ANALYTIC HIERARCHY PROCESS as a MANAGERIAL DECISION TOOL in the EVALUATION OF NEW PRODUCT IDEAS

Dr. Kaan YARALIOĞLU
D.E.U., Faculty of Economics &Business Administration .
k.yaralioglu@deu.edu.tr
Dr. Haluk KÖKSAL
American University of Beirut,Lebanon,
S. Olayan School of Business
mk79@aub.edu.lb

ÖZET

Bu çalismada bir tahminleme ve karar verme teknigi olarak gelistirilen Analitik Hiyerarsi Proses (AHP) teknigi, yeni ürün fikirlerinin degerlendirilmesi amacıyla yeniden gozden geçirilmistir. Bu amaçla AHP algoritmasi, yeni ürün fikirlerinin degerlendirilmesine uygun bir karar hiyerarsisi ile birlikte düzenlenerek olusturulan model bir ornek üzerinde cozülmustür.

ABSTRACT

In this study, Analytic Hierarchy Process (AHP), that was developed as an estimation and decision-making technique for managers, is reviewed for the evaluation of new product ideas. The AHP algorithm is solved on a hypothetical example consistent with the hierarchy developed to evaluate new product ideas.

INTRODUCTION

Although the screening of new product ideas is the most important development activity, it is generally not performed well enough in companies. The quality of managers' decisions on the screening of new product ideas directly affects the success and profitability of new products, and, therefore, provides a competitive advantage to the company. The studies in the literature indicate that idea screening is the most undertaken activity because it influences the market performance of a product. However, these studies also underline that managers do not undertake this activity effectively.

Complex managerial tools for improving managers' decisions on the screening of new product ideas have been developed, but most of the tools have not been adopted and applied by managers to support their decisions although they have been available for more than 25 years.

In this article, the Analytic Hierarchy Process (AHP) is being studied as a simple and useful managerial tool which can be helpful for managers in the selection of new product ideas that could be successful in the market. Decision makers can generally confront contradictions not only on the assessment of new product ideas but on all decisions. One of the reasons for contradictions is the need to consider many factors, such as cost, profitability, time and feasibility all of which can affect the decision. Indeed, the decision might be positive when it is assessed from one factor point of view; however, it could be negative when evaluated from another. As the number of alternatives increases, the decision process becomes more complex. The method chosen in this study evaluates every decision point for each evaluation factor separately and offers a complete logical decision in the end. AHP helps to increase the effectiveness of the current alternatives. It is a managerial tool which can be frequently applied to different decisions (Calantone et. al. 1999: 68; Partovi, 1994: 28).

NEW PRODUCT DEVELOPMENT

Business activities are affected by the research and development carried out globally and different technological and market opportunities arising from changes in the market. These forces are not under the control of companies. A company's survival and growth depends on its ability to fit into this continuously changing environment and respond to these changes. Along with the success gained by the competitors in the market, the changes in the technology and market push companies to develop and launch new products (Johne and Snelson, 1987: 133; Zhuang, et al., 1999: 57). Considering these factors, companies adopt a new product strategy based on the resources they allocate for new product development, new product development skills and knowledge, their history and the attitudes of top management. Thomas (1993: 8) argues that new product development is an important medium to gain a competitive advantage in the market no matter which strategy they follow.

The literature contains a vast body of research on the factors affecting new product success (Kksal,1996: 35-112). The research done by Page (1993: 283) has found that the activities carried out during the new product development process have a significant impact on the success of new products. However, the studies in the literature have come to the conclusion that although managers tend to allocate more resources towards the later stages, the success of a new product is determined by the activities undertaken before the realisation of the new product (Cooper and Kleinschmidt, 1988: 254-259; Cooper, 1994: 67-68; Montoya and Calantone, 1994: 412).

SCREENING of NEW PRODUCT IDEAS

One of the important stages is that of screening new product ideas, in which new product ideas are reviewed and successful ones pass through other stages for which more resources are allocated. The new product ideas discarded at this stage are either shelved or postponed. As a result, the failure rate can be decreased, resources used in unsuccessful projects can be diminished, and companies' income and profits can be increased.

According to Cooper and Kleinschmidt (1986: 75-77) the managers claim that although the screening of new products is an important stage making the highest contribution to the performance of a new product in the market, it ranks second out of the stages needing to be improved in the new product development process. Dwyer and Mellor (1991: 42,43) state that the initial stages of the new product development process, together with the screening of new product ideas are significantly associated with the sales of a new product and the profits expected from it.

Companies typically pursue an unsystematic approach in the new product development process. This approach is also valid for the screening of new product ideas. For example, Cooper and Kleinschmidt (1986: 77) claim that more than 98 percent of new product projects are completed through the application of an unsystematic procedure. Clearly, managers neither know nor prefer the managerial decision tools from which they could benefit.

In this study AHP is proposed and presented, with an example, as the application to enlighten managers on the usefulness of the method for new product idea screening.

ANALYTIC HIERARCHY PROCESS

Analytic hierarchy process can be defined as a decision and forecasting method giving the percentage distribution of decision points in terms of the factors affecting the decision. It is easy to evaluate the decision points in terms of any factor and reach a decision. However, making the decision gets harder as the number of factors to be evaluated increases. As a result, decision-makers need to consider all the evaluation factors together (Armacost, 1994: 386).

AHP has become preferred by decision-makers as a reliable tool since it ranks the evaluation factors according to their relative importance, then assesses the decision points for every factor and, finally, has a mathematical method combining these two stages.

