

Ranking Automotive Companies From The Perspective Of Purchasing Criteria With A Fuzzy Approach

Reza Pezeshkizadeh

Article Info	Abstract
<p>Article History</p> <p>Received: March 01,2026</p> <p>Accepted: June 01,2026</p> <p>Keywords : Purchase; Fuzzy AHP; Fuzzy VIKOR; Multi Criteria Decision-Making; Customer's satisfaction</p> <p>DOI: 10.5281/zenodo.20494930</p>	<p><i>This study intends to identify the influential factors which have an impact on the decision of people who want to buy cars manufactured by domestic or foreign companies. By identifying these factors, manufacturers can produce cars that satisfy the demands of customers and increase the shares of these manufacturers in the market. In this way, advertisements become more effective. This article describes a method by which the priorities of car-manufacturers are determined in a fuzzy environment. This article proposes a methodology which is based on a fuzzy analytical hierarchy process. This model includes 8 main criteria (indices) and the related sub-criteria (sub-indices). Hyundai, Kia Motors, Iran Khodro, and Saipa were the four companies that were included in this study.</i></p> <p><i>In order to rank the car-manufacturers, we propose a Fuzzy VlseKriterijumska I Kompromisno Optimizacija Resenje (FVIKOR) method. Moreover, in order to evaluate the criteria and calculate the weights of criteria, a FAHP is proposed.</i></p>

Introduction

Today competitions in the market have become more extensive and more professional. Even the least level of ignorance might lead to the failure of an organization. As the competitions become more and more serious in the markets, satisfying the demands of customers and creating a sense of loyalty among them become increasingly important. On the other hand, environmental changes have led to some changes in customers' demands. This makes manufacturers produce new and more developed models. Focus on customers' demands means paying attention to the quality of products and services. Every organization that tries to satisfy customers' demands should be familiar with these concepts. Familiarity with the concepts related to customers' satisfaction involves the investigation of various aspects of consumers' behavior. For example, we can examine the criteria which are taken into account by customers when they buy a car. Identifying those factors which have an impact on the decisions of customers can help manufacturers to satisfy the needs and demands of consumers.

There are a number of questions that determine degree of importance of these factors, such as "What percentages of sellers are paying attention to these factors at the time of buying?" "Do the policy-makers of manufacturing, selling, and marketing have this attitude or not?" An important question that is raised here is "What criteria are important for customers in buying an item?"

Today organizations have found that there is a strong correlation among customers' satisfaction, customers' loyalty to the organization, and the profits of organizations. Customers' satisfaction is considered as one of the criteria of success for organizations. They invest in those activities that enhance customers' satisfaction. But, because the resources of organizations are limited, those factors that create satisfaction among customers should be identified and ranked. Then, based on the resources of the organization and the priorities of these factors, necessary measures should be taken in order to enhance satisfaction among customers.

In order to achieve this goal, the behavior of consumers should be studied. In other words, those factors which are taken into account by customers throughout buying process should be identified. If these influential factors are identified by companies, they will be able to offer products and services that boost satisfaction among customers.

The concept of marketing means that the purpose of every industry is to boost satisfaction among customers rather than produce goods. The starting point of every industry is the consumer and his/her needs rather than raw materials and skills of selling or obtaining permission.

Only by a clear and comprehensive understanding of the customers can an organization satisfy the needs and demands of consumers. This emphasizes this point that it is crucial for companies to study the behavior of consumers (Moven and Minor, 2001).

The behavior of consumer includes a lot of aspects that can be investigated. It includes the investigation of the processes in which people select and buy a product or decline to use it (set aside) (Solomon, 1999).

The study of consumers' behavior is the investigation of exchange processes, which includes acquisition, consumption, set aside, services, ideas, and experiences (Moven and Minor, 2001). The exchange process is a fundamental element in consumers' behavior. The consumer is on one side of exchange process. In this process, resources are exchanged between the two sides. In addition, other resources might be exchanged between the two sides, such as emotions and information. The process of exchange takes place between consumers and companies. Exchanges might take place between companies or even between consumers themselves.

Researchers have paid little attention to consumption and set-aside phases. Throughout the investigation of consumption phase, the researcher studies the ways that a product is used by consumers and the experiences that are obtained by them. In set-aside phase, the consumer decides what to do after using the product. This phase shows the level of satisfaction among consumers after purchasing products or services. If consumers have unrealistic expectations, they will not receive the intended results. This leads to dissatisfaction among consumers (Moven and Minor, 2001).

In the past, the area of consumers' behavior focused only on buyers' behavior. It emphasized the interaction between consumers and producers at the time of buying. Today most marketers believe that the area of consumers' behavior is beyond the behavior that they show at the time of purchase (Solomon, 1999).

The suggested framework of Raju is called A-B-C-D pattern. It states that there is no buying behavior without access to products and services, and also there is no consumption without buying behavior. When marketers are able to facilitate these phases for the consumers, they are more effective in doing their jobs (Raju, 1995). suggest a methodology which includes a five-phase decision-making process (Cutler and Armstrong, 2002).

This is one of the most important methodologies which are taught in marketing and commercial courses about decision-making process. Now, it will be explained.

Phase one: In this phase, the problem is identified. When one of human needs motivates him/her to buy a product or service, it can be said that his/her internal motivator has become activated.

This internal motivator can be reinforced by an external motivator. For example, when a person sees the car of his neighbor, s/he might become motivated. A professional marketer seeks to identify the needs as well as the reasons that motivates and reinforces such needs. In this phase, the aim of marketing is to identify needs and to stimulate them.

Phase two: In this phase, data are collected and options are evaluated. When consumers are motivated by something, they seek to collect information from various sources. When the collected information justifies their motivations, they buy the product; otherwise avoid buying the product (Cutler and Armstrong, 2002).

At the of information collection, individuals might refer to their past experiences. This process is called "internal investigation". In the buying process of items such as shampoos that are used continuously, people resort to internal investigation. In order to obtain the needed information, sometime people resort to "external investigation". The external investigation sources include personal sources (relatives and friends), general sources (pricing organizations and marketing resources such as sellers), and published sources (books, journals, etc).

Phase three: In this phase, the collected information is evaluated and a decision is made on buying. After the collection of information from different sources, this information is evaluated and then the best option is selected for buying. It must be noted that it is difficult to distinguish between this phase and the pervious phase. But, it can be said that what happens between 'deciding to buy' and 'actual buying' is dependent on two factors:

- Attitudes and views of other people
- The unexpected situational factors (Solomon, 1999).

In the process of information evaluation, the consumers evaluate information by various quantitative and qualitative criteria. Then, based on these criteria, they decide to buy or not to buy a product. Today the skill of selling is dependent on the tools that can be used to convince consumers to buy a product. In fact, in this phase, all marketing activities are actualized (Loudon and Della Bitta, 1993)

Phase four: In this phase, product is consumed and evaluated by the consumers. They make comparison between the criteria that were in their mind before buying and the actual characteristics of the products. In other words, the expectations of consumer before buying are compared with the real characteristics of product. If the expectations before buying are consistent with the real features of products, consumer will be satisfied with his/her purchase; otherwise, a negative image of that product will be created in his/her mind (Schiff man and Leslie, 1997).

After purchase, if the collected information is consistent with consumer's expectation, s/he will look at them as "positive experiences". These experiences can serve as a source of information for other people. If the collected information is not consistent with consumer's expectations, s/he will look at them as "negative experiences". These are considered as unrealistic information (Jobber, 1995).

Therefore, this phase is very sensitive and its impacts are realized in phase five (decision on future purchase).

Phase five: In this phase, decisions are made about future research. After the selling of a product, the job of marketers is not finished. The behavior of consumers after buying the product is an important issue for professional marketers. When the characteristics of product are consistent with the expectations of consumers,

they may purchase the same product again in future and recommend that product to other potential customers. In contrast, dissatisfied consumer behaves in a different way. According to an empirical study, satisfied consumer talks to three people about his/her successful purchase. On the other hand, dissatisfied consumer talks to eleven people about his/her experience. Therefore, the face of the company can change in a very short time and the consumers will go to the rivals of that company to buy their products (Sant, 1997).

