A study on strategy development for e-commerce businesses with clustering and spherical fuzzy analytic hierarchy process

Kümeleme ve küresel bulanık analitik hiyerarşi süreci ile e-ticaret işletmeleri için strateji geliştirme üzerine bir çalışma

Serap Tepe [1],* , Serkan Eti [2]

[1] *University of Health Sciences, Department of Occupational Health and Safety*
[2] *Istanbul Medipol University, Department of Computer Programming*

Abstract

E-Commerce is a shopping method that allows trading or placing an order for any product or service on a website with various payment methods. This method is gaining importance day by day and increasing its market share. Although the reasons for choosing e-commerce for consumers are different from each other, in general, criteria such as time, payment options and individualization affect preferences. In this study; e-commerce sites were compared, and 14 e-commerce sites were determined as alternatives based on expert opinions. These identified e-commerce sites were evaluated in terms of criteria such as brand image & reliability, campaign, cargo speed, packaging, payment options, personnel, call center services and functionality of the application. In the first part of the study, two clusters of e-commerce sites were created using cluster analysis. These clusters are grouped as general service e-commerce sites and specific service e-commerce sites. Thus, two homogeneous groups were formed from the large heterogeneous group. In the second part of the study, the criteria were compared and sorted using the spherical fuzzy Analytic Hierarchy Process (AHP) method.

Keywords: E-commerce, Clustering, Analytical hierarchy process, Fuzzy logic

Öz

E-Ticaret, bir web sitesindeki herhangi bir ürün veya hizmet için çeşitli ödeme yöntemleriyle alım satım yapılmasına veya sipariş verilmesine olanak sağlayan bir alışveriş yöntemidir. Bu yöntem her geçen gün önem kazanmakta ve pazar payını arttırmaktadır. Tüketicilerin e-ticareti tercih etme nedenleri birbirinden farklı olsa da genel olarak zaman, ödeme seçenekleri ve bireyselleşme gibi kriterler tercihleri etkilemektedir. Bu çalışmada; e-ticaret siteleri karşılaştırılmış ve uzman görüşleri doğrultusunda alternatif olarak 14 e-ticaret sitesi belirlenmiştir. Belirlenen bu e-ticaret siteleri marka imajı ve güvenilirliği, kampanya, kargo hızı, paketleme, ödeme seçenekleri, personel, çağrı merkezi hizmetleri ve uygulamanın işlevselliği gibi kriterler açısından değerlendirilmiştir. Çalışmanın ilk bölümünde, küme analizi kullanılarak iki e-ticaret sitesi kümesi oluşturulmuştur. Bu kümeler genel hizmet e-ticaret siteleri ve özel hizmet e-ticaret siteleri olarak gruplandırılmıştır. Böylece büyük heterojen gruptan iki homojen grup oluşturulmuştur. Çalışmanın ikinci bölümünde ise, küresel bulanık Analitik Hiyerarşi Prosesi (AHP) yöntemi kullanılarak kriterler karşılaştırılmış ve sıralanmıştır.

Anahtar kelimeler: E-ticaret, Kümeleme, Analitik hiyerarşi süreci, Bulanık mantık

1 Introduction

Meeting human needs is the main principle of all economic activities. People need various products and services to survive. While meeting these needs was called trade in the beginning, the line between the concept of need and the concept of desire began to disappear with the change of time and conditions, and two driving forces, one innate and the other learned later, have shaped today's demand concept and allowed it to spread to all areas of life. The reason for the emergence of trade is the desire of man to meet his needs. Due to the limited production and resources, people wanted to provide the product or service that they did not have from someone else, and for this reason, they chose

to change with the product or service that they have. Over time, the needs have diversified and the feeling of not being satisfied with less has been added to this diversity and different meanings have been given to trade. Today, people can trade in both physical and virtual environments; In this way, they have the opportunity to choose from unlimited products and services. Both types of shopping offer different experiences to consumers and work to best respond to customer demand. Physical shopping is a type of shopping that has existed since the first times of commerce and responds to the expectations of the consumer such as touching the product to be purchased and experiencing the

product. Although its uncertainties are relatively less than online shopping, it leaves its place to internet shopping in many areas day by day. Today, consumers prefer online shopping for reasons such as limited time, traffic, parking problem, avoiding crowded environments. The fact that e-commerce offers consumers the opportunity to compare the features and prices of products, the presence of customer reviews and personalized services support shopping in the virtual environment. Thanks to internet shopping, consumers can quickly access all the information about the product they want and make comparisons between similar products. Consumers who work hard and do not want to spend their limited holiday opportunities on shopping, who pay more attention not to be in crowded environments with the pandemic period, and who prefer e-shopping due to many different criteria, cause this market to grow and develop itself. E-shopping systems are updating themselves day by day, expanding their product range and reaching consumers from all channels. As a result of this close relationship with the consumer, the time spent on e-commerce sites increases and the boundaries between wants and needs become unclear. During e-shopping, consumers are no longer just looking for the product; They pay attention to the delivery time, payment options, cargo speed and even the cargo company they work with. This situation causes e-shopping sites to carry out different studies in order to increase their service quality and to be preferred more.

