# Proposal for Multi-Criteria Approach to Automobile Selection

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## Abstact

Decision-making, needs for conscious or unconscious are in a way choice. Deciding cases, and scientific decision-making techniques change over time has caused to the emergence. Multi-criteria decision making techniques Analytic Hierarchy (AHP) and the Analytic Network (ANP) methods, qualitative and quantitative criteria are in the decision making process taking into account all of the decision-making process effectively helps them. In this study, AHP and ANP methods and approaches are examined customers' attention in buying a car, the criteria have been identified. Cars need to be considered when making the selection decision has been prioritized criteria. As a result of the application of AHP and AHP study results were compared.

**Key words:** Analytic Hierarchy Process, Analytic Network Process, Automotive

## 1. Introduction

People at all stages of live face with different problems and we search for solutions with different decision-making processes. When peoplelife become more complex, they searched different solutions to problems. The existence of problems in human life force them to make decisions. Therefore decision-making processis an indispensable and inevitable part of every stage of life.

Decision-making process developed for human life and has become a requirement to be able to make the right decision. Although it is not just personal process, it is the one of the most important activity for the organizations and for the business world. Nowadays, due to the technological advances andintense competition organizations and managers are facing with very complex conditions and problems. So, to be able to survive it's a crucial matter to make decisions effectively and properly. It is extremely important that in front of a complex and long term problem, organisations and managers needs make a decision not based on their instinct or feelings but collecting information, making analysis, having accurate results and making a detailed research. Multi-criteria decision making techniques advanced and using those techniques increased by the emerge of those problems. Throughmulti-criteriadecision-making techniques, the decision makers have the opportunity to see and evaluate objective criteriawhich numerically defined and numerically unidentified subjective criteria. By that way they can now choice one or whatever necessary from many alternatives.

The Analytic Hierarchy Process (AHP) is developed by Thomas L. Saaty to facilitate the decision-making process by using multi-criteria to solve complex problems.

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AHP multi-criteria decision making techniques evaluates problems in a hierarchical structure and based on binary comparison logic [1, 2].

Therefore AHP evaluates the criterias independent of each other, their relationship to each not the subject of consideration and the decision making problem is modeled as a hierarchical one-way.

Decision-making process of objective data in case of lack often AHP method is used, so that both objective data as well as decision-making process may be included as well as the decision-maker's personal preference and experience, as well as subjective data in decision-making processes can be included [3].

Analytic Network Process (ANP) technique is developed by Thomas L.Saaty again as a general approach than AHP is a multi-criteria decision making techniques. ANP is involved in a finite number of options in multiple criteria decision problems is a technique that finds the best option. In this technique, the upper level of the hierarchy, respectively, under a target and that target criteria, sub-criteria and the alternatives are at the bottom.

Evaluation of the decision-making process, the decision problem of the relationship between the criteria and criteria the possible with alternatives taking into account the relations between. ANP problems, and identify aspects of this relationship refers to the form of a network [4].

Criteria in the decision-making process takes into account the relationship between adhering to a single aspect of the problem that eliminates the necessity of modeling again, ANP is developed by Thomas L. Saaty which is method [5].

In AHP problems, a modeling using a hierarchical network structure is formed. In the meantime, all the criteria clusters (belonging to the same cluster or not) the dependencies between sub-criteria and sub-criteria in each set of criteria that belong to a set of internal dependencies are taken into consideration [6, 7].

Addiction and criteria to take into consideration the mutual relationship between the ANP method that allows the decision problem can be resolved more effectively and allow a realistic way and in real life to be the right decision is helping.