After making a decision on buying a product, the consumer might be faced with a psychological challenge. S/he thinks that it might have been better to buy another product. In this phase, the marketers have to persuade consumer to have a better feeling toward the bought product.

The present study intends to determine the criteria which are taken into account by buyers of cars. Also, it intends to rank car manufacturers on the basis on these criteria. In order to achieve this goal, the weights of criteria (indices) and sub-criteria (sub-indices) are determined by FAHP technique. In order to determine the most successful car manufacturer, FVIKOR technique is used.

The Proposed Methodology

A fuzzy method was used in this study. The reason behind using a fuzzy method was that the number of criteria (indices) and sub-criteria (sub-indices) was very high. After the preliminary studies, it was concluded that a combinatory method of fuzzy AHP and fuzzy VIKOR be used in this study. In the first stage, the weights of criteria (indices) were determined by fuzzy AHP method and pair-comparisons. In the next stage, alternatives were ranked by fuzzy VIKOR method (Institutue of Standard, 1996).

Identifying the Criteria (Indices)

In order to identify the special criteria (indices), some experts were conferred and international standards were taken as the base of the judgment. Also, in order to identify, the general criteria (indices) such as price, safety, etc, the opinions of a large number of common people who had some experience in this field were collected. In this way, the main criteria were identified. Finally, by the help of some experts in this field, the influential criteria (indices) and sub-criteria (sub-indices) were determined and investigated (Vander, 2003).

Determining the priorities (weights) of criteria based on FAHP method

The Analytic Hierarchy Process (AHP) introduced by Saaty (1980), directs how to determine the priority of a set of alternatives and the relative importance of attributes in a Multi criteria decision-making problems (Ferrier, 2002). Through AHP, the importance of several attributes is obtained from a process of paired comparison, in which the relevance of the attributes' class or drivers' categories of intangible assets are matched two-on-two in a hierarchic structure. This advantage of AHP and Fuzzy AHP can led to more usability of them as core of model's evaluation. In along of it other methods can be used as core of ranking operation, so Fuzzy AHP has a complementary role in model and is base of comparisons.

Modified fuzzy LLS

There are various computational models for fuzzy AHP. This paper the modified fuzzy Logarithmic Least Squares Method (LLSM) (Venieri et all, 2005).(Samadi et all, 2009), as the fuzzy AHP model. The related comparison with Extent fuzzy AHP model can be referred to, and the comparison with LLSM model can be referred to . Details of modified fuzzy LLSM are presented as follows:

Consider a fuzzy comparison matrix expressed by(Fda and Drug, 2010).

$$\bar{A} = (a_{ij})_{n \times n} \begin{bmatrix} (1,1,1) & (l_{12}, m_{12}, u_{12}) \dots & (l_{1n}, m_{1n}, u_{1n}) \\ \vdots & \ddots & \vdots \\ (l_{n1}, m_{n1}, u_{n1}) & (l_{12}, m_{12}, u_{12}) \dots & (1,1,1) \end{bmatrix} \quad (1)$$

$$a_{ij} = (l_{ij}, m_{ij}, u_{ij}) = a_{ij}^{-1} = \left(\frac{1}{u_{ji}}, \frac{1}{m_{ji}}, \frac{1}{l_{ji}} \right), \text{ and for } i, j = 1, \dots, n \text{ and } i \neq j. \quad (2)$$

The modified fuzzy LLSM developed in, which derives the priorities of the triangular fuzzy comparison matrix in (1).

Table 1: Synthesis of local fuzzy weights

Alternatives	Criterion 1	...	Criterion j	...	Criterion m	Global
	(W_1^L, w_1^M, w_1^U)	...	(W_j^L, w_j^M, w_j^U)	...	(W_m^L, w_m^M, w_m^U)	fuzzy weights
A_1	$(W_{11}^L, w_{11}^M, w_{11}^U)$	...	$(W_{1j}^L, w_{1j}^M, w_{1j}^U)$	...	$(W_{1m}^L, w_{1m}^M, w_{1m}^U)$	$(w_{A_1}^L, w_{A_1}^M, w_{A_1}^U)$
\vdots	\vdots	\vdots	\vdots
A_k	$(W_{k1}^L, w_{k1}^M, w_{k1}^U)$	...	$(W_{kj}^L, w_{kj}^M, w_{kj}^U)$	...	$(W_{km}^L, w_{km}^M, w_{km}^U)$	$(w_{A_k}^L, w_{A_k}^M, w_{A_k}^U)$
\vdots	\vdots	\vdots	\vdots
A_n	$(W_{n1}^L, w_{n1}^M, w_{n1}^U)$	...	$(W_{nj}^L, w_{nj}^M, w_{nj}^U)$	...	$(W_{nm}^L, w_{nm}^M, w_{nm}^U)$	$(w_{A_n}^L, w_{A_n}^M, w_{A_n}^U)$

The local weights have following forms:

$$MinJ = \sum_{i=1}^n \sum_{j=1, j \neq i}^n \left((\ln w_i^L - \ln w_j^U - \ln l_{ij})^2 + (\ln w_i^M - \ln w_j^M - \ln m_{ij})^2 + (\ln w_i^U - \ln w_j^L - \ln u_{ij})^2 \right) \quad (3)$$

$$w_i^L + \sum_{j=1, j \neq i}^n w_j^U \geq 1$$

Subject to

$$\sum_{i=1}^n w_j^M = 1 \quad i = 1, \dots, n \quad (4)$$

Fig. 2. Hierarchical tree to select the car

The optimum solution to the above model forms normalized triangular fuzzy weights $\tilde{w}_i = (w_i^U, w_i^M, w_i^L)$, $i=1, \dots, n$ to obtain the local fuzzy weights. After the local fuzzy weights are obtained, then Global fuzzy weight should be calculated with the presentation in table 1. Global fuzzy weights can be obtained by solving the following two linear programming models and an equation for each decision alternative.

$$w_{A_k}^L = \text{Min} \sum_{j=1}^m w_j$$

$$w_{A_k}^L = \text{Max} \sum_{j=1}^m w_j$$

$$w_{A_k}^L = \text{Min} \sum_{j=1}^m w_j$$

$$\text{where } \Omega_w = \begin{cases} W = (w_1, \dots, w_m) \\ w_j^U \geq w_j^M \geq w_j^L, \sum_{j=1}^m w_j = 1, j = 1, \dots, m \end{cases} \quad (8)$$

is the space of weights (w_j^L, w_j^M, w_j^U) is the normalized triangular fuzzy weight of criterion j ($j=1, \dots, m$) and $(w_{kj}^L, w_{kj}^M, w_{kj}^U)$ is the normalized triangular fuzzy weight of alternative A_k with respect to the criterion j ($k=1, \dots, K; j=1, \dots, m$).

Identifying the Alternatives

In order to identify the alternatives, four car manufacturers were selected for this study (Hyundai, Kia Motors, Iran Khodro, Saipa). The reason behind the selection of these brands was that these companies have extensive presence in the country. The two Iranian car manufacturers, Iran Khodro and Saipa, have a major share in car industry of the country. Also, the two foreign companies, Hyundai and Kia Motors, have a great share in the market of the country. So, a major part of products in the country is produced by these four car manufacturers.

Create decision matrix

In order to determine the impact of each criterion on alternatives and data, this study used the recommendations of experts and pair comparisons. According to table 2, the recommendations of experts were analyzed by AHP method. The priorities were transformed to fuzzy numbers. Geometrical mean was used in order to integrate different views.