There are different definitions used in the literature for e-commerce. According to the Organization for Economic Development and Cooperation, e-commerce is the buying and selling of goods or services over computer networks [1]. E-commerce is also defined as the transfer of commercial activities from the traditional way to electronic order, supply and distribution channels [2]. Today, with the spread of e-commerce, the speed factor has gained importance in issues such as time, information, ordering, procurement,

comparison and stock. In order to meet customer expectations and create customer loyalty, e-commerce sites are updated in both management and process activities. According to some researchers, the birth of e-commerce is called the 1990s, while others think that e-commerce is as old as electronic data interchange (EDI). In this context, the earliest examples of e-commerce were seen in the 1960s with the development of electronic data exchange (EDI) for exchanging business documents from one computer to another in a standardized format. This is the first generation of e-commerce or EDI, allowing companies to securely and efficiently exchange information, place orders and electronic money transfers from computers provided the opportunity [3]. The emergence of the Internet in the 1990s, with the processing of goods and services over the Internet ushered in the second era of e-commerce [4]. Today, when it comes to e-commerce, it is not just the sale of a product in electronic environment; different elements such as digital advertising and marketing tactics, social media management, content creation, customer relationship management, warehouse, stock, cargo process management, search engine optimization, but which are chains of the same ring and make e-commerce e-commerce are discussed. The priority of e-commerce is to provide consumers with fast and easy shopping opportunities. It is among the priorities of e-commerce that products and services can be delivered quickly to the consumer, shopping can be done easily without tiring the user, providing a high level of security for the purchasing processes and being open to change. According to the forms of e-commerce; It is classified in 5 units: from business to business, from business to consumer, from consumer to consumer, from business to public administration, from consumer to public administration [5]. This diversity ensures that many different stakeholders are in the same environment and that trade takes place.
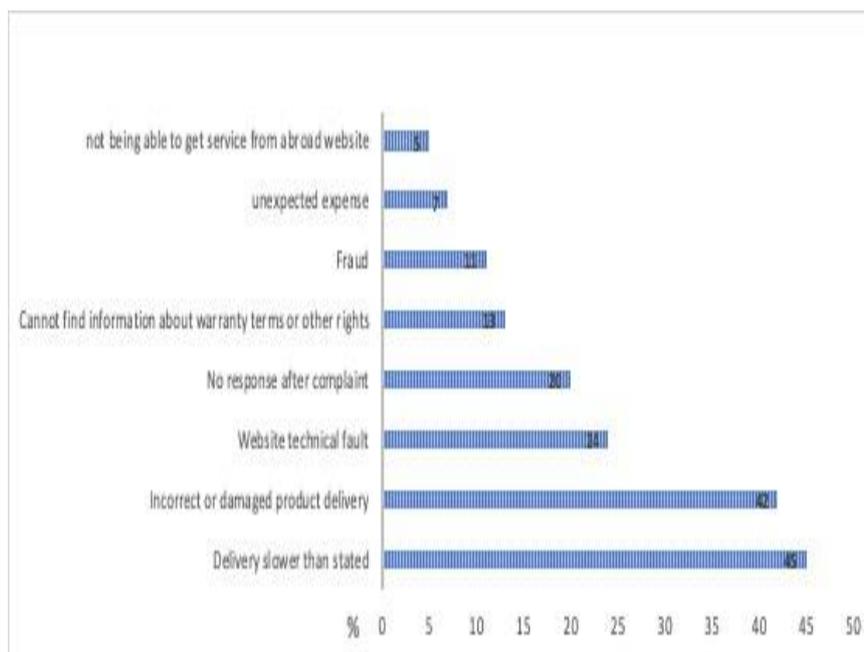

Figure 1. Complaints about internet shopping

While business-to-business e-commerce is a type of shopping for providing raw materials within or between companies; business-to-consumer e-commerce is the sale of products or services targeted at individual consumers. Likewise, e-commerce from consumer to consumer and activities from consumer or business to public administration are parameters that can be characterized under the title of e-commerce, although they involve different processes. In addition to the economic variables in the country, e-commerce can be affected by different factors such as the prevalence of financial products, the status of the internet infrastructure and logistics infrastructure [6]. Consumers' expectations for the improvement of after-sales processes are also one of the topics that e-commerce should improve. According to the TUIK 2016 report, the expectations of consumers regarding their complaints and the improvement of after-sales processes are given in Figure 1 [7].

