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Determining the Strategies on Turkish Automotive Sector Using Fuzzy AHP Based on the SWOT Analysis

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ABSTRACT

In order to outmaneuver increasing competition, organizations must plan their strategies for managing the future. Yet, planning is not solely adequate. It is important to ensure the sustainability of feasible plans which are supported by performance evaluations, and to focus on strategies that which pay attention to demands and expectations of stakeholders.

The most prominent features of the real-life problems are multiple criteria, complexity and uncertainty. Benefiting from expert and stakeholder views help to reach optimal solutions of those problems. Taking advantage of artificial intelligence techniques would also contribute to the achievement of optimal results. Strategy Focused Model (SFM) aims to provide the most optimal possible solutions to real-life problems that require multi-criteria decision making. In SFM, the views of stakeholders and strategists are input into the decision making process. The main criteria of a problem establish the mainframe of the model, and these criteria are utilized in SWOT analysis. Hence, SWOT analysis is developed to Sectional SWOT analysis (SSWOT) and become more effective in determining strategies. SFM suggests the use of SSWOT analysis. The model requires to determine the weights of criteria and sub-criteria as well as the weights of stakeholders' and strategists' views. Thereafter, those weights enter into the decision making process. Although there are various methods to calculate those weights, Fuzzy Analytic Hierarchy Process (FAHP) is the one used in this study. For Turkish branded automobile production, SFM is applied and results are obtained and discussed.

Keywords: Strategy Focused Model, Sectional SWOT (SSWOT), FAHP, Turkish automotive sector.

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1. INTRODUCTION

Strategy planning is crucial in every stage of business management, particularly toward the top of this hierarchical structure. Determining appropriate strategies is vital for companies and business organizations [1]. Moreover, the orientation of the strategies precedes the establishment of strategies. In other words, conducting the direction of strategies is essential. The clues for right steps could be attained in strategy planning analyses. One of the most respectable analysis tool is SWOT being useful for the strategists in strategy orientation. Once SWOT analysis is conceived properly the right directions emerge evenly.

SWOT analysis is a dynamic tool [2]. As the strategies are applied, the balance among the S-W-O-T changes. The purpose is to enhance the strengths, reduce the weaknesses, benefit from the opportunities, convert the threats to opportunities or else stave off them.

Studies are available that using artificial intelligence and expert systems to SWOT analysis in literature. Ghazinoory et al [3] attempt to solve strategy designation problem by the fuzzy SWOT analysis, assigning fuzzy membership functions to internal and external factors considering both qualitative and quantitative aspects. In the article of Hossein-Nasab et al [4] the internal and external factors are assigned fuzzy values. For the first time quantitative SWOT analysis in supplier selection is introduced by Amin et al study [5]. In, Houben et al [6] suggest high quality SWOT analysis for strategy planning to SMSE (Small and Medium Sized Enterprizes) managers. Moreover, the researcher's advice this software to be developed further.

The quantified SWOT analysis integrating MCDM (Multiple Criteria Decision Making) concept and fuzzy AHP is presented for the assessment of location selection in a competitive environment as an application [7]. It is claimed that this method may be combined with the GSM (Grand Strategy Matrix) concept which is similar to the proposed approach.

Kheirkhah et al [8] suggest fuzzy SWOT analysis, scaling the factors and associating the fuzzy levels. The aggregation of membership functions lead to assessment of the factors in optimist and pessimist points so as to determine the final strategy direction. Ghorbani et al [9] studied on fuzzy SWOT analysis associated with the TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) in prioritization of strategies, as an innovation. The SWOT evaluation outcomes are also used in fuzzy AHP, ANP and similar decision-making tools [10, 11, 12, 13].

Automotive industry/sector adds great value to the economy as well as constitutes the base for technological improvements in Turkey like other countries in the World. Proportion of export revenue provided by automotive industry is very essential for economy of Turkey. Automotive industry/sector is selected as field of practice because of its specific status. All studies devoted to this sector are significant due to its great value-added.