Similar studies conducted in AHP and ANP , When we examine these methods in which there is a complex decision problems and solutions applied in many different areas showed that the method used. Ersöz, Kabak, Yılmaz [6] graduate education courses, choosing a model proposal, Kabak and Uyar [8] in the logistics industry heavy commercial vehicle selection problem multi criteria approach, Terzi, Hacaloğlu and Aladağ [9] are buying a car problem, a decision to support model, Görener [10] is cutting the use of analytic network process in supplier selection, Aslan [11], including the study entitled analytic Network Process ANP method used in all studies and practical work has been done. Alptekin [12] is applied Analytic Network Process approach in Turkey with the white goods sector, the market share of the estimated work, Pamukçu [13] has chosen ANP and an application, Yüksel and Ali [14] are made ANP method in business strategy formulation in AHP has used. Dağdeviren, Eraslan, Kurt and Dizdar [15]aremade ANP supplier selection with an alternative approach to the problem, Canhasi [16] is applied in his study titled

ANP, and together with the use of AHP method is explained. Yılmaz [17] is made aircraft selection criteria for the evaluation of AHP and Fuzzy AHP application, Aydın [18] is made ANP and an industrial business in the application, Subaşı [19] is applied multi-criteria decision-making used in TOPSIS and AHP method and comparison of a toolkit, Rençber [20] is madelarge-scale projects decision making; ANP be respected, Gencer, Aydoğan and Aytürk [21] have chosen submachine gun with Analytic Hierarchy Process (AHP) has used in the study of choice. Özyürek and Özcan [22] are made in the automotive industry supplier selection factors affecting and supplier selection, Dikmen, Birgönül and Özorhon [23] are made the international market selection an ANP be respected, Gödren has chosen in [24] brand valuation methods and AHP model with the detection of Kaplan [25 ] has chosen with AHP choice of suppliers and retail industry be respected, Sinan [26] is applied a clothing business in the supplier selection and AHP-assisted supplier evaluation system, Kır [27] is made performance evaluation AHP approach and in the education sector, an application Göktolga and Gökalp [28] are applied business affecting the selection criteria and the alternatives with AHP method is used to determine the AHP and ANP methods.

In this study, the determination of the automotive needs of its customers according to their needs and automotive company to decide on the selection of auto parts, multi-criteria decision making method AHP and ANP methods were evaluated and the results.

## 2. Materials and Method

AHP and ANP use to determine the criteria to be used in the structure of eight different automotive company sales consultants, human resources departments were interviewed. As a result that this assessment will be used in the methods of AHP and ANP are main criteria and sub-criteria identified, the network structure was formed. Following these determination needs of customers in order to determine questionnaire was prepared to-server.

January forthe determination of the automotive needs of customers from March 2014, on-line survey was administered. 40 participants have responded to the questionnaire. AHP and ANP to the data obtainedfrom participant’s methods were used.

### *2.1. Theory /calculation*

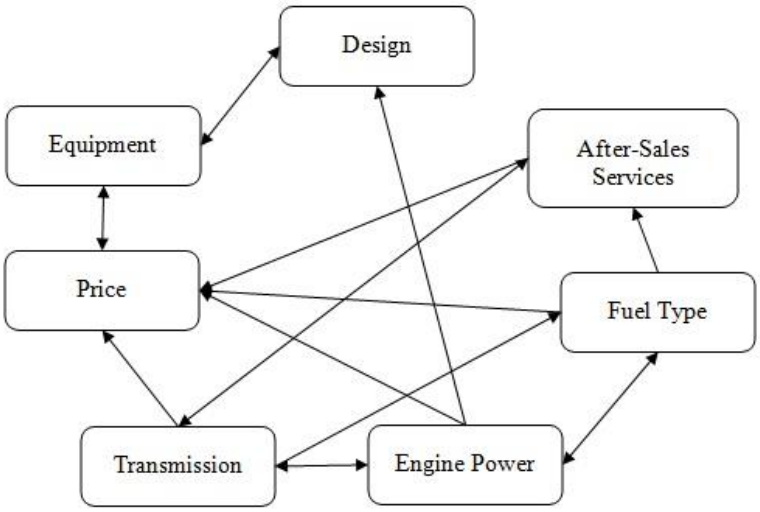
The scale of importance from 1 to 9 scales with the pairwise comparison matrix is prepared by Saaty [29] at criteria for determining the weight.