The stages of AHP are described below:

a- Structuring the decision hierarchy

Firstly, the decision points are determined. Then, the factors influencing a decision are described. The number of decision points is shown with "*m*" and the factors affecting the decision points are presented with "*n*".

b- Establishing a comparison matrix of the factors

The comparison matrix is a square matrix with *n* x *m* dimensions. The evaluation factors make up the rows and columns of the matrix. The comparisons are made by using the relative importance scale, as shown in Table 1. Since the values on the diagonal represent the same factor, they become 1. If the preference is used in favour of the factor in the row when the factor in any row is compared with the factor in the column, fraction (1/importance value) is preferred (Yaralolu,1999: 990)

factor in any column, integir (importance value) is employed. If the preference is used in favour of the

TABLE 1: SCALE Of RELATIVE IMPORTANCE

Intensity of Relative Importance	Definition	Explanation
1	Equal Importance	Two activities contribute equally to the objective
3	Moderate Importance	Experience and judgement another slightly favour one activity over
5	Essential or Strong	Experience or judgement strongly favours one activity over another
7	Importance Demonstrated	An activity is strongly favoured and its dominance is demonstrated in practice
9	Extreme (Absolute)	The evidence favouring one activity over another is of the highest possible order of affirmation
2,4,6,8	Intermediate values	When compromise is needed

c- Determining percentages for the importance distribution of the factors

The B row vector with *n* x 1 dimensions is established by using row vectors building the comparison matrix for importance distribution.

$B_i = \lfloor b_{ij} \rfloor_{nx1}$.......$i = 1,2,...,n$.......Formula 1

The components of this vector are calculated by using Formula 2, with the utilisation of the elements of the comparison matrix (a_{ij}). In other words, the elements of the B row vector are calculated by dividing the elements in the lines of the comparison matrix with the row sums (Saaty, 1990: 20).

Then, the obtained n times B row vector is structured in a matrix format and the median values of the elements in every row are calculated. The *n* value obtained in this way gives the percentage distribution of value factors, that is, importance values (W priority vector with *n* x 1 dimensions).

$$b_{ij} = \frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}} \text{.........................Formula 2}$$

d- Finding the percentage importance distribution in *m* decision points for every factor.

In this stage, the percentage of importance distribution related to every factor is determined as explained in b and c. In other words, pair-wise comparisons and matrix operations as explained in c are repeated as many times as the number of factors. However, in this time the dimensions of comparison matrices to be used in decision points for every factor will become m x m. After every comparison operation, S column vectors with m x 1 dimensions and showing percentage distribution of every evaluated factor to the decision points are obtained (Teck vd.,1997:130)

e- Reaching the result distribution in the decision points

In this stage, *n* times *S* column vectors are all brought together. Thus, a matrix with *m* x *n* dimensions is obtained. When this matrix is multiplied with the *W* priority vector the percentage distribution of decision points (alternatives) is reached.

APPLICATION

In this study the decision analysis related to the three new product types a car manufacturing company wants to launch into the market is done by employing the AHP method. The main purpose of the application is to present the consistency and applicability (feasibility) of AHP in the decision process. For this reason, the figures related to the evaluation criteria are fictitious. The logic integrity of the model is, however, considered.

The matrix operations in this study are calculated using the BASIC program, which has been developed for the method explained in Section 4 and is able to process the matrix operations with dimensions up to 500 x 500.

The company's decision-making team wishes to choose one of the products according to the results of the decision analysis. These products are of great importance for the company and the models are given the names of: Cabriole TX, Coupe TEX, and 4x4 Sport CR.

The team determined a total of 39 evaluation criteria under the 9 main sections and then requested the budgeting of all these factors related to the product models from the research and development department. The R&D department prepared the budgeting study after completing the feasibility studies. These evaluation factors and forecasted figures for the product models are given in Table 2.

The decision team firstly structured the decision hierarchy and compared the decision criteria with each other using Table 1. In the comparisons, every factor was compared with the others independently. If the predominance was used in favour of the base factor, the integer was given. If the predominance was employed in favour of the compared factors, the fraction was given. For example, the first row in Table 3 shows the comparison of the number of required additional machines (base factor) with the other factors. When the number of required additional machines is compared with the number of personnel, an integer of 3 was given due to using the preference in favour of the number of required additional machines. However, when the same factor was compared with the number of parts to be imported, ½ was employed because of using the preference in favour of the number of parts to be imported. The comparison results are presented in Table 3.

At this stage the decision team determined the importance order of the evaluation factors by using the AHP method mentioned in Section 4 and the ranking is shown in Table 4.

The second stage of the decision hierarchy makes up the evaluation of the product models from the view of every factor separately. In the evaluation, Tables 1 and 2 are used. The results of the evaluation are shown in Table 5.

In Table 5, the importance distributions of the decision points for every factor are calculated as explained in Section 4

As pointed out above, the AHP method requires a two-stage process. The first stage is the determination of the evaluation factors affecting the decision and the calculation of the percentage distributions. The second stage is to find the percentage distributions of the decision points and to form a matrix with m x n dimensions from the percentage distributions of the decision points.

In this study, the decision team reached the result distributions of the decision points by multiplying the column vector showing the percentage distribution related to the evaluation factors from the first stage, with the matrix giving the percentage distribution of the decision points according to the evaluation factors. The results are presented in Table 6.

The decision team determined the importance value of the Cabriole TX as 23 percent, the Coupe TEX as 26 percent, and the 4x4 Sport CR as 51 percent. Therefore, the company can make the decision to produce the 4x4 Sport CR model.