When the reasons for complaints are examined, it is seen that the slower delivery than stated is the subject that receives the most complaints. In addition, reasons such as incorrect product delivery and no response from the seller are common complaints in internet shopping. In order to prevent all these complaints, to meet customer expectations and to increase the share in total trade, the e-commerce approach must evaluate the opportunities well and strengthen the weak points. Opportunities such as increase in dynamic and young population, increase in internet usage, opportunities to reach new markets, accessibility, decrease in transaction costs are important opportunities for e-commerce and structural problems related to e-commerce can be solved by creating dynamic strategies. When look at the literature studies, it is seen that the studies generally concentrate on the obstacles in front of e-commerce, the general situation of e-commerce, the effect of technological developments on e-commerce, e-commerce strategies. In this sense, the presented study is important in terms of filling an important gap in the field and providing a new perspective. The study aims to propose a strategy according to the type of service to the businesses that provide services over the internet and aims to determine the strategies that e-commerce businesses should attach importance to in order to improve themselves.
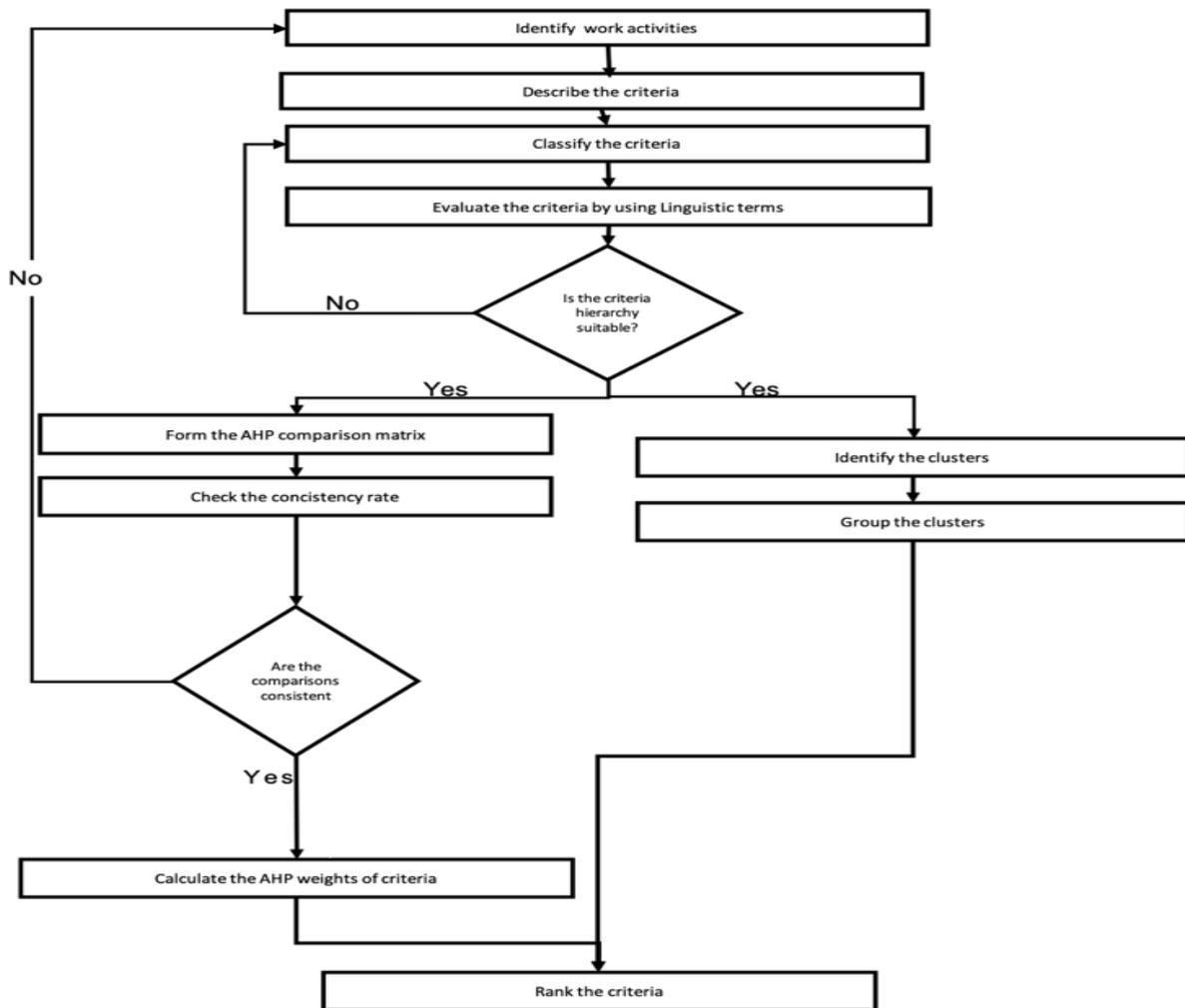

Figure 2. The framework of the proposed study

Studies in which data mining is used in studies on e-commerce businesses are included in the literature. In order to understand the behavior of e-commerce customers, strategies can be produced by classifying them with cluster analysis [8]. Apart from clustering of data mining techniques, artificial neural networks are frequently used in e-commerce studies [9-11]. Studies on e-commerce businesses are also frequently encountered in econometric studies. In the study on sales forecasting with artificial neural network modeling, it was investigated whether it is possible to train a single model to predict sales in all regions [12]. Since it can use data mining within unstructured textual structures, it can be the subject of analysis in the comments in e-commerce businesses [13-14]. The aim of this study is to classify the e-commerce businesses serving in Turkey and to produce specific strategies. For this purpose, firstly, two e-commerce groups were created with the clustering method. Then, using a common criterion pool, which criterion was important in these two groups was investigated by SF-AHP. It is aimed to produce separate strategies for each group of e-commerce businesses based on the criteria obtained as a result of the SF-AHP analysis. In the study, E-commerce sites serving in Turkey were compared, and 14 e-commerce sites were determined as alternatives based on expert opinions. These identified e-commerce sites were evaluated in terms of criteria such as brand image & reliability, campaign, cargo speed, packaging, payment options, personnel, call center services and functionality of the application. In the first part of the study, two clusters of e-commerce sites were created using cluster analysis. These clusters are grouped as general service e-commerce sites and specific service e-commerce sites. Thus, two homogeneous groups were formed from the large heterogeneous group. In the second part of the study, the criteria were compared and sorted using the spherical fuzzy AHP method. The rest of the paper organized as follows. In the introduction part of the paper, the concept of e-shopping and its history were mentioned and a literature review was presented, and the methodology of the study was summarized in the second part. In the third part of the paper, the findings are included, and the results are evaluated by discussing the findings in the following sections. The framework of the proposed study is given in Figure 2.