The purpose of this study is to provide a solution by establishing a strategy model that uses the opinions of stakeholders more actively and minimizes the objective and human made mistakes. Strategy Focused Model (SFM) aims to provide the most optimal possible solutions to real-life problems that require multi-criteria decision making. In SFM, the views of stakeholders and strategists are input into the decision-making process. The main criteria of a problem establish the mainframe of the model, and these criteria are utilized in SWOT analysis. Hence, SWOT analysis is developed to Sectional SWOT analysis (SSWOT) and become more effective in determining strategies. The model requires to determine the weights of criteria and sub-criteria as well as the weights of stakeholders' and strategists' views. Thereafter, those weights enter into the decision-making process. Although there are various methods to calculate those weights, Fuzzy Analytic Hierarchy Process (FAHP) is the one used in this study.

2. DETERMINING STRATEGIES AND SSWOT

SWOT Analyses which are used in order to assess the determination of strategy as first step are the analyses of strength and weakness inflicted by insiders of establishment and opportunities and threats inflicted by outsiders. Internal analysis which comprises analysis of current situation looks into powerful aspects and aspects open to development (weak aspects) of the matter handled in order to determine strategy. This is the phase of looking at yourself in the mirror and recognizing yourself. This is also described as own assessment. External environmental analysis is the phase of determination of opportunities and threats

Superiorities (powerful aspects) of a corporation are the indications that would provide prominence out of its competitors and make the sector develop and advance. Accordingly, aspects open to development (weak aspects) are the indications that would complicate the life of corporation and make it decline. Opportunities are the indications that would develop the corporation, advance it from its present situation and provide favourable environmental benefit. Threats are the unfavourable environmental indications that would make the corporation decline from its present situation and even cause termination of life of it [2].

The sectional SWOT analysis term used by Karatop is defined by the author as follows. "The difference of the PGZFT analysis from the SWOT analysis is that SWOT analysis is not performed on only the determined general topic but performed on the sub-criteria constituting the main topic. Thus, the analysis is conducted in a very detailed way and the results obtained are more suitable for strategy determination. A key criterion is to analyze the strengths, weaknesses, opportunities and threats of the main measure to identify the strengths and weaknesses of each sub-creterion. We analyze the main criteria by analyzing the threats. As the main criterion is analyzed by subdividing the sub-criteria, more focused, specific results can be obtained. This method is also called the SSWOT"[14].

The definitions in Table 1 are below.

n= Number of Main Criteria

z= Number of Sub Criteria

M_n= n. Main Criteria

S_{nz}= z. Sub Criteria of n. Main Criteria

In a decision model using SSWOT, M_n n. and thus there are n main criteria. The number of sub-criteria may be different for each main criteria. That is, M_1 is the number of subcriteria a (S_{11}, S_{12}, ..., S_{1a}) for the main criterion, while subcriterion number b (S_{21}, S_{22}, ..., S_{2b}) for the M_2 criterion can be. The number of sub criteria for M_n main criteria is z (S_{n1}, S_{n2}, ..., S_{nz}).

In addition, the meaning of the 3 indices (S_{xyz}) in the SSWOT column is Strong, (S) weak (W), opportunity (O) and threats (T). The first number is the main criterion, the second number is the sub-criterion, and the third number is the sequence number. For example;

(S_{xyz}) means: the first digit is the main criterion; the second digit is the sub-criterion and the third digit is the sequence number. For example;

S_{235} is 2nd criterion of the 3rd sub-criterion 5. strength

W_{123} 1st criterion of 2nd sub-criterion 3. weakness

It's defined as SSWOT when SWOT analysis is made subject is divided into main and sub criteria (Table 1).

Table 1. Sectional SWOT

MAIN CRITERIA	SUB CRITERIA	SSWOT			
M_1	S_{11}	S_{111}	W_{111}	O_{111}	T_{111}
		S_{112}	W_{112}	O_{112}	T_{112}
		..	..	..	..
	S_{12}	S_{121}	W_{121}	O_{121}	T_{121}
		S_{122}	W_{122}	O_{122}	T_{122}
		..	..	..	..
	..	..	..	..	..
	S_{1a}	S_{1a1}	W_{1a1}	O_{1a1}	T_{1a1}
		S_{1a2}	W_{1a2}	O_{1a2}	T_{1a2}
		..	..	..	..
M_2	S_{21}	S_{211}	W_{211}	O_{211}	T_{211}
		S_{212}	W_{212}	O_{212}	T_{212}
		..	..	..	..
	S_{22}	S_{221}	W_{221}	O_{221}	T_{221}
		S_{222}	W_{222}	O_{222}	T_{222}
		..	..	..	..
	..	..	..	..	..
	S_{2b}	S_{2b1}	W_{1b1}	O_{1b1}	T_{1b1}
		S_{2b2}	W_{1b2}	O_{1b2}	T_{1b2}
		..	..	..	..
..	..	..	..	..	..
..	..	..	..	..	..
M_n	S_{n1}	S_{n11}	W_{n11}	O_{n11}	T_{n11}
		S_{n12}	W_{n12}	O_{n12}	T_{n12}
		..	..	..	..
	S_{n2}	S_{n21}	W_{n21}	O_{n21}	T_{n21}
		S_{n22}	W_{n22}	O_{n22}	T_{n22}
		..	..	..	..
	..	..	..	..	..
	S_{nz}	S_{nz1}	W_{nz1}	O_{nz1}	T_{nz1}
		S_{nz2}	W_{nz2}	O_{nz2}	T_{nz2}
		..	..	..	..