CONCLUSION

The AHP method's use as a decision tool has gained preference due to its inclusion of many factors that can affect the decision making process at the same time. Depending on these characteristics, AHP can be used in the screening of new product ideas since it presents a numerical and logical method. However, the application of the AHP method depends on the judgements of the decision maker. Therefore, the objectivity of the method increases as the decision maker takes more objective decisions. Generally, the suggestions below can be considered to increase the objectivity likelihood of decisions:

1- The decision hierarchy should be defined in detail,

2- The evaluation factors should be able to be transformed into numerical values,

3- The evaluations of more than one decision maker should be considered in the same decision,

4- The median value should be used for the result decision distribution of more than one decision maker.

Table 2: Evaluation Criteria and Budget Estimations

Evaluation Factors		Cabriole TX	Coupe TEX	4x4 Sport CR
REQUIRED NUMBER of MACHINES	1. Number of Required Additional Machines	15	15	23
	2. Number of Personnel	126	145	132
	3. Number of Parts to be Produced by Sub-industry	655	405	586
	4. Number of Parts to be Imported	122	259	312
PRODUCTION COST PER UNIT	1.Raw Material Cost Per Unit ($)	25.000	25.000	32.000
	2.Personnel Cost Per Unit ($)	9.500	12.200	15.600
	3.Energy Cost Per Unit ($)	15.000	15.000	15.000
	4. Indirect Cost Per Unit ($)	12.500	13.400	13.400
MARKETING OPPORTUNITY	1. Number of Similar Products in the Market	8	12	4
	2. Magnitude of Potential Market ($)	256.000.000.000	160.000.000.000	135.000000.000
	3. Number of Distributors	145	102	85
	4.Number of Competitors	12	8	3
	5.Existence of Big competitors	No	Yes	Yes
	6. Growth Rate of Market (%)	15	8	8
	7.Frequency of New Product Introduction (year)	1	2	2
	8. Advertising Budget ($)	1.250.000	1.500.000	950.000
STORAGE AVABILITY	1. Number of Product to be Stored in the Factory	2.500	1.800	950
	2. Number of Product to be Sent to Distributors	7.350	3.800	2.250
	3. Sales from the Factory	1.050	750	200
TIME	1. Period of Being in the Market for the Product (year)	1	1	2
	2. Delivery Time (month)	2	3	3
PRICE PER UNIT	1. Price Per Unit ($)	72.000	80.600	91.000
	2. Discount Percentage (%)	5	4	2
	3. Price Advantage	Yes	No	No
	4. Price Elasticity	1.82	1.12	1.03
SUITABILITY to CUSTOMER REQURIMENTS	1. Number of Options	9	12	26
	2. Production in Accordance with Customer Request	No	Yes	Yes
	3. Technical Suitability (points)	7	6	10
	4. Usage Suitability (points)	8	8	8
PRODUCTION PROCESS	1. Production Period for Per Unit (day)	3	5	12
	2. Number of Stages in the Process	459	1.254	3.215
	3. Number of Repeated Stages in the Process	120	158	212
	4. Number of Quality Control Points	45	65	112
TOTAL PROJECT COST	1. Cost of Know-how ($)	3.500.000	6.000.000	9.300.000
	2. Cost of Mould($)	5.250.000	8.650.000	12.000.000
	3. Cost of Feasibility Study($)	950.000	950.000	1.260.000
	4. Cost of Machine($)	13.000.000	13.500.000	23.000.000
	5. Cost of Prototype Development ($)	2.500.000	3.250.000	5.000.000
	6. Cost of Testing ($)	650.000	940.000	2.120.000