2 Material and method

2.1 Cluster analysis

Cluster analysis is to create homogeneous groups from large heterogeneous groups [15]. With cluster analysis, it is aimed to have high homogeneity within the cluster and heterogeneity between clusters. Cluster analysis, which came to the fore frequently in the 1960s and was initially used in fields such as biology and ecology, has largely focused on grouping units [16]. The application phases of cluster analysis begin with data entry. Then the similarity or distance has to be measured. This measurement can be made in various ways. However, in cluster analysis applications, three methods predominate: correlational measures, distance measures, and association measures. Correlation and distance measures require metric data, while correlation measures may contain non-metric data. Considering that different measurement choices will result in different clustering results, the similarity measure to be used should be decided. The most commonly used similarity measurement method in practice is to use distance measures. In this context, Minkowski distance, Manhattan City-Block distance, Euclidean distance, Mahalanobis distance, Hotelling T² distance and Canberra distance are frequently used. Clustering is generally carried out in two ways: hierarchical clustering and non-hierarchical clustering. The most used methods are the hierarchical group of methods. The most preferred non-hierarchical clustering method is the k-means method. In this technique, units are divided into k clusters with the smallest sum of squares within clusters. First, each of the first k observations is taken as a cluster with one observation. In the second step, each of the remaining n-k observations is assigned to the cluster with the closest mean, and the cluster means are recalculated after each assignment. After all units are assigned to clusters, reassignment of n observations is made according to the cluster averages found last. Finally, in the final clustering relative to the previous cluster, the previous step is repeated until the observation transition between clusters stops [17]. Hierarchical methods are divided into two as agglomerative hierarchical cluster and divisive hierarchical cluster. The most effective method of hierarchical clustering is the hierarchical agglomeration method. The best part of the stacker clustering methods is that they are easy to read and interpret [18]. The divisive hierarchical clustering algorithm, which starts with assuming that all units are in a single cluster, is then divided into two additional clusters containing the most different units at each step. A single cluster is divided into two clusters, then one of these two clusters is divided into a total of three clusters. This continues until all observations become single-member clusters. Among the most widely used hierarchical stacker methods are the single link method, the full link method, the average link method and the Ward's method. There are many clustering algorithms in the literature. The choice of clustering algorithm to be used depends on the data type and purpose. The between-groups linkage method was used in hierarchical clustering. Euclidean distance calculation was preferred as a measurement. The steps of the algorithm are as follows.

1- The operations are started as n individuals and n clusters.

2- The two closest clusters are combined. Here, the distance (d_{ij}) between two clusters is the Euclidean distance. Equation (1) is used for calculation.

$$d_{ij} = \sqrt{\sum \left(x_{ik} - x_{jk}\right)^2} \tag{1}$$

3- By reducing the number of clusters by one, the iterated distance matrix is found.

4- Steps 2 and 3 are repeated (n-1) times [19].

2.2 Analytical hierarchy process

The Analytical Hierarchy Process (AHP) is one of the most preferred Multi-Criteria Decision Making (MCDM) methods. Developed by Saaty [20-21], this method involves a hierarchical order. At the top level of the hierarchy there is the goal. At one level lower, there are the main criteria and, if any, sub criteria below the main criteria. At the lowest step there are decision options, namely alternatives. AHP can be applied easily with many criteria, and it is a very effective method of making group decisions. Thanks to a sensitivity analysis, the flexibility of the result can be easily tested. AHP can evaluate both quantitative and qualitative criteria in decision making and include the preferences, judgments, intuitions and experiences of the group or individuals in the decision process. It is one of the most useful multi-criteria decision-making methods with a hierarchical structure that enables complex problems to be solved [22]. In the classical method, the evaluations of decision makers are represented as definite numbers. Nevertheless, fuzzy logic provides a mathematical capability that can be used to capture the uncertainties accompanying the human cognitive process in cases where decision makers cannot express their evaluations with definite numbers. The proposed spherical fuzzy AHP method in this study consists of several steps described in the following section.

Step 1. A hierarchical structure is created.

Step 2. Two-way comparisons are constructed using spherical fuzzy judgment matrices based on the linguistic terms given in Table 1. Equations (2) and (3) are used to obtain the score indices (SI).

$$SI = \sqrt{\left| 100 * \left[(\mu_{\tilde{A}_s} - \pi_{\tilde{A}_s})^2 - (\upsilon_{\tilde{A}_s} - \pi_{\tilde{A}_s})^2 \right] \right|}$$
for AMI, VHI, HI, SMI, and EI   (2)

$$\frac{1}{SI} = \frac{1}{\sqrt{\left| 100 * \left[(\mu_{\tilde{A}_s} - \pi_{\tilde{A}_s})^2 - (\upsilon_{\tilde{A}_s} - \pi_{\tilde{A}_s})^2 \right] \right|}}$$
for EI, SLI, LI, VLI and ALI   (3)

Where μ, υ and, π are the membership degree, nonmembership degree, and hesitancy degree of x, respectively.

Step 3. The consistency of pairwise comparison matrices is checked.

Step 4. The spherical fuzzy local weights for criteria and alternatives are calculated.

Using the SWAM operator given in Equation (4), the weight of each alternative is then determined [23].

$$SWAM_w (A_{SI}, \dots, A_{Sn}) = \left\langle \left[1 - \prod_{i=1}^{n} (1 - \mu_{A_{si}}^2)^{wi} \right]^{\frac{1}{2}}, \prod_{i=1}^{n} (\upsilon_{A_{si}}^{wi}), \left[\prod_{i=1}^{n} (1 - \mu_{A_{si}}^2)^{wi} - \prod_{i=1}^{n} (1 - \mu_{A_{si}}^2 - \pi_{A_{si}}^2)^{wi} \right]^{\frac{1}{2}} \right\rangle$$
where w=1/n.   (4)

Step 5. A hierarchical ranking of layers is created to obtain overall weights. Criterion weights are made fuzzy using equation (5) and the score function (S). It is normalized by equation (6). The spherical fuzzy product given by Eq. (7) is applied.