Table 2. DM preferences

Preferences DM	Definite numbers	Fuzzy numbers
Completely preferred or completely important or completely favorable	9	(9,9,9)
Preferred or important or favorable (very strong)	7	(6,7,8)
Preferred or important or favorable (strong)	5	(4,5,6)
A little more preferred or a little more important or a little more favorable	3	(2,3,4)
Equal preference or equal importance or equal favorability	1	(1,1,1)
Preferences between spaces (distances)	(2,4,6,8)	-

Ranking alternatives by the fuzzy VIKOR Method

The origins of fuzzy sets theory track back to an article by Lotfy Zadeh who stated that an element either belongs to a set or does not belong to a set at all in classical set theory. This type of true or false logic is commonly applied in financial applications. But, bi-value logic was not sufficiently comprehensive to deal with real world problems and presents a problem, because financial decisions are generally made under uncertainty fuzzy method a powerful method to solve complex decision problems (Ferrier, 2002). Based on the concept of fuzzy logic and the VIKOR method, the proposed fuzzy VIKOR method has been developed to provide a rational, systematic process by which to discover a best solution and a compromise solution that can be used to resolve a fuzzy multi-criteria decision-making problem. The proposed fuzzy VIKOR allows decision-makers to specify the preferred solutions for a given decision problem in real organizational settings (EPA United States, 2006). The procedure of fuzzy VIKOR consists of the following steps:

Step 1: Generate feasible alternatives, determine the evaluation criteria, and form a group of decision makers. Assume that there are m alternatives, k evaluation criteria and n decision makers.

Step 2: Define linguistic variables and their corresponding triangular fuzzy numbers. Linguistic variables were used to evaluate the importance of the criteria and the ratings of alternatives with respect to various criteria. A triangular fuzzy number can be defined as a triplet $\tilde{A} = (a_1, a_2, a_3)$ of crisp number with $a_1 < a_2 < a_3$ and number-ship function $f_{\tilde{A}}(x)$ of the fuzzy number \tilde{A} is given by (see fig.1)

$$f_{\tilde{A}}(x) = \begin{cases} 0, & x < a_1 \\ (x - a_1)/(a_2 - a_1), & a_1 \leq x \leq a_2 \\ (a_3 - x)/(a_3 - a_2), & a_2 \leq x \leq a_3 \\ 0, & x > a_3 \end{cases} \quad (9)$$

Suppose that \tilde{A} and \tilde{B} are two triangular fuzzy numbers (TFN) parameterized by the triplet (a_1, a_2, a_3) and (b_1, b_2, b_3) , respectively, the operational laws of these two triangular fuzzy numbers are as follows:

$$\tilde{A}(+) \tilde{B} = (a_1, a_2, a_3)(+)(b_1, b_2, b_3) = (a_1 + b_1, a_2 + b_2, a_3 + b_3) \quad (10)$$

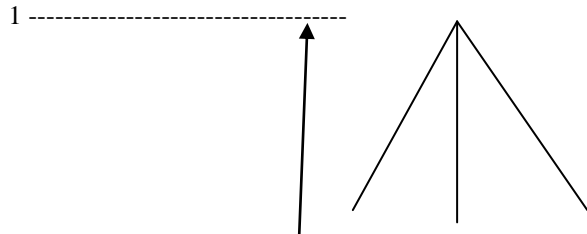
$$\tilde{A}(-) \tilde{B} = (a_1, a_2, a_3)(-)(b_1, b_2, b_3) = (a_1 - b_1, a_2 - b_2, a_3 - b_3) \quad (11)$$

$$\tilde{A}(*) \tilde{B} = (a_1, a_2, a_3)(*)(b_1, b_2, b_3) = (a_1 * b_1, a_2 * b_2, a_3 * b_3) \quad (12)$$

$$\tilde{A}(/) \tilde{B} = (a_1, a_2, a_3)(/)(b_1, b_2, b_3) = (a_1/b_1, a_2/b_2, a_3/b_3) \quad (13)$$

$$(\tilde{A})^{-1} = ((1/a_3)(1/a_2)(1/a_1)) \quad (14)$$

$f_{\tilde{A}}(x)\tilde{A}$



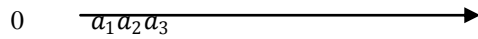


Fig. 2. Membership function of triangular fuzzy number.

Step 3: Integrate decision-makers' preferences and opinions. The decision is derived by aggregating the fuzzy weight of criteria and fuzzy rating of alternatives from n decision-makers calculated:

$$\tilde{w}_j = \frac{1}{n} [\sum_{e=1}^n \tilde{w}_j^e], \quad j=1,2,\dots,k \quad (15)$$

In addition, the preferences and opinions of n decision-makers with respect to j criterion for the important weight of each criterion and the rating of each alternative in the i th alternative can be calculated by:

$$\tilde{x}_{ij} = \frac{1}{n} [\sum_{e=1}^n \tilde{x}_{ij}^e], \quad i=1,2,\dots,m \quad (16)$$

Step 4: Calculate fuzzy weighted average and construct the (normalized) fuzzy decision matrix:

$$\tilde{D} = \begin{bmatrix} \tilde{x}_{11} & \cdots & \tilde{x}_{1n} \\ \vdots & \ddots & \vdots \\ \tilde{x}_{m1} & \cdots & \tilde{x}_{mk} \end{bmatrix}, \quad i=1,2,\dots,m; \quad j=1,2,\dots,k \quad (17)$$

$$\tilde{w} = [\tilde{w}_1, \tilde{w}_2, \dots, \tilde{w}_k], \quad j=1,2,\dots,k \quad (18)$$

Step 5: Determine the fuzzy best value (FBV) and fuzzy worst value (FWV):

$$\tilde{f}_j^* = \max \tilde{x}_{ij}, \quad \tilde{f}_j^- = \min \tilde{x}_{ij} \quad (19)$$

Step 6: Calculate the values

$$\tilde{S}_i = \sum_{j=1}^k \tilde{w}_j (\tilde{f}_j^* - \tilde{x}_{ij}) / (\tilde{f}_j^* - \tilde{f}_j^-), \quad \tilde{S}_i, \tilde{R}_i \quad (20)$$

$$\tilde{R}_i = \max_j [\tilde{w}_j (\tilde{f}_j^* - \tilde{x}_{ij}) / (\tilde{f}_j^* - \tilde{f}_j^-)] \quad (21)$$

where \tilde{S}_i is A_i with respect to all criteria calculated by the sum of the distance for the FBV, and \tilde{R}_i is R_i with respect to the j th criterion, calculated by the maximum distance of FBV.

Step 7: Calculate the values

$$\tilde{S}^*, \tilde{S}^-, \tilde{R}^*, \tilde{R}^-, \tilde{Q}_i :$$

$$\tilde{S}^* = \min \tilde{S}_i, \quad \tilde{S}^- = \max \tilde{S}_i \quad (22)$$

$$\tilde{R}^* = \min \tilde{R}_i, \quad \tilde{R}^- = \max \tilde{R}_i, \quad (23)$$

$$\tilde{Q}_i = v(\tilde{S}_i - \tilde{S}^*) / (\tilde{S}^- - \tilde{S}^*) + (1-v)(\tilde{R}_i - \tilde{R}^*) / (\tilde{R}^- - \tilde{R}^*) \quad (24)$$

Step 8: Determine a compromise solution. Assume that the two conditions given below are acceptable. Then, by using the index Q_i , determine a compromise solution (a') as a single optimal solution.

[C1]Acceptable advantage:

$$DQ = 1/m - 1 \quad (DQ = 0.25 \text{ if } m \leq 4) \quad (25)$$

[C2]Acceptable stability in decision making: under this condition, $Q(a')$ must be $S(a')$ or/and $R(a')$.

If [C1] is not accepted and $Q(a^{(m)}) - Q(a') < DQ$, then $a^{(m)}$ and a' are the same compromise solution. However, a' does not have a comparative advantage, so the compromise solutions $a', a'', \dots, a^{(m)}$ are the same. If [C2] is not accepted, the stability in decision making is deficient, although a' has a comparative advantage. Hence, compromise solutions of a' and a'' are the same.

Step 9: Select the best alternative. Choose $Q(a')$ as the best solution with the minimum of Q_i (Khaniki et al, 2008).