Table 3: The Comparisons Results of Evaluation Factors

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
1	--	6	3	½	2	3	5	7	1/5	1/5	3	1/5	1/5	1/3	5	5	7	7	5	2	5	1/3	2	2	5	6	4	2	3	5	3	3	3	1/2	1/3	5	1	5	7
2	1/6	--	1/4	1/5	1/4	1	1/3	1/4	1/8	1/8	1	1/9	1/9	1/3	1/2	1/3	1/3	1/4	1/3	1/2	1/5	1/7	2	2	5	6	5	5	5	2	1	1	1/3	1/3	1/3	5	1/6	2	3
3	1/3	4	--	1/3	1/5	1/3	3	3	1	1/3	3	1/5	1/6	2	1/3	1/3	5	5	5	1/3	3	1/3	2	2	3	5	1/3	3	3	2	1/3	3	1	1/3	1/5	1	1/5	1/3	3
4	2	5	3	--	1	3	2	2	3	1/3	5	2	1/5	1/3	3	3	7	7	7	1/3	3	3	5	3	2	1	1/3	3	3	3	1/5	2	1/3	1/3	1/5	2	1/5	1/3	5
5	1/2	4	5	1	--	5	3	3	5	1/3	3	2	2	3	1/3	5	2	2	2	1/3	5	5	7	5	3	5	3	2	2	1	5	7	1/2	5	7	9	1/3	5	7
6	1/3	1	3	1/3	1/5	--	1/5	1/4	1/3	1/5	2	1/3	1/3	3	1/5	5	5	5	3	1/2	1/3	1/5	5	2	5	5	1/3	3	3	1/3	1/3	1/3	3	1/2	1/2	3	1/6	½	3
7	1/5	3	1/3	½	1/3	5	--	3	1/4	¼	3	1/2	1/3	3	1/4	5	6	6	5	1/3	1/3	1/6	5	3	5	3	2	5	1/3	1/3	1/5	1/5	1/3	2	1/3	5	1/5	3	5
8	1/7	4	1/3	½	1/3	4	1/3	--	1/3	1/3	3	1/3	1/4	1	1/4	3	4	4	4	1/3	1/3	1/6	4	4	4	2	1/5	1/3	1/3	1/4	1/5	1/5	1/5	1/3	1/5	3	1/6	2	2
9	5	8	1	1/3	1/5	3	4	3	--	1/3	5	1	1/5	1/3	1/5	5	5	5	5	1/5	3	1/2	7	1/3	3	1/3	1/5	1/5	1/3	1/5	1/2	1/2	1/5	1/5	1/5	3	1/3	2	3
10	5	8	3	3	3	5	4	3	3	--	2	2	1/2	1	3	3	2	2	1	1/2	1/3	1	3	1/3	1	1/3	1/3	1/3	1/3	1	3	5	1/2	3	3	5	1/2	5	5
11	1/3	1	1/3	1/5	1/3	1/2	1/3	1/3	1/5	½	--	1/6	1/5	1/2	3	3	3	1	5	1/5	5	1/3	3	5	1	3	1/3	2	3	1/3	1/3	1/3	1/5	2	1/2	5	1/5	2	5
12	5	9	5	½	1/2	3	2	3	1	½	6	--	1/5	1/3	5	4	5	5	5	3	1/3	1/3	3	1/3	1/3	3	1/5	1/3	1/3	1/5	3	4	1	3	2	3	1/2	5	6
13	5	9	6	5	1/2	3	3	4	5	2	5	5	--	5	3	5	7	5	5	3	1/3	1/5	1/3	1/5	1/3	1/3	1/5	1/3	1/5	1/3	3	4	3	1/2	1/3	1	1/2	2	3
14	3	3	1/2	3	1/3	1/3	1/3	1	3	1	2	3	1/5	--	1/3	5	3	1	1	1	1/3	1/3	2	1/3	1	5	3	3	3	1/3	3	3	1	3	3	6	2	5	7
15	1/5	2	3	1/3	3	5	4	4	5	1/3	1/3	1/5	1/3	3	--	3	1	1/3	1/3	1/3	1/5	1/5	2	1/3	1	2	3	3	3	1/3	3	3	2	5	5	2	1	2	5
16	1/5	3	3	1/3	1/5	1/5	1/5	1/3	1/5	1/3	1/3	1/4	1/5	1/5	1/3	--	1/3	1/5	1/3	1/5	1/3	1/6	1/3	1/5	1/2	1/3	1/5	1/3	1/3	1/5	1/3	1/3	1	1/3	1/3	3	1/6	2	5
17	1/7	3	1/5	1/7	1/2	1/5	1/6	1/4	1/5	½	1/3	1/5	1/7	1/3	1	3	--	1/5	1/5	1/5	1	1/5	1/3	1/3	1/2	1/5	1/5	1/5	1/5	3	2	2	1/3	1/5	1/5	3	1/6	3	5
18	1/7	4	1/5	1/7	1/2	1/5	1/6	1/4	1/5	½	1	1/5	1/5	1	3	5	5	--	3	1/3	1/3	1/2	3	1/5	3	1/3	1/5	1/3	1/3	1/3	1/3	1/3	1/2	1/3	1/4	3	3	5	5
19	1/5	3	1/5	1/7	1/2	1/3	1/5	1/4	1/5	1	1/5	1/5	1/5	1	3	3	5	1/3	--	1/7	2	1/5	1/3	1/5	1/3	1/3	1/5	1/5	1/5	1/3	1/3	1/3	1/4	1/5	1/5	3	1/6	3	5
20	1/2	2	3	3	3	2	3	3	5	2	5	1/3	1/3	1	3	5	5	3	7	--	5	1/3	3	1/5	1/5	3	3	3	3	5	5	5	1/3	3	2	5	1/5	1	5
21	1/5	5	1/3	1/3	1/5	3	3	3	1/3	3	1/5	3	3	3	5	3	1	3	½	1/5	--	1/6	3	1/5	3	1/3	1/5	1/3	1/3	1	1	1	1/3	1/5	1/5	5	1/2	3	5
22	3	7	3	1/3	1/5	5	6	6	2	1	3	3	5	3	5	6	5	2	5	3	6	--	6	1/3	5	7	5	5	3	5	6	7	3	3	2	5	3	5	6
23	1/2	1/2	1/2	1/5	1/7	1/5	1/5	1/4	1/7	1/3	1/3	1/3	3	1/2	1/2	3	3	1/3	3	1/3	1/3	1/6	--	1/5	3	3	1/2	2	2	2	1/3	1/3	1/3	1/4	1/3	3	1/5	1/3	1
24	1/2	1/2	1/2	1/3	1/5	1/2	1/3	1/4	3	3	1/5	3	5	3	3	5	3	5	5	5	5	3	5	--	3	5	5	6	6	1/3	2	2	3	1	3	5	1/2	6	7
25	1/5	1/5	1/3	½	1/3	1/5	1/5	1/4	1/3	1	1	3	3	1	1	2	2	1/3	3	5	1/3	1/5	1/3	1/3	--	3	1/3	1/3	1/3	1/5	1/2	1/2	1/4	1/5	1/6	1/2	1/7	1/3	1
26	1/6	1/6	1/5	1	1/5	1/5	1/3	1/2	3	3	1/3	1/3	3	1/5	1/2	3	5	3	3	1/3	3	1/7	1/3	1/5	1/3	--	1/3	1/3	1/3	1/5	1/4	1/4	1/5	3	1/3	5	1/5	1/3	5
27	1/4	1/5	3	3	1/3	3	1/2	5	5	3	3	5	5	1/3	1/3	5	5	5	5	1/3	5	1/5	2	1/5	3	3	--	1	1	5	1/4	1/3	1/5	5	5	6	1/3	6	9
28	1/2	1/5	1/3	1/3	1/2	1/3	1/5	3	5	3	1/2	3	3	1/3	1/3	3	5	3	5	1/3	3	1/5	1/2	1/6	3	3	1	--	1	3	5	4	1/3	3	3	5	1	1/3	1/3
29	1/3	1/5	1/3	1/3	1/2	1/3	3	3	3	3	1/3	3	5	1/3	1/3	3	5	3	5	1/3	3	1/3	1/2	1/6	3	3	1	1	--	3	1/3	1/3	3	1	1/2	7	1/3	1/3	1/4
30	1/5	1/2	1/2	1/3	1	3	3	4	5	1	3	5	3	3	3	5	1/3	3	3	1/5	1	1/5	1/2	3	5	5	1/5	1/3	1/3	--	1/2	2	3	5	4	6	1	5	7
31	1/3	1	3	5	1/5	3	5	5	2	1/3	3	1/3	1/3	1/3	1/3	3	1/2	3	3	1/5	1	1/6	3	1/2	2	4	4	1/5	3	2	--	1	1/4	2	1	5	1/3	3	5
32	1/3	1	1/3	½	1/7	3	5	5	2	1/5	3	1/4	1/4	1/3	1/3	3	1/2	3	3	1/5	1	1/7	3	1/2	2	4	3	1/4	3	1/2	1	--	1/5	1/5	1/5	3	1/6	2	4
33	1/3	3	1	3	2	1/3	3	5	5	2	5	1	1/3	1	1/2	1	3	2	4	3	3	1/3	3	1/3	4	5	5	3	1/3	1/3	4	5	--	1	1/2	6	1/2	3	5
34	2	3	3	3	1/5	2	1/2	3	5	1/3	1/2	1/3	2	1/3	1/5	3	5	3	5	1/3	5	1/3	4	1	5	1/3	1/5	1/3	1	1/5	1/2	5	1	--	1/2	1/4	1/6	5	7
35	3	3	5	5	1/7	2	3	5	5	1/3	2	1/2	3	1/3	1/5	3	5	4	5	1/2	5	1/2	3	1/3	6	3	1/5	1/3	2	1/4	1	5	2	2	--	5	1/4	3	5
36	1/5	1/5	1	1/2	1/9	1/3	1/5	1/3	1/3	1/5	1/5	1/3	1	1/6	1/2	1/3	1/3	1/3	1/3	1/5	1/5	1/5	1/3	1/5	2	1/5	1/6	1/5	1/7	1/6	1/5	1/3	1/6	4	1/5	--	1/6	1/3	1
37	1	6	5	5	3	6	5	6	3	2	5	2	2	1/2	1	6	6	1/3	6	5	2	1/3	5	2	7	5	3	1	3	1	3	6	2	6	4	6	--	7	9
38	1/5	1/2	3	3	1/5	2	1/3	1/2	1/2	1/5	1/2	1/5	1/2	1/5	1/2	1/2	1/3	1/5	1/3	1	1/3	1/5	3	1/6	3	3	1/6	3	3	1/5	1/3	1/2	1/3	1/5	1/3	3	1/7	--	5
39	1/7	1/3	1/3	1/5	1/7	1/3	1/5	1/2	1/3	1/5	1/5	1/6	1/3	1/7	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/6	1	1/7	1	1/5	1/9	3	4	1/7	1/5	1/4	1/5	1/7	1/5	1	1/9	1/5	--