$$S(\widetilde{w}_j^s) = \sqrt{\left| 100 * \left[(3\mu_{\tilde{A}_s} - \frac{\pi_{\tilde{A}_s}}{2})^2 - (\frac{\upsilon_{\tilde{A}_s}}{2} - \pi_{\tilde{A}_s})^2 \right] \right|}$$ (5)

$$\overline{w}_j^s = \frac{S(\widetilde{w}_j^s)}{\sum_{j=1}^{n} S(\widetilde{w}_j^s)}$$ (6)

$$\tilde{A}_{sij} = \overline{w}_j^s . \tilde{A}_{s_i} = \left\langle (1 - (1 - \mu_{\tilde{A}_s}^2)^{\overline{w}_j^s}), \upsilon_{\tilde{A}_s}^{\overline{w}_j^s}, \right.$$
$$\left. ((1 - \mu_{\tilde{A}_s}^2)^{\overline{w}_j^s} - (1 - \mu_{\tilde{A}_s}^2 - \pi_{\tilde{A}_s}^2)^{\overline{w}_j^s})^{1/2} \right\rangle \forall i$$ (7)

The final spherical fuzzy AHP score ($\tilde{F}$), for each alternative Ai, is obtained by carrying out the spherical fuzzy arithmetic addition over each global preference weights, as given in Eq. (8)

$$\tilde{F} = \sum_{J=1}^{n} \tilde{A}_{S_{ij}} = \tilde{A}_{S_{i1}} \oplus \tilde{A}_{S_{i2}} \dots \oplus \tilde{A}_{S_{in}} \forall i$$ (8)

i.e. $\tilde{A}_{S_{11}} \oplus \tilde{A}_{S_{12}} = \left\langle (\mu_{\tilde{A}_{S_{11}}}^2 + \mu_{\tilde{A}_{S_{12}}}^2 - \mu_{\tilde{A}_{S_{11}}}^2 \mu_{\tilde{A}_{S_{12}}}^2)^{1/2}, \right.$

$\upsilon_{\tilde{A}_{S_{11}}} \upsilon_{\tilde{A}_{S_{12}}}, (1 - \mu_{\tilde{A}_{S_{12}}}^2) \pi_{\tilde{A}_{S_{11}}}^2$

$\left. + (1 - \mu_{\tilde{A}_{S_{11}}}^2) \pi_{\tilde{A}_{S_{12}}}^2 - \mu_{\tilde{A}_{S_{11}}}^2 \mu_{\tilde{A}_{S_{12}}}^2)^{1/2} \right\rangle$

Step 6. The final score for each alternative is determined using the score function given by Eq. (5).

Step 7. Alternatives are ranked according to their point scores. The largest value indicates the best solution [24 - 27].

Table 1. Linguistic measures of importance

Linguistic measures of importance used for pairwise comparisons		
	(μ, υ, π)	Score Index (SI)
Absolutely more important (AMI)	(0.9, 0.1, 0.0)	9
Very high importance (VHI)	(0.8, 0.2, 0.1)	7
High importance (HI)	(0.7, 0.3, 0.2)	5
Slightly more important (SMI)	(0.6, 0.4, 0.3)	3
Equally important (EI)	(0.5, 0.4, 0.4)	1
Slightly low importance (SLI)	(0.4, 0.6, 0.3)	1/3
Low importance (LI)	(0.3, 0.7, 0.2)	1/5
Very low importance (VLI)	(0.2, 0.8, 0.1)	1/7
Absolutely low importance (ALI)	(0.1, 0.9, 0.0)	1/9

3 Findings

Based on expert opinions, 14 e-commerce sites were determined as alternatives in the paper. These identified e-commerce sites were evaluated in terms of criteria such as brand image & reliability, campaign, cargo speed, packaging, payment options, personnel, call center services and interface functionality of the application. In the first part

of the study, two clusters of e-commerce sites were created using cluster analysis. These clusters are grouped as general service e-commerce sites and specific service e-commerce sites. Thus, two homogeneous groups were formed from the large heterogeneous group. In the second part of the study, the criteria were compared and sorted using the spherical fuzzy AHP method. Looking at the criteria; A brand's image is a term that describes consumers' thoughts, impressions, ideas and feelings about the brand. In other words, brand image is consumers' views on how they perceive and interpret the brand's identity. Campaign is an important competitive power for e-commerce sites. Campaigns increase sales, attract attention and enable the brand to reach more people. Today, consumers give importance to the packaging of the product and the speed of shipping. The packaging of the product is important in terms of both hygiene and delivery of the product without any damage. In addition, payment options for consumers are an important criterion in choosing an e-shopping site. Some e-commerce sites only have the option to pay with credit profit. However, some e-commerce sites had card payment, cash on delivery, coupon options, and these options make shopping more attractive. For consumers, easy access to the call center regarding the product or service they purchase and personnel criteria affect their e-commerce site preferences. In addition, the simplicity of the interface used and the functionality of the site are also important parameters. Situations such as a plain and simple interface, safe shopping, protection of personal data and personalization of consumer-specific options are important for the consumer. In Figure 3, two homogeneous groups of e-commerce sites were created using cluster analysis. While the first group is the group of e-commerce businesses that provide general services, the second group includes businesses that provide specific services.
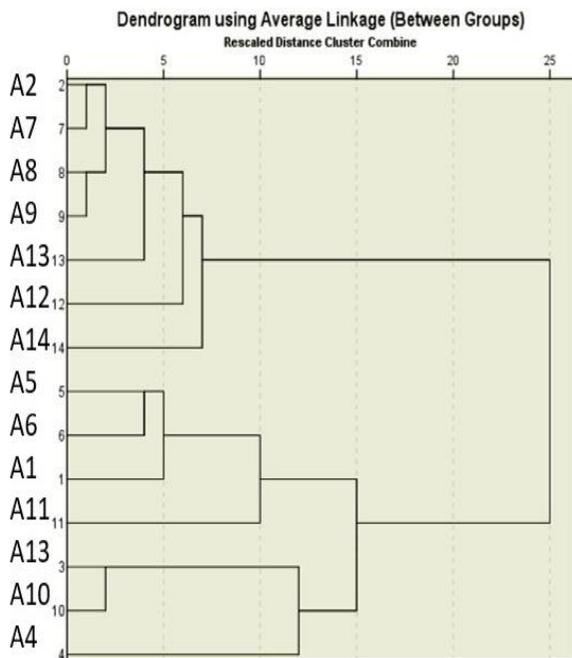