Hence, SWOT analysis is developed to Sectional SWOT analysis (SSWOT) and become more

effective in determining strategies. It is thought that sensitive and systematic results may be obtained when strategy is focued on with SSWOT.

3. APPLICATION

3.1. Turkish Automotive Sector

Automotive industry/sector adds great value to the economy as well as constitutes the base for technological improvements in Turkey like other countries in the World. Proportion of export revenue provided by automotive industry is very essential for economy of Turkey. Automotive industry/sector is selected as field of practice because of its specific status. All studies devoted to this sector are significant due to its great value-added.

It is noted in the strategic objective no.3 of strategic master plan of Ministry of Industry that the manufacture of technological products with great value-added are intended in order to revitalize the industry of the Country considering the priority of strategy of industry. Developing cooperation of university and industry, innovation, and increasing volume of R&D are mentioned in the aforesaid objective as well [15]. This sector has been gaining importance rapidly since great value-added technological products comprise automotive industry too as mentioned above.

Automotive industry takes part in policies and goals of strategic technologies of "information and communication technologies, mechatronics, production process and technologies, material technologies, energy" in the "2003-2023 Strategic Document" of National Policies of Science and Technology [15]. Significance of science and technology was indicated in the same document in order to reach 2023 Vision of Turkey and it were emphasized that this goal cannot be achieved with science and technology only. Necessity of transforming hegemony of science and technology into economic and social benefits i.e. transforming development of science and technology into products and services was put forward. Turkish automotive industry is 17th manufacturer of World and 7th of Europe [16]. Turkiye had taken 6th place in European automotive sales ranking in period of January-June 2013 [17].

Turkish automotive sub-industry increases both range of products (such range enables proportion of 85-90% domestic production of vehicles produced in Turkey) and the quality. This augments the competitiveness in international market as well as increases the export revenues [17, 18, 19, 20]. However, facts of clustering in sub-industry, without detailed inventory together with insufficient R&D and without paying necessary importance hinder sub-industry to get better situation.

3.2. Strategy Focused Model

SFM are described as follows with application.

SSWOT analysis prepared according to main and sub criteria effecting the decision as detailed in figure 1 constitute main frame of strategy focused model.

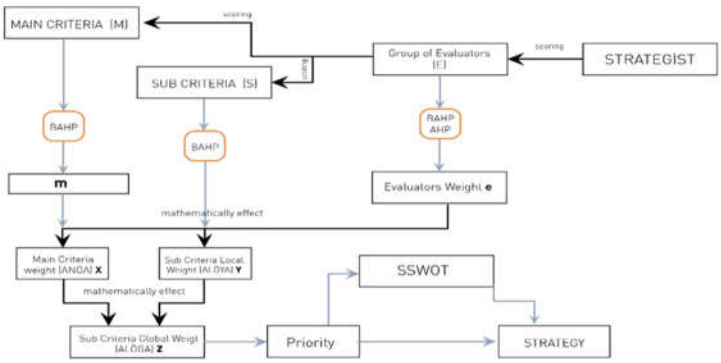

Figure 1. Strategy Focused Model

Strategy Focused Model (SFM) aims to provide the most optimal possible solutions to real-life problem that require multi-criteria decision-making. In Strategy Focused Model, the views of stakeholders and strategist are input into the decision-making process. The main criteria of a problem establish the mainframe of the model, and these criteria are utilized in SWOT analysis. Hence, SWOT analysis is developed to Sectional SWOT analysis (SSWOT) and become more effective in determining strategies. The model required to determine the weights of criteria and sub-criteria as well as the weights of stakeholder and strategist views. Thereafter, those weights enter into the decision-making process. Although there are various methods to calculate those weights, Fuzzy Analytic Hierarchy Process (FAHP) is the one used in this study. AHP is widely used in industrial applications and in policy planning and strategic planning [21, 22, 23]. At the same time, it was necessary to use the BAHP because linguistic expressions were used in evaluations.