Case study

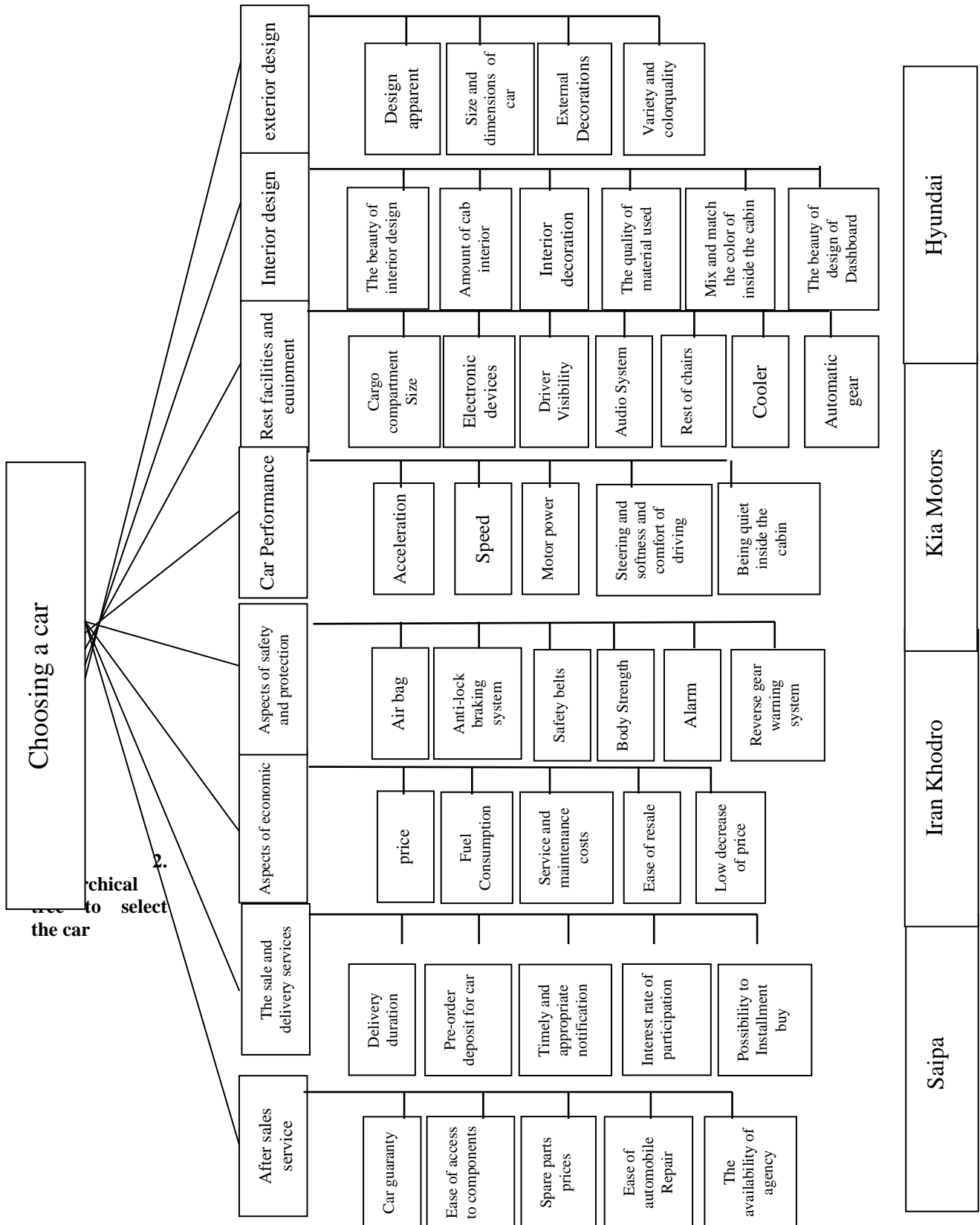
Car manufacturing industry has made a lot of progress in different areas, such as increasing the power of engine, improving safety system, reducing pollutants, etc. Today reducing fuel consumption has attracted the attention of car manufacturers and researchers. Because of economic crisis and problems of energy, this issue has become more important.

As we know, cars consume a lot of fuel. This is especially the case with those cars that consume fossil fuels. Car designers and large car manufacturers in the world have always sought to find new ways to reduce fuel consumption. In other words, they have sought to prevent the waste of energy in cars. The optimum use of fuel and preventing the waste of energy has been a focal point for car designers and manufacturers.

Another issue which has been very important for car designers is the safety of passengers. Today intelligent systems are used in cars to improve the safety. These intelligent systems have already been used in ordinary cars. Various controlling systems have been designed. Depending on their applications, these intelligent systems become activated and help the drivers. What we want to do in this article is to identify and evaluate the criteria which are taken into account by customers. In this way and based on these criteria, the four car manufacturers (Hyundai, Kia Motors, Iran Khodro, Saipa) are ranked.

Car manufacturing is one of the most important industries in our country. It has had a major role in the economic growth of the country. Some experts believe that this industry has been one of the most important

elements in the economic development of the country. After construction industry, it has been the second player in the economic development of the country and it has produced the maximum number of jobs among the industries. In this article, it was tried to identify the influential criteria and to present a fuzzy combinatory methodology. Fuzzy AHP and Fuzzy VIKOR were used to identify the criteria. Based on the directory of Industries Organization and international standards and the views of experts in this field, a number of criteria were identified. All in all, there were a large number of criteria and sub-criteria. By conferring a number of experts, the most important criteria were identified and the hierarchy tree was drawn. By using a fuzzy approach, the car manufacturers were r



Hyundai, Kia Motors, Iran Khodra, and Saipa were the alternatives of this study. Based on the criteria and sub-criteria, these alternatives are ranked.

After drawing the hierarchy tree, the data were given to 100 experts and professional buyers in this industry. By pair-comparisons, DMs indicated their preferences. The pair-comparison matrix was made by FAHP method. The opinions (views) were converted to fuzzy numbers and their geometric mean was calculated. The final weights of criteria (indices) were obtained by LINGO software, which have been presented in table (3.11). In table 3, the weights of main criteria are calculated, including exterior design, Interior design, Rest facilities and equipment, Car Performance, Aspects of safety and protection, Aspects of economic, The sale and delivery services, After sales service. The weights of these main criteria are (0.12,0.15,0.19), (0.07,0.07,0.08), (0.05,0.053,0.07), (0.04,0.04,0.05), (0.05,0.05,0.06), (0.06,0.07,0.072), (0.22,0.26,0.29) and (0.26,0.29,0.31) respectively. In table 4, the weights of exterior design sub-criteria (sub-indices) are calculated. This criterion is related to the Design apparent, Size and dimensions of car, External Decorations and Variety and color quality. The weights of exterior design sub-criteria (sub-indices) are (0.13,0.17,0.2), (0.12,0.15,0.19), (0.46,0.46,0.46) and (0.18,0.21,0.22) respectively. In table 5, the weights of Interior design sub-criteria (sub-indices) are calculated. These criteria (indices) are related to The beauty of interior design, Amount of cab interior, interior decoration, The quality of material used, Mix and match the color of inside the cabin and The beauty of design of Dashboard. The weights of these Interior design sub-criteria (sub-indices) are (0.33,0.4,0.44), (0.13,0.15,0.17), (0.1,0.11,0.12), (0.14,0.17,0.19), (0.09,0.11,0.15) and (0.05,0.06,0.09) respectively. In table 6, the weights of Rest facilities and equipment sub-criteria (sub-indices) are calculated. These criteria (indices) are related to Cargo compartment Size, Electronic devices, Driver Visibility, Audio System, Rest of chairs, cooler and Automatic gear. The weights of Rest facilities and equipment sub-criteria (sub-indices) are (0.31,0.36,0.39), (0.11,0.13,0.15), (0.1,0.11,0.12), (0.14,0.16,0.19), (0.08,0.11,0.15), (0.05,0.06,0.08) and (0.05,0.06,0.08). In table 7, the weights of Car Performance sub-criteria (sub-indices) are calculated. This criterion is dependent on Acceleration, speed, motor power, Steering and softness and comfort of driving and Being quiet inside the cabin. The weights of Car Performance sub-criteria (sub-indices) are (0.1,0.11,0.12), (0.13,0.14,0.15), (0.38,0.41,0.42), (0.14,0.17,0.21) and (0.14,0.17,0.21) respectively. In table 8, the weights of Aspects of safety and protection sub-criteria (sub-indices) are calculated. This criterion is related to Air bag, Anti-lock braking system, Safety belts, Body Strength, alarm and Reverse gear warning system. The weights of Aspects of safety and protection sub-criteria (sub-indices) are (0.07,0.08,0.09), (0.11,0.11,0.12), (0.34,0.37,0.39), (0.12,0.14,0.17), (0.12,0.14,0.17) and (0.12,0.14,0.17) respectively. In table 9, the weights of Aspects of economic sub-criteria (sub-indices) are calculated. This criterion is related to price, Fuel Consumption, Service and maintenance costs, Ease of resale and Low decrease of price economic. The weights of Aspects of economic sub-criteria (sub-indices) are (0.39,0.46,0.52), (0.25,0.28,0.31), (0.06,0.07,0.08), (0.09,0.11,0.12) and (0.06,0.08,0.1) respectively. In table 10, the weights of The sale and delivery services sub-criteria (sub-indices) are calculated. This criterion is related to Delivery duration, Pre-order deposit for Car, Timely and appropriate notification, Interest rate of participation and Possibility to Installment buy. The weights of The sale and delivery services sub-criteria (sub-indices) are (0.38,0.46,0.51), (0.27,0.3,0.34), (0.06,0.06,0.07), (0.09,0.1,0.12) and (0.07,0.08,0.09) respectively. In table 11, the weights of After sales service sub-criteria (sub-indices) are calculated. This criterion is related to Car guaranty, Ease of access to components, Spare parts prices, Ease of automobile Repair and The availability of agency. The weights of After sales service sub-criteria (sub-indices) are (0.3,0.4,0.46), (0.22,0.28,0.34), (0.07,0.07,0.08), (0.11,0.15,0.19) and (0.08,0.1,0.13) respectively.