Survey form geometric means of data obtained by taking the binary comparison matrix are formed. In pairwise comparisons made in the case of multiple decision makers give the geometric mean to say that the result is consistent [8, 29].

The criteria be used in the problems of automotive companies are determined by sales consultants. In Table 1 below the main criteria to be used in the problem, sub-criteria and the network structure of the problems are given in Figure 1.

**Table 1**. Criteria

| **Main Criteria** | **Sub-Criteria** |
|---|---|
| Equipment (E) | (E1) Safety Equipment<br>(E2) Comfort Equipment<br>(E3) Standard Equipment<br>(E4) Technological Systems<br>(E5) Deputy Accessories |
| Design (D) | (D1) Interior Design<br>(D2) Exterior Design |
| Fuel Type (F) | (F1) Diesel<br>(F2) Benzine |
| Engine Power (EP) | (F1) ≤ 1600 cc<br>(F2) 1600cc 2000 cc arası<br>(F3) ≥ 2000 cc |
| Transmission Type (T) | (T1) automatic<br>(T2) Manuel |
| Price (P) | (P1) 30 000 – 45 000 TL<br>(P2) 45 000 – 60 000 TL<br>(P3) 60 000 TL |
| After-Sales Services (SS) | (SS1) Service-Maintenance Cost<br>(SS2) service Network<br>(SS3) Quick sale |




**Şekil 1.** ANP network structure

The questionnaire results sorted by taking the geometric mean of the importance weights are calculated. The main criteria and importance weights of the pairwise comparisons are shown in Table 2. Dependence between the main criteria matrix is given in Table 3. Addiction priority vector in cells located at the intersection of sets of criteria, the zero values in cells without dependencies are given the location. Weights calculated discrepancy rates paired comparison matrices 0.10 was found to be less than. This condition is consistent and the comparison assessments hierarchical model thus established is understood that a valid structure.

**Table 2.** Dual Comparisonof Main Criteria

| | **E** | **D** | **F** | **EP** | **T** | **P** | **SS** | **Weights** |
|---|---|---|---|---|---|---|---|---|
| **Equipment (E)** | 1,00 | 3,48 | 4,46 | 4,66 | 4,88 | 4,64 | 5,60 | 0,3667 |
| **Design (D)** | 0,29 | 1,00 | 3,33 | 3,69 | 4,21 | 4,35 | 4,35 | 0,2201 |
| **Fuel Type (F)** | 0,22 | 0,30 | 1,00 | 3,28 | 2,98 | 4,00 | 5,75 | 0,1554 |
| **Engine Power (EP)** | 0,21 | 0,27 | 0,30 | 1,00 | 2,91 | 3,23 | 3,24 | 0,1002 |
| **Transmission Type (T)** | 0,20 | 0,24 | 0,34 | 0,34 | 1,00 | 2,87 | 2,93 | 0,0718 |
| **Price (P)** | 0,22 | 0,23 | 0,25 | 0,31 | 0,35 | 1,00 | 3,05 | 0,0526 |
| **After-Sales Services (SS)** | 0,18 | 0,23 | 0,17 | 0,31 | 0,34 | 0,33 | 1,00 | 0,0332 |

**Tablo 3.** The main criterion of inter-dependence matrix

| | **E** | **D** | **F** | **EP** | **T** | **P** | **SS** | **AHP Weights** | **ANP Weights** |
|---|---|---|---|---|---|---|---|---|---|
| **E** | 0,00 | 0,83 | 0,00 | 0,00 | 0,00 | 0,44 | 0,00 | 0,3667 | 0,206 |
| **D** | 0,81 | 0,00 | 0,00 | 0,67 | 0,00 | 0,00 | 0,00 | 0,2201 | 0,362 |
| **F** | 0,00 | 0,00 | 0,00 | 0,24 | 0,00 | 0,25 | 0,81 | 0,1554 | 0,064 |
| **EP** | 0,00 | 0,17 | 0,82 | 0,00 | 0,83 | 0,16 | 0,00 | 0,1002 | 0,233 |
| **T** | 0,00 | 0,00 | 0,18 | 0,09 | 0,00 | 0,09 | 0,19 | 0,0718 | 0,048 |
| **P** | 0,19 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,0526 | 0,071 |
| **SS** | 0,00 | 0,00 | 0,00 | 0,00 | 0,17 | 0,05 | 0,00 | 0,0332 | 0,015 |