Following to step of study strategy focused model;

STEP 1: Determination of main and sub criteria effecting of decision for production (of automobile)

5 main and 15 sub criteria has been determined effecting decision for production of automobile. (Table 2)

STEP 2: Performing SWOT analysis for sub-criteria determined for production (of Turkey patented cars.).

Reports of corporations and establishments efficient in determination of strategy in automotive industry have been examined and SWOT analysis has been evaluated (Table 2).

Table 2. SSWOT for Production of Automobile

MAIN CRITERIA	SUB-CRITERIA	S	W	O	T	Σ
The Society (S)	Education and culture of the society (E C S)	2	3	4	3	30
	Family structure and Economical Situation of the Society (F E S)	3	2	2	2	
	Perception and Expectation of the Society (P E S)	3	2	2	2	
Manufacture and Technology (M&T)	Labor force (L F)	3	2	3	1	70
	Production (P)	9	9	10	3	
	Technology and R&D (T R&D)	2	4	6	10	
	Design (D)	1	3	2	2	
Environment (EN)	Fuel Sensitive to Environment (F S E)	3	3	2	1	23
	Technology Sensitive to Environment (T S E)	2	2	2	2	
	Society Sensitive to Environment (S S E)	2	2	1	1	
Economy (EC)	Aspect of Manufacturer (A S)	3	1	3	1	23
	Aspect of Consumer (A C)	1	1	2	6	
	Economical Stability of the Country (E S C)	1	1	2	1	
Market (M)	Local Market (L M)	1	1	3	3	24
	Foreign Market F M)	5	3	5	3	
		41	**39**	**49**	**41**	**170**

STEP 3: Specifying group of evaluators and numbers.

Evaluator group and the numbers are determined as they are seen in Table 3.

k=Number of evaluator groups,

E_k = Evaluator group,

e_k= Importance rate of k evaluator group about the subject

STEP 4: Calculation of grade of reputation according to opinions of group of evaluators

Orders below were followed to find out the rates of evaluator groups.

- Surveys were prepared and applied that will provide the importance rates of the strategists' evaluator groups
- Survey datum were converted to the linguitic expressions and adapted to the comparison matrix.
- Consistency calculation was made and was paid attention to the rate of consistency be smaller than 0,1.
- Linguistic expressions were expressed with triangular fuzzy numbers. Linguistic expressions were added to the comparison matrix as “9, 7, 5, 3, 1” as cover to the “Very important, important, average, less important, equal”. Seven strategist surveys were calculated in the same way.
- FAHP was applied. But, within the procedure, minimum values were considered and evaluators' rates other than expert academician, manufacturer craft and and expert manufacturer were taken as '0'. When ordinary AHP was applied, values are very close to '0'. Evaluation rates of evaluator groups were calculated by ordinary AHP (Table 3).

STEP 5: Preparation of surveys

Survey was prepared to determine the importance degrees of main criteria with repsect to each other and the importance degrees of sub-crteria with respect to each other. The purpose of the survey is to determine the strategies to which we need to head. It is wanted from the evaluator groups to compare and contrast the importance degrees of main and sub-criteria.

STEP 6: Application of surveys

Survey was applied to 145 people, but; for 100 surveys were evaluated for the reasons such as, misfilling or high inconsistency rate of comparison matrix ın chart 6, only the evaluation of main criteria of the survey is seen. Other sub-criteria were evaluated similarly.

STEP 7: Transfer of linguistic expressions in data of surveys to matrixes

Datum from the surveys (Table 4) were adapted to the comparison matrix according to importance range in the Table 5.