Table 4: Importance Order of Evaluation Factors

Importance Order	Evaluation Criteria	Percentage Weight
1	Price Per Unit	5.6
2	Cost of Machine	5.1
3	Cost of Raw Material Per Unit	4.8
4	Price Advantage	4.3
5	Number of Required Additional Machines	4.1
6	Existence of Big Competitor	3.8
7	Production in Accordance with Customer Requirements	3.6
8	Magnitude of Potential Market	3.5
9	Number of Parts to be Imported	3.2
	Number of Competitors	3.2
	Number of Quality Control Points	3.2
	Period of Being in the Market for the product	3.2
10	Cost of Mould	3.1
11	Frequency of New Product Introductions in to Market	3.0
12	Growth Rate of Market	2.9
13	Technical Suitability	2.6
	Production Period Per Unit	2.6
14	Energy Cost Per Unit	2.5
	Number of Stages in the Process	2.5
15	Usage Suitability	2.4
	Cost of Know-how	2.4
16	Number of Similar Products in the Market	2.3
17	Delivery Time	2.2
18	Number of Parts to be Produced by Sub Industry	2.1
	Personnel Cost Per Unit	2.1
19	Number of Distributors	1.9
20	Number of Personnel	1.8
	Number of Repeated Stages in the Process	1.8
21	Indirect Cost Pet Unit	1.7
	Number of Product to be Sent to Distributor	1.7
22	Number of Options	1.5
23	Price Elasticity	1.4
24	Cost of Prototype Development	1.3
25	Discount Percentage	1.2
26	Number of Products to be Stored in the Factory	1.1
	Sales from the Factory	1.1
27	Advertising Budget	0.8
28	Cost of Feasibility Study	0.7
	Cost of Testing	0.7

