, five different websites with similar product marketing efforts were selected and examined in terms of preference according to the evaluation criteria determined.

It is aimed that the analysis results obtained will provide a guide to the firm's current situation analysis and future improvement studies.

In the first phase of the study, the criteria that are important in terms of preference have been determined considering expert opinions. The importance levels of the 11 assessment criteria identified were determined by the Analytical Hierarchy Process, which is a multi-criteria decision-making technique.

The analysis and evaluations carried out on the questionnaire of one hundred and eighty users revealed that the reliability, navigation and detailed filtering criteria had the greatest effect on preference. Within the scope of this study, it is suggested that alternatives will provide maximum benefit in the improvement and development works on the criteria having the highest weight on the end user. In order to increase the level of preferability by the end user, the feedback provided by the criteria other than these 3 criteria will create a long development process.

When the alternatives are examined, it is necessary to improve the alternatives A1 and A2, especially in the detailed filtering criterion. The A2 alternative should also include more studies involving criteria for reliability and navigation. When the A5, which has the highest preferability, is examined, it is observed that it has almost the highest scores in all three criteria.

Once the weights of the evaluation criteria were determined, a preference analysis was conducted for five alternative websites marketed by similar products using the VIKOR method, which allowed the second phase of the study to assess different risk levels.

According to the analysis results, it was observed that the order of options changed at different risk levels. Considering condition 2 for all v values, the A5, which has a steady stance on each of S, Q and R, has been identified as the best performing alternative.

REFERENCES

[1] M. A. Sungur, H. Ankaralı, Ş. Cangür, "Web Tabanlı İstatistiksel Analiz: Faktöriyel Varyans Analizi ve Etkileşim Etkisinin Çoklu Karşılaştırma Yöntemi ile İncelenmesi", *Bilişim Teknolojileri Dergisi*, 10(1), 13-20, 2017.

[2] Ş. Baloğlu, Y. A. Pekcan, "The Website Design and Internet Site Marketing Practices of Upscale and Luxury Hotels in Turkey", *Tourism Management*, 27(1), 171-176, 2016.

[3] J. D. Gould, L. Clayton, "Designing for usability: Key principles and what designers think", *Communications of the ACM*, 28(3), 300-11, 1985.

[4] C. C. Whiteehead, "Evaluating Web Page and Web Site Usability", **Proceedings of the 44th Annual Southeast Regional Conference ACM-SE 44**, Melbourne, Florida, USA, 788-780, 2006.

[5] S. Akbaş, T. Erbay Dalkılıç, "Multi-Criteria Supplier Selection Based on Fuzzy Pairwise Comparison in AHP", *Journal of Science*, 31(1), 296-308, 2018.

[6] A. Albayrak, F. Duran, R. Bayır, "Development of Intelligent Decision Support System Using Fuzzy Cognitive Maps for Migratory Beekeepers", *Turkish Journal of Electrical Engineering&Computer Science*, 26(5), 2476-2488, 2018.

[7] Ö. Türkşen, "Optimization and Decision Making Stages for Multiple Responses: An Application of NSGA-II and FCM Clustering Algorithm", *Gazi University Journal of Science*, 28(2), 321-330, 2015.

[8] W-Y Chiu, G-H Tzeng, H-L Li, "A New Hybrid MCDM Model Combining DANP With VIKOR To Improve E-Store Business", *Knowledge-Based Systems*, 37, 48-61, 2013.

[9] W-C Chou, Y-P Cheng, "A hybrid fuzzy MCDM approach for evaluating website quality of professional accounting firms", *Expert Systems with Applications*, 39, 2783-2793, 2014.

[10] C-L Lin, Y-H Shih, G-H Tzeng, H-C Yu, "A service selection model for digital music service platforms using a hybrid MCDM approach", *Applied Soft Computing*, 48, 385-403, 2016.

[11] D. Kang, W. Jang, Y. Park, "Evaluation of e-commerce websites using fuzzy hierarchical TOPSIS based on E-S-QUAL", *Applied Soft Computing*, 42, 53-65, 2016.

[12] R. Liang, J. Wang, H. Zhang, "Evaluation of e-commerce websites: An integrated approach under a single-valued trapezoidal neutrosophic environment", *Knowledge-Based Systems*, 135, 44-59, 2017.

[13] D. Pamučar, Ž. Stević, E.K. Zavadskas, "Integration of interval rough AHP and interval rough MABAC methods for evaluating university web pages", *Applied Soft Computing*, 67, 141-163, 2018.

[14] S. Felek, Y. Yuluğkural, Z. Aladağ, "Mobil İletişim Sektöründe Pazar Paylaşımının Tahmininde AHP ve ANP Yöntemlerinin Kıyaslaması", *Endüstri Mühendisliği Dergisi*, 18(1), 6-22, 2007.

[15] İ. Ertuğrul, A. Özçil, "Çok Kriterli Karar Vermede TOPSIS ve VIKOR Yöntemleriyle Klima Seçimi", *Çankırı Karatekin Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, 4(1), 267-282, 2014.