Table 3. Evaluator group definitons and the numbers

	Evaluator Group (Ek)	Definiton	Survey	e_k
1	Expert Academicin (E A)	Academician who made studies about automotive or who has the competence to put forward an idea in his area	15	0,240672
2	Academician (A)	.Academicians who are aut of the definitions of Expert Academicians.	15	0,233202
3	Maufacturer Craft (M C)	An engineer or a technician who works in a car manufacturer company.	6	0,192356
4	Expert Employee (E E)	Employees who work in a position other than manufacturing in a car company.	6	0,077261
5	Technical Employee (T E)	An engineer or a technician who works in a company other than car manufacturing.	6	0,073398
6	Expert Manufacturer (E M)	Senior officials or owners of a car manucaturing company.	6	0,067983
7	Manufacturer (M)	Senior officials or owners of the companies other than car manufacturing	6	0,048406
8	Automobile Fancier Society (A F S)	Society which is intereted in and follows the news about automotive industry.	15	0,045364
9	Society (S)	Society which is out of the group of people who is intereted in and follows the news about automotive industry.	25	0,021358
		TOTAL	100	

Table 4. Survey for main criteria

MAIN CRITERIA	VI	I	A	LI	E	LI	A	I	VI	MAIN CRITERIA
The Society								X		M&T
The Society					X					EN
The Society									X	EC
The Society									X	M
M&T	X									EN
M&T							X			EC
M&T						X				M
EN									X	EC
EN									X	M
EC				X						M

Table 5. Importance Range

Importance Degree	Linguistic Expression
1	Both factors are equally important (E)
2	1st factor is less important than the 2nd factor (LI)
3	1st factor being averagely important with respect to 2nd factor (A)
4	1st factor is more important than the 2nd factor (I)
5	1st factor is very important than the 2nd factor (VI)

STEP 8: Classification of criteria according to groups of evaluators

Matrixes are divided into nine groups: Expert Academicin (EA), Academician (A), Maufacturer Craft (MC), Expert Employee (EE), Technical Employee (TE), Expert Manufacturer (EM), Manufacturer (M), Society (S), Automobile Fancier Society (AFS) (Table 6).

Table 6. Criteria' Number of Evaluations According to Evaluator Groups

MAIN CRITERIA		Comparison Matrix (CM)	S	M&T	EN	EC	M
SUB CRITERIA			CM	CM	CM	CM	CM
E A	90	15	15	15	15	15	15
A	90	15	15	15	15	15	15
M C	36	6	6	6	6	6	6
E E	36	6	6	6	6	6	6
T E	36	6	6	6	6	6	6
E M	36	6	6	6	6	6	6
M	36	6	6	6	6	6	6
A F S	90	15	15	15	15	15	15
S	150	25	25	25	25	25	25
TOTAL	**600**	**100**	**100**	**100**	**100**	**100**	**100**

These matrixes are divided into two more groups according to main an sub-criteria. This time 15 comparison matrixes of main criteria of expert academicians and 15 comparison matrixes of each sub-criteria of society, manufacture and technology, environment, market. Similarly, it is applied to all groups.

STEP 9: Score of consistency

Consistency calculation of sample survey is given below based on table 7 and table 8.

CI= 0,054237353

RI= 1,188

CR= 0,045654337

Table 7. Normalization Matrix and Rates for Main Criterion

	S	M&T	EN	EC	M		Wi
S	0,062	0,038	0,058	0,089	0,051		0,0601
M&T	0,25	0,155	0,294	0,149	0,128		0,1953
EN	0,062	0,031	0,058	0,089	0,051		0,0586
EC	0,312	0,465	0,294	0,447	0,512		0,4064
M	0,312	0,310	0,294	0,223	0,256		0,2793

In AHP, if consistency rate of dual comparison matrix is smaller than 0.1, inconsistency can be said acceptable. But, if it is bigger than 0.1,

inconsistency is unacceptable. In this situation, values related to the matrix is reviewed and changed appropriately. All these process is repeated for all new dual comparison matrixes. In application, main criteria dual comparison matrix rate was found 0,0456 ≤ 0.1. Dual comparison matrix is %95 consistent.

Table 8. Main Criterion Comparison Matrix and Rates

	S	M&T	EN	EC	M		W_i			
S	1	0,25	1	0,2	0,2		0,0601835		0,3048194	
M&T	4	1	5	0,33333	0,5		0,1953231		1,0044089	
EN	1	0,2	1	0,2	0,2	x	0,0586331	=	0,2950533	
EC	5	3	5	1	2		0,4064631		2,1453098	
M	5	2	5	0,5	1		0,2793972		1,467358	
	16	6,45	17	2,23333	3,9				5,2169494	N_{max}

STEP 10: Expression of linguistic expressions with triangular fuzzy numbers

Importance degree, which is defined in five levels in application, is expressed in Triangular Fuzzy Numbers.