Table 5: The Evaluation of the Product Models

Number of Required Additional Machines

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	---	1	1/5
Coupe TEX	1	--	1/5
4x4 Sport CR	5	5	--

Model Code	Percentage Weight
Cabriole TX	14
Coupe TEX	14
4x4 Sport CR	72

Number of Personnel

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1/5	1/3
Coupe TEX	5	--	3
4x4 Sport CR	3	1/3	--

Model Code	Percentage Weight
Cabriole TX	11
Coupe TEX	63
4x4 Sport CR	26

Number of Parts to be Produced by Sub- industry

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	3	2
Coupe TEX	1/3	--	½
4x4 Sport CR	1/2	2	--

Model Code	Percentage Weight
Cabriole TX	54
Coupe TEX	16
4x4 Sport CR	30

Number of Parts to be Imported

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1/5	1/7
Coupe TEX	5	--	¼
4x4 Sport CR	7	4	--

Model Code	Percentage Weight
Cabriole TX	7
Coupe TEX	25
4x4 Sport CR	68

Raw Material Cost Per Unit

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1	1/5
Coupe TEX	1	--	1/5

Model Code	Percentage Weight
Cabriole TX	14
Coupe TEX	14

4x4 Sport CR	5	5	--

4x4 Sport CR	72

Personnel Cost Per Unit

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1/5	1/7
Coupe TEX	5	--	1/5
4x4 Sport CR	7	5	--

Model Code	Percentage Weight
Cabriole TX	7
Coupe TEX	23
4x4 Sport CR	70

Energy Cost Per Unit

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1	1
Coupe TEX	1	--	1
4x4 Sport CR	1	1	--

Model Code	Percentage Weight
Cabriole TX	33
Coupe TEX	33
4x4 Sport CR	34

Indirect Cost Per Unit

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1/3	1/3
Coupe TEX	3	--	1
4x4 Sport CR	3	1	--

Model Code	Percentage Weight
Cabriole TX	14
Coupe TEX	43
4x4 Sport CR	43

Number of Similar Products in the Market

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	4	¼
Coupe TEX	1/4	--	1/6
4x4 Sport CR	4	6	--

Model Code	Percentage Weight
Cabriole TX	24
Coupe TEX	9
4x4 Sport CR	67

Magnitude of Potential Market

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole	--	6	8

Model Code	Percentage Weight
Cabriole TX	74

TX			
Coupe TEX	1/6	--	4
4x4 Sport CR	1/8	1/4	--

Coupe TEX	19
4x4 Sport CR	7

Number of Distributors

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	5	7
Coupe TEX	1/5	--	5
4x4 Sport CR	1/7	1/5	--

Model Code	Percentage Weight
Cabriole TX	70
Coupe TEX	23
4x4 Sport CR	7

Number of Competitors

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1/4	1/7
Coupe TEX	4	--	1/5
4x4 Sport CR	7	5	--

Model Code	Percentage Weight
Cabriole TX	8
Coupe TEX	21
4x4 Sport CR	71

Existence of Big Competitor

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	9	9
Coupe TEX	1/9	--	1
4x4 Sport CR	1/9	1	--

Model Code	Percentage Weight
Cabriole TX	82
Coupe TEX	9
4x4 Sport CR	9

Growth Rate of Market

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1/6	1/6
Coupe TEX	6	--	1
4x4 Sport CR	6	1	--

Model Code	Percentage Weight
Cabriole TX	8
Coupe TEX	46
4x4 Sport CR	46

Frequency of New Product Introductions in to Market

	Cabriole TX	Coupe TEX	4x4 Sport CR

Model Code	Percentage Weight

Cabriole TX	--	1/6	1/6
Coupe TEX	6	--	1
4x4 Sport CR	6	1	--

Cabriole TX	8
Coupe TEX	46
4x4 Sport CR	46

Advertising Budget

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1/3	6
Coupe TEX	3	--	7
4x4 Sport CR	1/6	1/7	--

Model Code	Percentage Weight
Cabriole TX	30
Coupe TEX	63
4x4 Sport CR	7

Number of Products To be Stored in the Factory

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1/3	5
Coupe TEX	3	--	6
4x4 Sport CR	1/5	1/6	--

Model Code	Percentage Weight
Cabriole TX	29
Coupe TEX	63
4x4 Sport CR	8

Number of Products to be sent to Distributors

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	5	7
Coupe TEX	1/5	--	3
4x4 Sport CR	1/7	1/3	--

Model code	Percentage Weight
Cabriole TX	72
Coupe TEX	19
4x4 Sport CR	9

Sales from the Factory

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1/5	1/7
Coupe TEX	5	--	3
4x4 Sport CR	7	1/3	--

Model Code	Percentage Weight
Cabriole TX	8
Coupe TEX	59
4x4 Sport CR	33

Period of Being in the Market for The Product

	Cabriole	Coupe	4x4 Sport

Model Code	Percentage

	TX	TEX	CR
Cabriole TX	--	1	½
Coupe TEX	1	--	½
4x4 Sport CR	2	2	--

	Weight
Cabriole TX	25
Coupe TEX	25
4x4 Sport CR	50

Delivery Time

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1/3	1/3
Coupe TEX	3	--	1
4x4 Sport CR	3	1	--

Model Code	Percentage Weight
Cabriole TX	14
Coupe TEX	43
4x4 Sport CR	43

Price Per Unit

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1/3	1/5
Coupe TEX	3	--	1/3
4x4 Sport CR	5	3	--

Model Code	Percentage Weight
Cabriole TX	11
Coupe TEX	26
4x4 Sport CR	63

Discount Percentage

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	2	5
Coupe TEX	1/2	--	½
4x4 Sport CR	1/5	2	--