[16] E. Aydemir, "Akademik Personel Performans Değerlendirmesinde Bir Karar Desrek Sistemi Önerisi", *Bilişim Teknolojileri Dergisi*, 12(2), 131-140, 2019.

[17] M. Hamurcu, T. Eren, "A Fuzzy Analytical Network Process Approach to the Selection of the Rail System Projects", *Sigma Journal of Engineering and Natural Science*, 9(4), 415-426, 2018.

[18] F. Ersöz, M. Kabak, "Savunma Sanayi Uygulamalarında Çok Kriterli Karar Verme Yöntemlerinin Literatür Araştırması", *Savunma Bilimleri Dergisi*, 9(1), 97-125, 2010.

[19] M. Toksarı, "Analitik Hiyerarşi Prosesi Yaklaşımı Kullanılarak Mobilya Sektörü İçin Ege Bölgesi'nde Hedef Pazarın Belirlenmesi", *Yönetim ve Ekonomi Dergisi*, 14(1), 171-180, 2007.

[20] E. Triantaphyllou "Using the Analytic Hierarchy Process for Decision Making in Engineering Applications: Some Challenges", *Inter'l Journal of Industrial Engineering*: *Applications and Practice*, 2(1), 35-44, 1995.

[21] R. N. Gasımov, **Karar Analizi**, Osman Gazi Üniversitesi Endüstri Mühendisliği Bölümü Ders Notları, 2004.

[22] Ü. Şengül, M. Eren, S. E. Shiraz, "Bulanık AHP ile Belediyelerin Toplu Taşıma Araç Seçimi", *Erciyes Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, 40, 143-165, 2012.

[23] E. Şenyiğit, B. Demirel, "The Selection of Material in Dental Implant with Entropy Based Simple Additive Weighting and Analytic Hierarchy Process Method", *Sigma Journal of Engineering and Natural Science*, 36(3), 731-740, 2018.

[24] Z. G. Göktolga, B. Göklalp, "İş Seçimini Etkileyen Kriterlerin ve Alternatiflerin AHP Metodu ile Belirlenmesi", *Celal Bayar Üniversitesi İktisadi ve İdari Birimler Dergisi*, 13(2), 71-86, 2012.

[25] B. Yeşilyurt, K.Karakuş, Ş. Gür, "Çok Ölçütlü Karar Verme Yöntemleri ile Hastane Bilgi Yönetim Sistemleri İçin Paket Programı Seçimi", *Başkent Üniversitesi Ticari Bilimler Fakültesi Dergisi*, 3(1), 1-21, 2019.

[26] C.L. Hwang, K. Yoon, **Multiple Attributes, Decision Making Methods and Applications**, Springer, Berlin Heidelberg, 1981.

[27] M. Yurdakul, Y.T. İç, "Türk Otomotiv Firmalarının Performans Ölçümü ve Analizine Yönelik TOPSIS Yöntemini Kullanan Bir Örnek Çalışma", *Gazi Üniversitesi Mühendislik ve Mimarlık Fakültesi Dergisi*, 18(1), 1-18, 2003.

[28] S. Opricovic, G.H. Tzeng, "Compromise Solution by MCDM Methods: A Comparative Analysis of VIKOR and TOPSIS", *European Journal of Operational Research*, 156(2), 445-455, 2004.

[29] E. Çakır, B. Kutlu Karabıyık, "Bütünleşik SWARA-COPRAS Yöntemi kullanılarak Bulut Depolama Hizmet Sağlayıcılarının Değerlendirilmesi", *Bilişim Teknolojileri Dergisi*, 10(4), 417-434, 2017.

APPENDICES

Appendix 1

Please read the explanations below before completing the questionnaire.
1. Answer the questions on a binary comparison basis.
2. Each comparison will be evaluated independently.
3. Binary comparisons will be made according to the following table values.

Table 10. Binary comparison between criteria scale values and definitions

Scale Values	Definitions
1	Equally important
3	Moderately important
5	Strongly important
7	Extremely important
9	Definitely important
2,4,6,8	Intermediate values

Table 11. Survey template applied in the study

Accessibility	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Home page
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Page Structure
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Text View
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Search Box
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Detailed Filtering
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Brand and Product Diversity
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Navigation
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Updatability
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Communication
Home page	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Page Structure
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Text View
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Search Box
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Detailed Filtering
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Brand and Product Diversity
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Navigation
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Updatability
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Communication
Page Structure	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Text View
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Search Box
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Detailed Filtering
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Brand and Product Diversity
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Navigation
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Updatability
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Communication

Table 11. (Continuation) Survey template applied in the study

Text View	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Search Box
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Detailed Filtering
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Brand and Product Diversity
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Navigation
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Updatability
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Communication
Search Box	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Detailed Filtering
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Brand and Product Diversity
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Navigation
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Updatability
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Communication
Detailed Filtering	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Brand and Product Diversity
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Navigation
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Updatability
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Communication
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Brand and Product Diversity
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Navigation
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Updatability
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Communication
Brand and Product Diversity	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Navigation
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Updatability
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Communication
Navigation	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Updatability
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Communication
Updatability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Communication