Figure 3. Cluster analysis results

The criteria determined in the second part of the study were compared for both groups using the spherical fuzzy AHP method. In Table 2, the decision matrix for general service e-commerce sites is given. In Table 3, the weights and rankings of the criteria for general service e-commerce sites are given. Decision matrix for e-commerce sites providing specific services is given in Table 4. In Table 5, the weights and rankings of the criteria for e-commerce sites providing specific services are given.

Table 2. Decision matrix (E-commerce sites providing general service)

		Brand image	Campaign	Shipping Speed	Packaging	Payment Option	Employee	Call Center	Interface Usability
	μ	0.50	0.47	0.14	0.20	0.55	0.14	0.12	0.70
	v	0.40	0.59	0.87	0.80	0.50	0.87	0.88	0.32
	π	0.40	0.10	0.10	0.10	0.11	0.00	0.00	0.00
	μ	0.13	0.40	0.08	0.08	0.25	0.24	0.13	0.08
	v	0.28	0.40	0.83	0.83	0.40	0.66	0.80	0.52
	π	0.10	0.40	0.00	0.00	0.10	0.00	0.00	0.00
	μ	0.83	0.77	0.50	0.76	0.66	0.14	0.14	0.78
	v	0.17	0.25	0.40	0.27	0.42	0.87	0.87	0.24
	π	0.10	0.00	0.40	0.00	0.00	0.00	0.00	0.00
E-commerce sites providing general service	μ	0.71	0.77	0.66	0.50	0.66	0.14	0.35	0.66
	v	0.32	0.25	0.42	0.40	0.41	0.87	0.63	0.36
	π	0.10	0.00	0.00	0.40	0.00	0.00	0.00	0.10
	μ	0.71	0.60	0.76	0.76	0.50	0.36	0.35	0.66
	v	0.32	0.40	0.27	0.27	0.40	0.62	0.63	0.36
	π	0.10	0.10	0.00	0.00	0.40	0.00	0.00	0.10
	μ	0.87	0.79	0.87	0.87	0.75	0.50	0.42	0.61
	v	0.13	0.20	0.13	0.13	0.24	0.40	0.52	0.46
	π	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.00
	μ	0.89	0.82	0.87	0.87	0.76	0.72	0.50	0.84
	v	0.11	0.18	0.13	0.13	0.23	0.25	0.40	0.17
	π	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00
	μ	0.60	0.77	0.17	0.65	0.57	0.74	0.20	0.50
	v	0.42	0.25	0.83	0.38	0.48	0.29	0.81	0.40
	π	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.40
	μ	0.74	0.71	0.66	0.70	0.62	0.48	0.32	0.67
	v	0.24	0.29	0.38	0.33	0.37	0.55	0.67	0.34
	π	0.45	0.11	0.11	0.11	0.11	0.00	0.00	0.00

Table 3. Weights and ranking

	s	w	Rank
Brand image	19.57	0.14	4
Campaign	20.90	0.15	1
Shipping Speed	19.26	0.14	5
Packaging	20.50	0.15	2
Payment Option	18.17	0.13	6
Employee	14.09	0.10	7
Call Center	8.84	0.06	8
Interface Usability	19.94	0.14	3

Table 4. Decision matrix (E-commerce sites with specific services)

		Brand image	Campaign	Shipping Speed	Packaging	Payment Option	Employee	Call Center	Interface Usability
E-commerce sites with specific services	μ	0.50	0.66	0.65	0.66	0.67	0.72	0.67	0.70
	ʋ	0.40	0.40	0.43	0.40	0.39	0.31	0.39	0.32
	π	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	μ	0.09	0.40	0.08	0.08	0.24	0.06	0.24	0.08
	ʋ	0.32	0.40	0.40	0.40	0.32	0.20	0.32	0.25
	π	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00
	μ	0.82	0.55	0.50	0.87	0.66	0.50	0.18	0.74
	ʋ	0.21	0.51	0.40	0.13	0.42	0.58	0.83	0.29
	π	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00
	μ	0.54	0.54	0.14	0.50	0.66	0.32	0.42	0.70
	ʋ	0.55	0.55	0.87	0.40	0.42	0.67	0.52	0.33
	π	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00
	μ	0.68	0.60	0.76	0.76	0.50	0.64	0.42	0.70
	ʋ	0.36	0.42	0.27	0.27	0.40	0.38	0.52	0.33
	π	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.00
	μ	0.61	0.54	0.87	0.87	0.69	0.50	0.32	0.81
	ʋ	0.44	0.55	0.13	0.13	0.32	0.40	0.67	0.18
	π	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.00
	μ	0.69	0.60	0.87	0.87	0.72	0.81	0.50	0.86
	ʋ	0.34	0.42	0.13	0.13	0.25	0.18	0.40	0.14
	π	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00
	μ	0.60	0.55	0.70	0.75	0.66	0.32	0.16	0.50
	ʋ	0.42	0.52	0.33	0.25	0.40	0.67	0.85	0.40
	π	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.40
	μ	0.62	0.56	0.69	0.76	0.63	0.57	0.41	0.71
	ʋ	0,37	0,47	0,31	0,24	0,36	0,38	0,53	0,27
	π	0,41	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Table 5. Weights and ranking

	s	w	Rank
Brand image	16.480	0.113	7
Campaign	16.739	0.115	6
Shipping Speed	20.726	0.142	3
Packaging	22.653	0.156	1
Payment Option	18.830	0.129	4
Employee	16.984	0.117	5
Call Center	12.099	0.083	8
Interface Usability	21.132	0.145	2