Model Code	Percentage Weight
Cabriole TX	59
Coupe TEX	19
4x4 Sport CR	22

Price Advantage

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1/5	1/5
Coupe TEX	5	--	1
4x4 Sport CR	5	1	--

Model Code	Percentage Weight
Cabriole TX	10
Coupe TEX	45
4x4 Sport CR	45

Price Elasticity

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	4	5
Coupe TEX	1/4	--	3
4x4 Sport CR	1/5	1/3	--

Model Code	Percentage Weight
Cabriole TX	67
Coupe TEX	23
4x4 Sport CR	10

Number of Options

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1/3	1/6
Coupe TEX	3	--	1/5
4x4 Sport CR	6	5	--

Model Code	Percentage Weight
Cabriole TX	9
Coupe TEX	21
4x4 Sport CR	71

Production in Accordance with Customer Requirements

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1/5	1/5
Coupe TEX	5	--	1
4x4 Sport CR	5	1	--

Model Code	Percentage Weight
Cabriole TX	8
Coupe TEX	46
4x4 Sport CR	46

Technical Suitability

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	2	1/5
Coupe TEX	1/2	--	1/7
4x4 Sport CR	5	7	--

Model Code	Percentage Weight
Cabriole TX	17
Coupe TEX	9
4x4 Sport CR	74

Usage Suitability

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1	1
Coupe TEX	1	--	1
4x4 Sport CR	1	1	--

Model Code	Percentage Weight
Cabriole TX	33
Coupe TEX	33
4x4 Sport CR	34

Period of Production Per Unit

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	3	7
Coupe TEX	1/3	--	6
4x4 Sport CR	1/7	1/6	--

Model code	Percentage Weight
Cabriole TX	63
Coupe TEX	30
4x4 Sport CR	7

Number of Stages in the Process

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1/5	1/9
Coupe TEX	5	--	1/5
4x4 Sport CR	9	5	--

Model Codc	Percentage Weight
Cabriole TX	6
Coupe TEX	22
4x4 Sport CR	72

Number of Repeated Stages in the Process

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1/3	1/5
Coupe TEX	3	--	1/3
4x4 Sport CR	5	3	--

Model Code	Percentage Weight
Cabriole TX	11
Coupe TEX	26
4x4 Sport CR	63

Number of Quality Control Points

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1/5	1/8
Coupe TEX	5	--	1/7
4x4 Sport CR	8	7	--

Model Code	Percentage Weight
Cabriole TX	6
Coupe TEX	20
4x4 Sport CR	74

Cost of Know-how

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1/5	1/8
Coupe TEX	5	--	1/5
4x4 Sport	8	5	--

Model Code	Percentage Weight
Cabriole TX	7
Coupe TEX	22
4x4 Sport CR	71

CR			

Cost of Mould

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1/5	1/7
Coupe TEX	5	--	1/5
4x4 Sport CR	7	5	--

Model Code	Percentage Weight
Cabriole TX	7
Coupe TEX	23
4x4 Sport CR	70

Cost of Feasibility Study

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1	¼
Coupe TEX	1	--	¼
4x4 Sport CR	4	4	--

Model Code	Percentage Weight
Cabriole TX	16
Coupe TEX	16
4x4 Sport CR	68

Cost of Machine

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1	1/7
Coupe TEX	1	--	1/7
4x4 Sport CR	7	7	--

Model Code	Percentage Weight
Cabriole TX	11
Coupe TEX	11
4x4 Sport CR	78

Cost of Prototype Development

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1/3	1/5
Coupe TEX	3	--	1/5
4x4 Sport CR	5	5	--