In the next step, the preferences of DMs about the alternatives (relative to each criterion) were collected and their geometric mean was calculated. In order to rank, the decision matrices were made by FVIKOR method (first step of VIKOR). In the second step, based on formula (19), the best and the worst values were selected from the values of each criterion in decision matrix (table 12). Based on the calculation of weights in the previous step, the third step was taken (table 3.11). In the fourth step and based on formula (20), the values of S_i were calculated. Also, based on formula (21), the values of R_i were obtained. In the fifth step and based on formulas (22), (23), and (24), the value of Q_i were obtained ($v=0.5$). In the sixth step and based on the amount of increase in values, their ranks were determined (table 13).

Table 3. The weights of principal criteria (indexes)

	exterior design	Interior design	Rest facilities and equipment	Car Performance
exterior design	(1,1,1)	(1.7,2.8,3.87)	(2.45,3.7,4.5)	(2.8,3.9,4.5)
Interior design	(0.26,0.35,0.6)	(1,1,1)	(1.7,2.8,3.9)	(2.3,2.4,2)

Rest facilities and equipment	(0.2,0.3,0.4)	(0.26,0.35,0.6)	(1,1,1)	(0.6,0.7,1)
Car Performance	(0.2,0.26,0.36)	(0.24,0.3,0.5)	(1,1,4,1.7)	(1,1,1)
Aspects of safety and protection	(0.2,0.3,0.4)	(0.29,0.4,0.7)	(0.45,0.5,0.6)	(1.7,2,2.2)
Aspects of economic	(0.24,0.3,0.5)	(0.45,0.71,1)	(0.4,0.6,0.9)	(1.4,1.7,2)
The sale and delivery services	(1.7,2.8,3.9)	(3,4,5)	(4,5,6)	(4,5,6)
After sales service	(2.45,3.5,4.8)	(3.5,4.47,5.5)	(4,5,6)	(3.5,4.5,5.5)

Table 3 (continued)

Aspects of safety and protection	Aspects of economic	The sale and delivery services	After sales service	weight
(2.45,3.5,4.5)	(2,3,2,4,2)	(0.3,0.4,0.6)	(0.2,0.3,0.41)	(0.12,0.15,0.19)
(1.4,2.4,3.5)	(1,1,4,2,2)	(0.2,0.25,0.3)	(0.19,0.2,0.29)	(0.07,0.07,0.08)
(1.73,2,2.2)	(1.2,1.6,2.4)	(0.16,0.2,0.25)	(0.16,0.2,0.25)	(0.05,0.053,0.07)
(0.45,0.5,0.6)	(0.5,0.6,0.7)	(0.16,0.2,0.25)	(0.19,0.2,0.29)	(0.04,0.04,0.05)
(1,1,1)	(0.9,1.2,1.6)	(0.2,0.2,0.3)	(0.19,0.2,0.29)	(0.05,0.05,0.06)
(0.63,0.9,1.2)	(1,1,1)	(0.3,0.4,0.6)	(0.19,0.2,0.29)	(0.06,0.07,0.072)
(3.46,4.5,5.5)	(1.7,2.8,3.9)	(1,1,1)	(1,1,1)	(0.22,0.26,0.29)
(3.46,4.5,5.5)	(3.5,4.5,5.5)	(1,1,1)	(1,1,1)	(0.26,0.29,0.31)

Table 4. The weights of sub-criteria (exterior design)

	Design apparent	Size and dimensions of car	External Decorations	Variety and color quality	Weight
Design apparent	(1,1,1)	(1,2,3)	(0.4,0.5,0.6)	(0.28,0.34,0.6)	(0.13,0.17,0.2)
Size and dimensions of car	(0.33,0.5,1)	(1,1,1)	(0.4,0.5,0.6)	(0.6,0.8,1)	(0.12,0.15,0.19)
External Decorations	(1.7,2,2.2)	(1.7,2,2.2)	(1,1,1)	(4,5,6)	(0.46,0.46,0.46)
Variety and color quality	(1.9,2.9,3.6)	(1,1.3,1.7)	(0.17,0.2,0.25)	(1,1,1)	(0.18,0.21,0.22)

Table 5. The weights of sub-criteria (Interior design)

	The beauty of interior design	Amount of cab interior	interior decoration	The quality of material used
The beauty of interior design	(1,1,1)	(2.5,3.7,4.8)	(3,4,5)	(3,4,5)
Amount of cab interior	(0.21,0.27,0.4)	(1,1,1)	(2.45,3.46,4.47)	(0.71,1,1.41)
interior decoration	(0.2,0.25,0.33)	(0.22,0.29,0.41)	(1,1,1)	(0.5,0.58,0.71)
The quality of material used	(0.2,0.25,0.33)	(0.71,1,1.41)	(1.41,1.73,2)	(1,1,1)
Mix and match the color of inside the cabin	(0.33,0.5,1)	(0.77,1,1.29)	(0.55,0.66,1)	(0.29,0.41,0.71)
The beauty of design of Dashboard	(0.18,0.22,0.29)	(0.45,0.71,1)	(0.25,0.33,0.5)	(0.26,0.38,0.69)

Table 5(continued)

Mix and match the color of inside the cabin	The beauty of design of Dashboard	thgiew
(1,2,3)	(3.46,4.47,5.48)	(0.33,0.4,0.44)
(0.77,1,1.29)	(1,1.41,2.24)	(0.13,0.15,0.17)
(1,1.5,1.8)	(2,3,4)	(0.1,0.11,0.12)
(1.45,2.65,3.76)	(2.3,3.4,4.57)	(0.14,0.17,0.19)
(1,1,1)	(1,2,3)	(0.09,0.11,0.15)
(0.33,0.5,1)	(1,1,1)	(0.05,0.06,0.09)

Table 6. The weights of sub-criteria (Rest facilities and equipment)