When comparing the results of two tables; In Table 2 as the first three criteria, 36.67% hardware, design 22%, 15.5% criteria fuel type, while the first three criteria in Table 3; Design 36.2%, 23.3% and 20.6% of the engine power is located inthe hardware criteria. These ANP criteria indicate the importance of inter-dependency relationship. When the criteria listed in Table 4, interior design, safety equipment, 1600 cc engine capacity and diesel fuel type is selected.

As a result of this analysis, the internal design criteria were achieved by customers as an important value. Customers spend more time in the car because the car's interior design gives importance to be seen.

Other criteria related to a certain extent when we look at its safety equipment, reducing the risk of accidents to prevent loss of life and property and therefore the customers' requirements in terms of protection was found to be one of the important criteria.

Engine by volume, was seen as an important criterion for automotive customers. Due to the taxation system in Turkey, according to other engine volumes of 1600 cc engine power receives a greater value and are seen to be an important criterion.

Some automobile companies as a result of an investigation which has been performed, the customers of diesel cars, which operate more efficiently and less need of repair, and they thought it was determined that they gave weight to the production of diesel-powered vehicle.

Peugeot has launched in 1992, "Rose" from the model car's gasoline 6.6% share of sales, while achieving a 77% sales of diesel models has been shown to reach [31].

As a result of analysis of this study, as stated preference for diesel fuel vehicle proved the effectiveness of detection of the analysis.

**Table 4.** Calculation Results Obtained from the ANP Method

| **Main Criteria** | | **Sub Criteria** | | |
|---|---|---|---|---|
| | Holistic Weights | | Relative Weights | Holistic Weights |
| **E** | 0,206 | **E1** | 0,444 | 0,091 |
| | | **E2** | 0,313 | 0,064 |
| | | **E3** | 0,183 | 0,038 |
| | | **E4** | 0,086 | 0,018 |
| | | **E5** | 0,048 | 0,010 |
| **D** | 0,362 | **D1** | 0,768 | 0,278 |
| | | **D2** | 0,202 | 0,073 |
| **F** | 0,064 | **F1** | 0,828 | 0,053 |
| | | **F2** | 0,172 | 0,011 |
| **EP** | 0,233 | **EP1** | 0,656 | 0,153 |
| | | **EP2** | 0,243 | 0,057 |
| | | **EP3** | 0,101 | 0,023 |
| **T** | 0,048 | **T1** | 0,802 | 0,039 |
| | | **T2** | 0,198 | 0,010 |
| **P** | 0,071 | **P1** | 0,635 | 0,045 |
| | | **P2** | 0,267 | 0,019 |
| | | **P3** | 0,098 | 0,007 |
| **SS** | 0,015 | **SS1** | 0,651 | 0,010 |
| | | **SS2** | 0,248 | 0,004 |
| | | **SS3** | 0,101 | 0,002 |

In their analysis, according to customers' requests, we designed a car, interior design, safety equipment, the 1600 cc engine capacity and diesel fuel type they prefer a car that is seen.

## 3. Result

The competitive environment of firms operating in the automotive industry is growing very fast nowadays to achieve more sales, share and compete with your competitors to know their car manufactures customer-oriented barsare required. As a result of customer-oriented production of automotive companies and potential customers will increase production costs will be reduced in the process. In this study wedeterminedthe criteriato be used incar selection, determination of the degree of importance of these criteria calculated by the method of AHP and ANP and AHP and ANP after the results were compared.

As a result of analysis, the needs of customers can be determined by automotive companies, and as a result of this determination can be produced automobile is seen as a result of customer requirements. Companies analyzed and the country or region, country or area that cars produced in accordance with the request.

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