Model Code	Percentage Weight
Cabriole TX	10
Coupe TEX	21
4x4 Sport CR	69

Cost of Testing

	Cabriole TX	Coupe TEX	4x4 Sport CR
Cabriole TX	--	1/3	1/6
Coupe TEX	3	--	1/6

Model Code	Percentage Weight
Cabriole TX	9
Coupe TEX	19

4x4 Sport CR	6	6	--

4x4 Sport CR	72

Table 6: Result Distributions of Decision Points

$$\begin{vmatrix} 0.14 & 0.11 & 0.54 & 0.07 & 0.14 & 0.07 & 0.33 & 0.14 & 0.24 & 0.74 & 0.70 & 0.08 & 0.82 & 0.08 & 0.08 & 0.30 & 0.29 & 0.72 & 0.08 & 0.25 & 0.14 & 0.11 & 0.59 & 0.10 & 0.67 & 0.09 & 0.08 & 0.17 & 0.33 & 0.63 & 0.06 & 0.11 & 0.06 & 0.07 & 0.07 & 0.16 & 0.11 & 0{:}10 & 0.09 \\ 0.14 & 0.63 & 0.16 & 0.25 & 0.14 & 0.23 & 0.33 & 0.43 & 0.09 & 0.19 & 0.23 & 0.21 & 0.09 & 0.46 & 0.46 & 0.63 & 0.63 & 0.19 & 0.59 & 0.25 & 0.43 & 0.26 & 0.19 & 0.45 & 0.23 & 0.21 & 0.46 & 0.09 & 0.33 & 0.30 & 0.22 & 0.26 & 0.20 & 0.22 & 0.23 & 0.16 & 0.11 & 0.21 & 0.19 \\ 0.72 & 0.26 & 0.30 & 0.68 & 0.72 & 0.70 & 0.34 & 0.43 & 0.67 & 0.07 & 0.07 & 0.71 & 0.09 & 0.46 & 0.46 & 0.07 & 0.08 & 0.09 & 0.33 & 0.50 & 0.43 & 0.63 & 0.22 & 0.45 & 0.10 & 0.71 & 0.46 & 0.74 & 0.34 & 0.07 & 0.72 & 0.63 & 0.74 & 0.71 & 0.70 & 0.68 & 0.78 & 0.69 & 0.72 \end{vmatrix} \text{x} \begin{vmatrix} 0.041 \\ 0.018 \\ 0.021 \\ 0.032 \\ 0.048 \\ 0.021 \\ 0.025 \\ 0.017 \\ 0.023 \\ 0.035 \\ 0.019 \\ 0{,}032 \\ 0.038 \\ 0.029 \\ 0.030 \\ 0.008 \\ 0.011 \\ 0.017 \\ 0.011 \\ 0.032 \\ 0.022 \\ 0.056 \\ 0.012 \\ 0.043 \\ 0.014 \\ 0.015 \\ 0.036 \\ 0.026 \\ 0.024 \\ 0.026 \\ 0.025 \\ 0.018 \\ 0.032 \\ 0.024 \\ 0.031 \\ 0.007 \\ 0.051 \\ 0.013 \\ 0.007 \end{vmatrix} = \begin{vmatrix} 0.23 \\ 0.26 \\ 0.51 \end{vmatrix}$$

REFERENCES

ARMACOST, R. L., (1994): "Identification of Determinant Attributes Using The Analytic Hierarchy Process", Journal of Academy of Marketing Science, Fall, Vol. 22, pp. 383.

CALANTONE, Roger J., BENEDETTO , C. Anthony Di and SCHMİDT, Jeffrey B. (1999): "Using the Analytic Hierarchy process in New Product Screening" The Journal of Product Innovation Management, Vol. 16, pp. 65-76.

COOPER, R. G., (1984): "The Impact of New Product Strategies", Industrial Marketing Management, Vol. 12, pp. 243-256.

COOPER, R. G., KLEİNSCHMİDT, Elko (1986): "An Investigation into the New Product Process: Steps, Deficiencies, and Impact" The Journal Product of Innovation Management, Vol. 13, pp. 71-85.

COOPER, R. G., KLEİNSCHMİDT, Elko (1988):"Resource Allocation in the New Product Process", Industrial Marketing Management, Vol.17, pp.249-262.

COOPER, Robert G., (1994): "New Products: The Factors that Drive Success", International Marketing Review, Vol. 11, pp. 60-76.

CRAWFORD, C. Merle, (1979): "New Product Failure Rates-facts and fallacies", Research Management, September, pp. 9-13.

DWYER, Larry and MELLOR, Robert (1991): "Organizational Environment, New Product Process Activities, and Project Outcomes", The Journal of Product Innovation Management, Vol. 8, pp. 39-48.

EDGETT, Scott, SHİPLEY,David and FORBES,Giles (1992): "Japanese and British Companies Compared: Contributing factors to Success and Failure in NPD", The Journal of Product Innovation Management, Vol. 19, pp. 3-10.

JOHNE, Axel and SNELSON,Patricia (1987): "Innovate or Die", Management Today, November, pp. 133.

KOKSAL, Mehmet Haluk (1996): "The Critical Marketing success and Failure Factors in New Product development in the UK Electronics Industry" Unpublished Phd Thesis, University of Exeter, September.

MİN, H. (1994): "Location Analysis of International Consolidation Terminals Using the Analytic Hierarchy Process", Journal of Business Logistics, Vol. 15, pp. 20-25.

MONTOYA, Mitzi M. and CALANTONE, Roger (1994):"Determinants of New Product Performance: A Review and Meta Analysis", The Journal of Product Innovation Management, Vol.11, pp.397-417.

PAGE, Albert L. (1993): "Assessing New Product Development Practices and Performance: Establishing Crucial norms", The Journal of Product Innovation Management, Vol. 10, pp. 273-290.

PARTOVİ, Fariborz Y. (1994): "Determining What to Benchmark: An Analytic Hierarchy

Process Approach", International Journal of Operations & Production Management, Vol. 14, pp .25-39.

SAATY, T. L. (1980): Analytic Hierarchy Process, McGraw Hill, New York.

SAATY, T. L. (1990): Multi-criteria Decision Making: Analytic Hierarchy Process, RWS Publications, Pittsburgh.

TECK, M. C. , MENG, C. C., CHEE, B. O.and Theong, H. T. (1997): "Analytical Procedures for New and Matured Industries", Managerial Auditing Journal, Vol. 12/3, pp. 123-134.

THOMAS, Robert J. (1993): New Product Development: Managing and Forecasting Strategic Success, John Wiley and Sons Inc., New York.

YARALIOĞLU, K. (1999): "Analitik Hiyerarsi Proses (AHP) Modeli ile Genel Seçim Sonuçlarinin Ongorülmesi", 4. Ulusal Ekonometri ve Istatistik Sempozyumu, pp. 981-997, Antalya.

YARALIOĞLU,K. (2001) : "Performans Degerlendirmede Analitik Hiyerarsi Proses", DEU. Iktisadi ve Idari Bilimler Fakültesi Dergisi, Cilt 16, Say 1, pp. 137-145, Izmir,

ZHUANG, Lee, WİLLİAMSON,David and CARTER, Mike (1999): "Innovate or Liquidate- Are All Organisations Convinced? A two-phased study into the innovation process", Management Decision, Vol. 37, pp. 57-71.