	Cargo compartment Size	Electronic devices	Driver Visibility	Audio System
Cargo compartment Size	(1,1,1)	(0.4,0.66,1)	(1.2,2.1,3.3)	(3,4,5)
Electronic devices	(1,1.5,2.5)	(1,1,1)	(2.5,3.5,4.5)	(1.3,2.3,3.3)
Driver Visibility	(0.3,0.47,0.8)	(0.2,0.3,0.4)	(1,1,1)	(1,2,3)
Audio System	(0.2,0.25,0.33)	(0.3,0.4,0.77)	(0.33,0.5,1)	(1,1,1)
Rest of chairs	(1.9,2.2,2.4)	(1,1.5,1.8)	(2.5,3.5,4.5)	(2,3.5,4.5)

cooler	(0.33,0.5,1)	(0.27,0.4,0.66)	(1,1,1)	(1.4,2.5,3.5)
Automatic gear	(1.5,2,2.5)	(0.9,1.15,1.6)	(2.5,3.5,4.5)	(4,5,6)

Table 6(continued)

Rest of chairs	cooler	Automatic gear	Weight
(0.4,0.45,0.53)	(1,2,3)	(0.4,0.5,0.66)	(0.31,0.36,0.39)
(0.55,0.67,1)	(1.5,2.5,3.6)	(0.6,0.9,1.2)	(0.11,0.13,0.15)
(0.2,0.3,0.4)	(1,1,1)	(0.2,0.3,0.4)	(0.1,0.11,0.12)
(0.22,0.29,0.5)	(0.3,0.4,0.7)	(0.16,0.2,0.25)	(0.14,0.16,0.19)
(1,1,1)	(2.3,3.4,4.4)	(0.6,0.9,1.2)	(0.08,0.11,0.15)
(0.23,0.3,0.44)	(1,1,1)	(0.2,0.3,0.4)	(0.05,0.06,0.08)
(0.9,1.2,1.6)	(2.4,3.5,4.5)	(1,1,1)	(0.05,0.06,0.08)

Table 7. The weights of sub-criteria (Car Performance)

	Acceleration	speed	motor power	Steering	Being quiet inside the cabin	Weight
Acceleration	(1,1,1)	(2,3,4)	(3.5,4.5,5.5)	(4,5,6)	3.5,4.5,5.48	0.1,0.11,0.12)
speed	(0.25,0.3,0.5)	(1,1,1)	(3,4,5)	3.5,4.5,5.5)	(4,5,6)	(0.13,0.14,0.15
motor power	(0.2,0.2,0.3)	(0.2,0.25,0.33)	(1,1,1)	0.4,0.5,0.6)	(0.6,0.7,1)	(0.38,0.41,0.42
Steering	(0.17,0.2,0.25)	(0.2,0.2,0.29)	(1.73,2,2.2)	(1,1,1)	(1,1.5,2.5)	(0.14,0.17,0.21
Being quiet inside the cabin	(0.2,0.2,0.3)	(0.2,0.2,0.25)	(1,1,1,1.7)	(0.4,0.7,1)	(1,1,1)	(0.14,0.17,0.21

Table 8. The weights of sub-criteria (Aspects of safety and protection)

	Air bag	Anti-lock braking system	Safety belts
Air bag	(1,1,1)	(0.2,0.3,0.4)	(0.17,0.2,0.25)
Anti-lock braking system	(2.5,3.5,4.5)	(1,1,1)	(0.55,0.67,1)
Safety belts	(4,5,6)	(1,1.5,1.8)	(1,1,1)
Body Strength	(2,3,4)	(0.26,0.36,0.56)	(0.2,0.25,0.33)
alarm	(1.4,2.4,3.5)	(0.3,0.4,0.6)	(0.3,0.4,0.58)
Reverse gear warning system	(3.5,4.5,5.5)	(0.6,0.9,1.2)	(0.4,0.7,1)

Table 8(continued)

	Body Strength	alarm	Reverse gear warning system	Weight
	(0.25,0.33,0.5)	(0.3,0.4,0.7)	(0.2,0.2,0.29)	(0.07,0.08,0.09)
	(1.8,2.8,3.9)	(1.7,2.8,3.9)	(0.9,1.2,1.58)	(0.11,0.11,0.12)
	(3,4,5)	(1.7,2.8,3.9)	(1,1.4,2.24)	(0.34,0.37,0.39)
	(1,1,1)	(0.3,0.5,1)	(0.3,0.4,0.67)	(0.12,0.14,0.17)
	(1,2,3)	(1,1,1)	(0.2,0.25,0.36)	(0.12,0.14,0.17)
	(1.5,2.5,3.5)	(2.8,3.9,4.9)	(1,1,1)	(0.12,0.14,0.17)

Table 9. The weights of sub-criteria (Aspects of economic)

	price	Fuel Consumption	Service and maintenance costs	Ease of resale	Low decrease of price	Weight
price	(1,1,1)	(2.5,3.5,4.5)	(3,4,5)	(3,4,5)	3.5,5.5,6)	(0.39,0.46,0.52)
Fuel Consumption	(0.2,0.3,0.4)	(1,1,1)	(4,5,6)	(3.2,4,5)	(3,4,5)	(0.25,0.28,0.31)
Service and maintenance	(0.2,0.25,0.3)	(0.17,0.2,0.25)	(1,1,1)	0.4,0.5,0.6)	0.5,0.7,1)	(0.06,0.07,0.08)

costs						
Ease of resale	(0.2,0.25,0.3)	(0.2,0.25,0.3)	(1.73,2,2.2)	(1,1,1)	1,1.5,2.5)	(0.09,0.11,0.12)
Low decrease of price	(0.16,0.2,0.29)	(0.2,0.25,0.3)	(1,1.45,2)	(0.4,0.7,1)	(1,1,1)	(0.06,0.08,0.1)

Table 10. The weights of sub-criteria (The sale and delivery services)

	Delivery duration	Pre-order deposit for Car	Timely and appropriate notification	Interest rate of participation	Possibility to Installment buy	Weight
Delivery duration	(1,1,1)	(2,3,4)	(4,5,6)	(3,4,5)	(3.5,4.5,5.48)	(0.38,0.46,0.51)
Pre-order deposit for Car	0.25,0.3,0.5)	(1,1,1)	(4,5,6)	(3.5,4.5,5.5)	(4,5,6)	(0.27,0.3,0.34)
Timely and appropriate notification	0.17,0.2,0.25)	(0.17,0.2,0.25)	(1,1,1)	(0.4,0.5,0.6)	(0.6,0.7,1)	(0.06,0.06,0.07)
Interest rate of participation	0.2,0.25,0.33)	(0.2,0.2,0.29)	1.7,2.1,2.2)	(1,1,1)	(1,1.4,2.24)	(0.09,0.1,0.12)
Possibility to Installment buy	0.18,0.2,0.29)	(0.17,0.2,0.25)	1,1.41,1.7)	(0.45,0.7,1)	(1,1,1)	(0.07,0.08,0.09)

Table 11. The weights of sub-criteria (After sales service)

	Car guaranty	Ease of access to components	Spare parts prices	Ease of automobile	The availability of agency	Weight
Car guaranty	(1,1,1)	(1,2,3)	(4.5,5.5,6.5)	(1.5,2.5,3.5)	2.5,3.5,4.5)	(0.3,0.4,0.46)
Ease of access to components	(0.3,0.5,1)	(1,1,1)	(3,4,5)	(1.5,2.5,3.5)	(2,3,4)	0.22,0.28,0.34)
Spare parts prices	(0.15,0.19,0.2)	(0.2,0.25,0.33)	(1,1,1)	(0.4,0.5,0.7)	(0.4,0.6,1)	0.07,0.07,0.08)
Ease of automobile Repair	(0.3,0.4,0.67)	(0.3,0.4,0.67)	(1.5,2,2.5)	(1,1,1)	(1,2,3)	0.11,0.15,0.19)
The availability of agency	(0.2,0.3,0.4)	(0.25,0.3,0.5)	(1,1.7,2.4)	(0.33,0.5,1)	(1,1,1)	0.08,0.1,0.13)

Table 12. The creation of matrices (first phase of VIKOR) and determining the best and the worst values of criteria's weights (second and third phase of VIKOR)