4 Conclusion and discussion

E-commerce is a system that works with the logic of digitally processing, storing and transmitting the functions of companies in the form of voice, text and image. In other words, e-commerce is the realization of commercial transactions in electronic environment. Speed, simplicity, reliability and performance are crucial values for e-commerce. The aim of e-commerce is to deliver products and services to the customer in the easiest, fastest and most reliable way. Thanks to e-commerce shopping, customers can quickly access all the information about the product they want and make comparisons between similar products. This situation has led to an increase in the importance of e-commerce sites and the use of these sites has become widespread. With the spread of e-commerce sites, a brand perception begins to form on the behalf of the customers, and with this perception, customers tend to shop more from the e-commerce sites they feel closest to and establish a connection with. Criteria such as the campaigns organized by the shopping sites, the way the products are packaged, the fast and safe delivery of the products to the customers, and the payment options are the necessary criteria for an e-commerce site to reach more customers, it's also necessary for creating a loyal customer base and increasing its competitive power. In the first part of the presented study, two clusters of e-commerce sites were created using cluster analysis. These clusters are grouped as general service e-commerce sites and specific service e-commerce sites. Thus, two homogeneous groups were formed from the large heterogeneous group. Although they all seem to provide the same service at first, it has been seen that groups with different features of e-commerce sites are formed with the achievement of more homogeneous structures. In the second part of the study, the criteria were compared and sorted using the spherical fuzzy AHP method. According to the results obtained; It has been determined that the campaign is the most important criterion in e-commerce sites that provide general service. Packaging follows this criterion. In this group, the interface usability and brand image of the application were determined as the third and fourth in the ranking. This situation is expected for general service e-commerce sites. Customers wait for the campaign times for shopping or turn to e-commerce sites with more campaigns. For consumers, the packaging style of the products they buy

is important, the importance given to packaging is actually the key to the safe delivery of the product and the customer to feel that he is taken care of. Using a simple interface while shopping has a positive effect on the customer experience. A brand perception for that e-commerce site is formed in the mind of the customer, who makes a purchase from a well-designed and useful e-commerce site, and whose product is delivered quickly and perfectly. Interface usability has come to the fore in both general and specific e-commerce websites. When shopping is done through e-commerce applications or web interface, the functionality and ease of these areas where the customer is contacted will be effective in choosing the same business for the next order of the customer. Since in-app question-answer or follow-up is generally used for product, order tracking, purchasing or different questions, it has been determined that criteria such as personnel, call center are not very effective and are not very important for the customer compared to other criteria. When look at the e-commerce sites serving in the specific field, it is seen that the packaging is in the first place. Since the e-commerce sites in this group are mainly food or emergency products, it is an expected result that consumers want to be sensitive in packaging. It is important for this group that an ordered dish is packaged hygienically without getting cold. The usefulness of the interface of the site and the speed of shipping are other important criteria. Again, it has been determined that the call center is perceived as less important compared to other criteria, as there are in-app question-answer options on the sites in this group. Although the personnel criterion is lower in the ranking for e-commerce sites that provide general service, it is higher in the ranking for e-commerce sites that provide specific services because each company uses its own courier in these sites, and the customer is dealing with different personnel so this criterion gains importance for this group. In the study, 14 e-commerce sites were evaluated in terms of criteria such as service variety, number of cities served, product variety, cargo speed, average delivery time, number of contracted cargos, campaigns, personnel, payment options, call center, application functionality, and brand image. Criteria comparisons were made for the clustered homogeneous groups that emerged, and the ranking was made by calculating the criterion weights. In the study, clustering was done on 14 e-commerce companies. The limitations of the study can be summarized as follows. The first limit is the geographical constraint of the study. In other words; all businesses in the study provide service in Turkey. The second constraint is the measurable variables for cluster analysis. The third constraint is on the basis of variables. Eight variables were considered when listing the mentioned businesses. By increasing these variables, different detailed studies can be done. For the future studies, more different cluster-based strategies can be produced by obtaining more clusters with a more comprehensive sample in different studies. A similar study can be carried out with other computational methods in cluster analysis. By using criterion weights, e-commerce sites in each cluster can be ranked with different multi-criteria decision-making methods.

Conflict of interest

The authors declare that there is no conflict of interest.

Similarity rate: %2

References

[1] Organization for economic co-operation and development, Glossary of statistical terms: Electronic commerce. https://stats.oecd.org/glossary/detail.asp?ID=4721 /Accessed 13 December 2021.

[2] Current status of e-commerce in Turkey, http://www.halitkaya.net/turkiyede-ki-e-ticaretin-guncel-durumu/ Accessed 16 December 2021.

[3] J. Sullivan, and K. Walstrom, Consumer perspectives on service quality of electronic commerce web sites, Journal of Computer Information Systems, 41(3), 8-14, 2001.https://doi.org/10.1080/08874417.2001.11647001

[4] P. Mwencha, Taxation of electronic commerce-a commentary, Financing for Development, 1(1). 70- 79, 2009.