	Design apparent	Size and dimensions of car	External Decorations	Variety and color quality	The beauty of interior design
W	(0.13,0.17,0.2)	(0.12,0.15,0.19)	(0.46,0.46,0.46)	(0.18,0.21,0.22)	(0.33,0.4,0.44)
Hyundai	(2.21,2.82,3.36)	(0.62,0.7,0.84)	(0.73,0.8,0.92)	(1.25,1.36,1.45)	(2.2,2.4,2.45)
Kia Motors	(1.07,1.4,1.79)	(0.76,0.92,1.15)	(0.73,0.87,1.05)	(0.92,1.09,1.25)	(1.77,2.04,2.28)
Iran Khodro	(0.5,0.58,0.69)	(1.09,1.25,1.36)	(1.15,1.3,1.4)	(0.56,0.62,0.7)	(0.5,0.61,0.74)
Saipa	(0.37,0.43,0.54)	(1.09,1.25,1.36)	(0.97,1.11,1.23)	(1,1.09,1.22)	(0.3,0.36,0.46)
	(0.37,0.43,0.54)	(0.62,0.7,0.84)	(0.73,0.8,0.92)	(1.25,1.36,1.45)	(0.3,0.36,0.46)
	(2.21,2.82,3.36)	(1.09,1.25,1.36)	(1.15,1.3,1.4)	(0.56,0.62,0.7)	(2.2,2.4,2.45)

Table 12(continued)

	interior decoration	The quality of material used	Mix and match the color of inside the cabin	The beauty of design of Dashboard	Cargo compartment Size
Amount of cab interior					

(0.13,0.15,0.17)	(0.1,0.11,0.12)	(0.14,0.17,0.19)	(0.09,0.11,0.15)	(0.05,0.06,0.09)	(0.31,0.36,0.39)
(1.77,2.04,2.28)	(2.06,2.63,3.16)	(1.68,2.34,2.91)	(2.06,2.63,3.16)	(0.64,0.82,1.12)	(0.64,0.79,0.99)
(0.29,0.35,0.43)	(0.94,1.25,1.59)	(1.04,1.42,1.89)	(0.56,0.67,0.8)	(2.18,2.76,3.29)	(0.32,0.39,0.52)
(0.59,0.71,0.88)	(0.39,0.49,0.64)	(0.47,0.53,0.65)	(0.64,0.84,1.19)	(0.74,0.96,1.21)	(1.83,2.49,3.06)
(1.68,1.97,2.21)	(0.48,0.62,0.87)	(0.48,0.56,0.71)	(0.56,0.67,0.8)	(0.37,0.46,0.59)	(1.07,1.29,1.56)
(0.29,0.35,0.43)	(0.38,0.49,0.64)	(0.47,0.53,0.65)	(0.56,0.67,0.8)	(0.37,0.46,0.59)	(0.32,0.39,0.52)
(1.77,2.04,2.28)	(2.06,2.63,3.16)	(1.68,2.34,2.91)	(2.06,2.63,3.16)	(2.18,2.76,3.29)	(1.83,2.49,3.06)

Table 12(continued)

Electronic devices	Driver Visibility	Audio System	Rest of chairs	cooler	Automatic gear
(0.11,0.13,0.15)	(0.1,0.11,0.12)	(0.14,0.16,0.19)	(0.08,0.11,0.15)	(0.05,0.06,0.08)	(0.05,0.06,0.08)
(0.95,1.13,1.36)	(0.85,1.04,1.27)	(1.62,2.11,2.68)	(0.83,1.01,1.22)	(0.34,0.42,0.59)	(0.7,1,1.43)
(0.49,0.57,0.67)	(0.65,0.84,1.16)	(0.89,1.12,1.45)	(1.11,1.56,1.98)	(1.25,1.77,2.19)	(0.67,0.95,1.32)
(0.87,0.97,1.08)	(0.78,1.01,1.34)	(0.97,1.25,1.53)	(0.88,1.14,1.54)	(0.8,1.09,1.53)	(0.73,1,1.36)
(1.34,1.61,1.86)	(0.79,1.13,1.48)	(0.29,0.34,0.41)	(0.45,0.56,0.73)	(0.95,1.22,1.56)	(0.76,1.05,1.49)
(0.49,0.57,0.67)	(0.65,0.84,1.16)	(0.29,0.34,0.41)	(0.45,0.56,0.73)	(1.25,1.77,2.19)	(0.76,1.05,1.49)
(1.34,1.61,1.86)	(0.79,1.13,1.48)	(1.62,2.11,2.68)	(1.12,1.56,1.98)	(0.34,0.42,0.59)	(0.67,0.95,1.32)

Table 12(continued)

Acceleration	speed	motor power	Steering	Being quiet inside the cabin	Air bag
(0.1,0.11,0.12)	(0.13,0.14,0.15)	(0.38,0.41,0.42)	(0.38,0.41,0.42)	(0.14,0.17,0.21)	(0.07,0.08,0.09)
(1.25,1.36,1.45)	(1.15,1.49,1.94)	(0.33,0.4,0.52)	(1.09,1.25,1.36)	(0.5,0.59,0.73)	(2.13,2.71,3.23)
(0.77,0.87,1)	(1.57,2.03,2.43)	(0.62,0.81,1.13)	(0.45,0.56,0.77)	(0.5,0.59,0.73)	(0.75,0.92,1.09)
(0.56,0.62,0.7)	(0.64,0.8,0.98)	(1.04,1.43,1.98)	(0.64,0.87,1.21)	(1.86,2.45,2.99)	(0.75,0.84,0.95)
(1.25,1.36,1.45)	(0.34,0.41,0.56)	(1.49,2.16,2.75)	(1.3,1.65,1.93)	(0.84,1.19,1.56)	(0.4,0.48,0.62)
(1.25,1.36,1.45)	(1.57,2.03,2.43)	(1.49,2.16,2.75)	(1.3,1.65,1.93)	(1.86,2.45,2.99)	(2.13,2.71,3.23)
(0.56,0.62,0.7)	(0.34,0.41,0.56)	(0.33,0.4,0.52)	(0.45,0.56,0.77)	(0.5,0.59,0.73)	(0.4,0.48,0.62)

Table 12(continued)

Anti-lock braking system	Safety belts	Body Strength	alarm	Reverse gear warning system	price
(0.11,0.11,0.12)	(0.34,0.37,0.39)	(0.12,0.14,0.17)	(0.12,0.14,0.17)	(0.12,0.14,0.17)	(0.39,0.46,0.52)
(1.36,1.71,1.98)	(0.73,0.87,1.05)	(1.83,2.49,3.06)	(20,20,20)	(0.84,1.13,1.57)	(1.08,1.19,1.3)
(0.73,0.95,1.21)	(0.76,1.09,1.51)	(0.36,0.46,0.67)	(16,16,16)	(0.8,1.09,1.53)	(1.56,1.73,1.87)
(0.4,0.52,0.8)	(0.83,1.15,1.67)	(0.92,1.26,1.65)	(15,15,15)	(0.75,0.96,1.23)	(0.71,0.79,0.87)
(0.92,1.2,1.43)	(0.71,0.92,1.15)	(0.52,0.69,0.91)	(15,15,15)	(0.61,0.84,1.09)	(0.56,0.62,0.7)
(1.36,1.71,1.98)	(0.83,1.15,1.67)	(1.83,2.49,3.06)	(15,15,15)	(0.84,1.13,1.57)	(1.56,1.73,1.87)
(0.4,0.52,0.8)	(0.73,0.87,1.05)	(0.36,0.46,0.67)	(20,20,20)	(0.61,0.84,1.09)	(0.56,0.62,0.7)

Table 12(continued)

Fuel Consumption	Service and maintenance costs	Ease of resale	Low decrease of price	Delivery duration	Pre-order deposit for Car
(0.25,0.28,0.31)	(0.06,0.07,0.08)	(0.09,0.11,0.12)	(0.06,0.08,0.1)	(0.38,0.46,0.51)	(0.27,0.3,0.34)
(1.65,2.23,2.7)	(0.9,1.2,1.8)	(0.5,0.98,1.81)	(1.42,1.96,2.42)	(0.72,1.09,1.68)	(1.02,1.23,1.4)
(1.1,1.54,2.56)	(1.76,2.13,2.8)	(1.2,1.78,2.59)	(1.25,1.75,1.93)	(0.7,1.12,1.8)	(1.5,1.7,1.8)
(0.54,0.64,0.85)	(0.52,0.68,0.95)	(0.83,0.88,0.97)	(0.66,0.72,0.8)	(0.85,1.06,1.43)	(0.6,0.72,0.86)
(0.5,0.57,0.69)	(0.6,0.7,0.85)	(0.67,0.8,0.99)	(0.79,0.88,1.3)	(0.72,0.94,1.29)	(0.66,0.72,0.8)
(1.75,2.23,2.63)	(1.52,2.33,2.81)	(1.35,1.88,2.35)	(1.45,1.66,1.83)	(0.74,1.03,1.47)	(1.57,1.75,1.86)
(0.42,0.51,0.6)	(0.62,0.72,0.93)	(0.75,0.83,0.98)	(0.52,0.58,0.64)	(0.42,0.63,1)	(0.66,0.72,0.8)

Table 12(continued)

Timely and appropriate notification	Interest rate of participation	Possibility to Installment buy	Car guaranty
(0.06,0.06,0.07)	(0.09,0.1,0.12)	(0.07,0.08,0.09)	(0.3,0.4,0.46)
(1.42,2.33,2.63)	(0.9,1.29,1.76)	(0.77,0.93,1.14)	(1.46,1.66,1.83)
(1.5,1.86,2.46)	(1.37,2.05,2.62)	(1.45,1.96,2.39)	(1.35,1.49,1.63)
(0.58,0.63,0.76)	(0.66,0.77,1.02)	(0.8,0.84,0.87)	(0.6,0.82,0.9)
(0.5,0.55,0.66)	(0.62,0.78,0.93)	(0.54,0.63,0.82)	(0.73,0.82,1)
(1.2,1.83,2.13)	(1.76,2.4,3.01)	(1.45,1.97,2.49)	(1.26,1.41,1.53)
(0.57,0.64,0.75)	(0.72,0.82,0.9)	(0.65,0.76,0.98)	(0.5,0.6,0.7)

Table 12(continued)

Ease of access to components	Spare parts prices	Ease of automobile	The availability of agency
(0.22,0.28,0.34)	(0.07,0.07,0.08)	(0.11,0.15,0.19)	(0.08,0.1,0.13)
(0.74,1.03,1.46)	(1.28,1.39,1.5)	(1.86,2.43,2.83)	(0.9,1.29,1.75)
(0.8,1.19,1.63)	(1.66,1.83,1.97)	(1.5,1.85,2.35)	(1.63,2.33,2.91)
(0.72,0.96,1.43)	(0.79,0.82,0.96)	(0.57,0.74,0.84)	(0.66,0.75,0.95)
(0.72,0.96,1.11)	(0.76,0.82,0.97)	(0.59,0.66,0.77)	(0.6,0.71,0.8)
(0.81,1.11,1.67)	(1.42,1.55,1.78)	(1.23,2.03,2.63)	(1.62,2.23,2.81)
(0.71,0.93,1.23)	(0.666,0.74,0.86)	(0.54,0.64,0.75)	(0.62,0.72,0.86)

Based on the explanation of sixth step and the calculations in table (13), Hyundai brand had the best rank. We examine two conditions about it.

Acceptable advantage;

$Q(a^2) - Q(a^1) \geq 1/(J-1)$; $(-2.8082) - (-2.9198) = 0.1116 \leq 0.333$, so the first condition is not satisfied.

Acceptable stability in decision making ;

Hyundai brand is not the best ranked by corresponding S_j or/and R_j . So, the second condition is not satisfied, too.

Because C1 condition is not satisfied and based on $Q(a^{(M)}) - Q(a') < DQ$, a collection of $(a', a'', \dots, a^{(M)})$ options are chosen as the superior options. According to the results of calculations, Hyundai and Kia Motors were the best brands..

Table13. calculation of vikor method

	Rank	Rank	Rank	Rank	Rank	
<u>Hyundai</u>	(-0.3,2.73,8.86)	3	(0.14,0.55,2.1)	4	(-13.6,0.96,1.12)	1
<u>Kia Motors</u>	(-0.06,2.84,9.64)	4	(0.13,0.63,2.16)	3	(-13.38,0.97,1.32)	2
Iran Khodro	(-2.65,1.43,7.48)	1	(0.32,0.41,0.41)	1	(-0.79,0,0.78)	4
Saipa	(-0.98,2.51,8.54)	2	(-0.25,0.43,1.92)	2	(-12.63,0.59,4.31)	3

Conclusion

Today decision-making problems are extensively used in the projects and articles. The present article intended to rank car manufacturers. In this way, the manufacturer that produced the high-quality cars could be identified. Four companies were included in this study. Various criteria were evaluated in this study, including external design, internal design, comfort facilities and equipments, efficiency of car, safety, cost-effectiveness, selling and delivery services, and after-sale services. The views of 100 experts and qualified individuals were collected to select these criteria. These criteria were compared in pairs. The weights were determined by fuzzy AHP and the best company was selected by fuzzy VIKOR. The obtained results in this study were consistent with the results of a field research (100 consumers in the market). In terms of distribution and selling, Hyundai brand was the best compared to other brands. This method can be used for other types of industrial products.

References

- Moven, John, C. & Minor, Smith. (2001) Consumer's Behavior. Anas Salehi Ardestani. Ann Publications, Tehran.
- Solomon, Michael R. (1999) «Consumer behavior», Prentice Hall, New Jersey, 4th ed., pp.7- 10.
- Raju, P.S. (1995) «Consumer behavior in global markets: The A-B-C-D paradigm and its application to eastern Europe & third world», journal of consumer marketing, Vol.12, No. 5, pp. 37-56.
- Cutler, Philip & Armstrong, Gary.(2002) Principles of Marketing. Ali Parsaian. Adabestan Publications, Tehran. First edition.
- Loudon, David I & Albert J.Della Bitta (1993) «Consumer behavior», Mc Graw Hill, fourth ed., pp. 513-514
- Schiffman, Leon G.& Leslie Lazar Kanuk (1997) «Consumer behavior», Prentice Hall, New Jersey, 6th ed., pp.560-564.
- Jobber, David (1995) «Principles & practice of marketing", Mc Graw Hill, 2nd ed. pp. 84-127.
- Sant, Roger (1997) «Did he jump or was he pushed», Marketing news, pp.2-21
- Ferrier C. (2002) Bottled Water Understanding a Social Phenomenon Fraij, Publisher: RoyalSwedish Academy of Sciences; 34.
- Venieri D, Vantaraskis A, Komininous G. Papapetropuloy M. (2005) Microbiological evaluation of bottled non-carbonated (still) water from domestic brands in Greece.Int J food Microbiol; 107(1) :68-72.
- Samadi MT, Rahmani AR, Sedehi, Sonboli. (2009) Evaluation of Chemical Quality in 17 Brands of Iranian Bottled Drinking Waters. J Res Health; 9(2): 25-31.
- FDA U.S. Food and Drug Administration. (2010) Regulation of Bottled Water: Appendix. "Mineral Water", Retrieved ,03-28.

N.G.F.M Van der Aa. (2003) Classification of Mineral Water Type, and Comparison with Drinking Water Standards, *Environmental Geology*; 44: 554-63.

Institute of Standard & Industrial Research of Iran, Bottled Water Standards. (1996); 6694 Standard.

EPA United States Environmental Protection Agency. (2006) Overview of Contaminants & Their Potential Health Effects. 2006, Edition of the Drinking Water Standard and Health Advisors.

Khaniki J, Mahdavi M, Gasri A, Saeidinia S. Investigation of Nitrate in Mineral Bottled Waters in Tehran. *Health & Environment J* 2008; 1: 45-50.

Author Information

Reza Pezeshkizadeh

Phd student of Ahvaz Azad University, ahvaz, Iran