[5] Ö. Toptan Yılmaz and O. Bayram. E-commerce and e-export in Turkey during the COVID-19 pandemic. Kayseri University Journal of Social Sciences, Vol 2, No 2, 37-54, 2020. https://doi.org/10.51177/kayusosder.777097

[6] B. Yeniçeri, An e-Commerce strategy: content marketing, new media refereed, Academic, E-journal, issue 8, 25-40, 2020.

[7] TUSIAD, The Driving Force of the Economy in a Digitalized World: E-Commerce. https://www.eticaretraporu.org/wp-content/uploads/2017/04 /TUSIAD_E-Ticaret_Raporu_2017.pdf / Accessed 16 December 2021.

[8] Y. Jiang, and S. Yu, Mining e-commerce data to analyze the target customer behavior. In First International Workshop on Knowledge Discovery and Data Mining pp. 406-409, IEEE, 2008.

[9] H. Pan, and H. Zhou, Study on convolutional neural network and its application in data mining and sales forecasting for E-commerce. Electronic Commerce Research, 20(2), 297-320, 2020. https://doi.org/10.1007/s10660-020-09409-0

[10] K. Bandara, P. Shi, C. Bergmeir, H. Hewamalage, Q. Tran, and B. Seaman, Sales demand forecast in e-commerce using a long short-term memory neural network methodology. In International conference on neural information processing 462-474, Springer, Cham, 2019. https://doi.org/10.1007/978-3-030-36718-3_39

[11] L. Peng, and L. Lai, A service innovation evaluation framework for tourism e-commerce in China based on BP neural network. Electronic Markets, 24(1), 37-46, 2014.https://doi.org/10.1007/s12525-013-0148-0

[12] K. Zhao, and C. Wang, Sales forecast in e-commerce using convolutional neural network. arXiv preprint arXiv:1708.07946,2017. https://doi.org/10.48550/arXiv.1708.07946

[13] A. Bayhaqy, S. Sfenrianto, K. Nainggolan, and E.R. Kaburuan, Sentiment analysis about E-commerce from tweets using decision tree, K-nearest neighbor, and naïve bayes. International conference on orange technologies (ICOT) 1-6, IEEE, 2018. https://doi.org/10.1109/ICOT.2018.8705796

[14] M. Zhang, E-commerce comment sentiment classification based on deep learning. In 2020 IEEE 5th International Conference on Cloud Computing and Big Data Analytics, 184-187, IEEE, 2020. https://doi.org/10.1109/ICCCBDA49378.2020.9095734.

[15] C. Yılmaz Yaman and G. A. Doğu, Examination of provinces in terms of school sports activities with clustering analysis, Iğdır University Journal of Social Sciences, 26, pp.182-205, 2021.

[16] J. F. Hair Jr., W. C. Black, J. Barry Babin and R. E. Anderson, Multivariate Data Analysis, Harlow: Pearson Education Limited, 2014.

[17] H. Tatlidil, Applied Multivariate Statistical Analysis, Ankara: Akademi Printing House, 1992.

[18] Ş. Kalaycı, SPPS Applied Multivariate Statistical Techniques, Ankara: Dynamic Academy, 2017.

[19] M. Yeşilbudak, H. Kahraman, and H. Karacan, Veri madenciliğinde nesne yönelimli birleştirici hiyerarşik kümeleme modeli. Gazi Üniversitesi Mühendislik Mimarlık Fakültesi Dergisi, 26(1), 27-39, 2011.

[20] S. Yüksel, S. Eti, S. Prosekov, and G.S. Uluer, A study on the energy problem in the Eastern Mediterranean: Text mining and AHP-based strategy recommendations. In Strategic Approaches to Energy Management 27-38, Springer, Cham, 2021. https://dx.doi.org/10.1007/978-3-030-76783-9_3

[21] T. L. Saaty, Axiomatic foundation of the analytic hierarchy process, Management Science, vol. 32, no. 7, p. 841-855, 1986.

[22] A. Y. Korkusuz, U. H. İnan, Y. Özdemir and H. Başlıgil, Occupational health and safety performance measurement in healthcare sector using integrated multi criteria decision making methods, Journal of the Faculty of Engineering and Architecture of Gazi University vol. 35, no. 1, p. 81-96, 2020. https://doi.org/10.17341/gazimmfd.441032

[23] S. Ashraf, S. Abdullah, T. Mahmood, F. Ghani, and T. Mahmood, Spherical fuzzy sets and their applications in multi-attribute decision making problems. Journal of Intelligent & Fuzzy Systems, 36(3), 2829-2844, 2019. https://doi.org/10.3233/JIFS-172009

[24] F. Kutlu Gündoğdu and C. Kahraman, A Novel spherical fuzzy analytic hierarchy process and its renewable energy application. Soft Computing 24, 4607–4621, 2020. https://doi.org/10.1007/s00500-019-04222-w

[25] M. Mathew, R.K. Chakrabortty, and M.J. Ryan, A novel approach integrating AHP and TOPSIS under spherical fuzzy sets for advanced manufacturing system selection. Engineering Applications of Artificial Intelligence, 96, 103988, 2020. https://doi.org/10.1016/j.engappai.2020.103988

[26] F. Kutlu Gündoğdu, and C. Kahraman, Spherical fuzzy analytic hierarchy process (AHP) and its application to industrial robot selection. In International Conference on Intelligent and Fuzzy Systems, 988-996, Springer, Cham, 2019. https://doi.org/10.1007/978-3-030-23756-1_117

[27] O. Dogan, Process mining technology selection with spherical fuzzy AHP and sensitivity analysis. Expert Systems with Applications, 178, 114999, 2021. https://doi.org/10.1016/j.eswa.2021.114999