Dual comparion matrix values which is converted from the linguistic expressions' importance degrees in table 9, are expressed with triangular fuzzy numbers in table 10 appropriately for the conversion of fuzzy importance degrees.

Table 9. Expressing The Linguistic Expressions with Triangular Fuzzy Numbers

Linguistic Expressions	Importance Degree (ID)	Fuzzy ID	Conjugate of Fuzzy ID
Equal (E)	1	(1, 1, 1)	(1, 1, 1)
Less Important (L I)	2	(1, 3, 5)	(1/5, 1/3, 1)
Average (A)	3	(3, 5, 7)	(1/7, 1/5, 1/3)
Important (I)	4	(5, 7, 9)	(1/9, 1/7, 1/5)
Very Important (V I)	5	(7, 9, 9)	(1/9, 1/9, 1/7)

Table 10. Main Criteria Dual Comparison Matrix

	S			M&T			EN			EC			M		
	L	M	u	L	M	u	L	m	u	L	m	u	L	m	u
S	1	1	1	0,1	0,1	0,2	1	1	1	0,1	0,1	0,1	0,1	0,1	0,1
M&T	5	7	9	1	1	1	7	9	9	0,1	0,2	0,3	0,2	0,3	1
EN	1	1	1	0,1	0,1	0,1	1	1	1	0,1	0,1	0,1	0,1	0,1	0,1
EC	7	9	9	3	5	7	7	9	9	1	1	1	1	3	5
M	7	9	9	1	3	5	7	9	9	0,2	0,3	1	1	1	1

STEP 11: Calculation of local weights of main criteria according to groups of evaluators

Matrixes, which are divided into nine evaluator groups, are reduced to one matrix by tehir geometric means. Rates are calculated in accordance with the fuzzy AHP procedure for all evaluator groups.

Main Criteria Local Weight matrix general structure is as in the table 11.

Table 11. Main criteria local weight matrix on the basis of evaluator group

	E_1	E_2	E_3	..	..	E_k
M_1	m_{11}	m_{12}	m_{13}	..	..	m_{1k}
M_2	m_{21}	m_{22}	m_{23}	..	..	m_{2k}
M_3	m_{31}	m_{32}	m_{33}	..	..	m_{3k}
..	..	..	..	..	..	..
..	..	..	..	..	..	..
M_n	m_{n1}	m_{n2}	m_{n3}	..	..	m_{nk}

When main criteria local weight chart is examined, main criteria of manufacture and technology is usually given importance by all evaluator groups (Table 12).

Table 12. Main criteria local weight on the basis of sample evaluator group

	E A	A	M C	E E	T E	E M	M	A F S	S
S	0,029	0,067	0,082	0,203	0,136	0,061	0,077	0	0,032
M&T	0,321	0,138	0,359	0,254	0,348	0,311	0,287	0,337	0,286
EN	0,105	0,243	0,087	0,166	0,399	0,217	0,073	0,032	0,131
EC	0,310	0,364	0,278	0,192	0,115	0,199	0,247	0,372	0,332
M&T	0,232	0,185	0,192	0,183	0	0,210	0,313	0,257	0,216
	1	1	1	1	1	1	1	1	1

STEP 12: Calculation of Main Criteria Local Weight

Main Criteria Local Weight (Main Criteria Local Weight- MACLOW) values are obtained by the multiplication of the weights which are determined by the evaluator groups (Table 13)

Table 13. MACLOW General calculation matrix

MACLOW	
X_1	$e_1 m_{11} + e_2 m_{12} + e_3 m_{13} + \ldots + e_k m_{1k}$
X_2	$e_1 m_{21} + e_2 m_{22} + e_3 m_{23} + \ldots + e_k m_{2k}$
X_3	$e_1 m_{31} + e_2 m_{32} + e_3 m_{33} + \ldots + e_k m_{3k}$
..	……
..	……
X_n	$e_1 m_{n1} + e_2 m_{n2} + e_3 m_{n3} + \ldots + e_k m_{nk}$

X_n= n. MACLOW value belonging to main criterium. MACLOW The sum of MACLOW values are one (1).

$$\sum_{i=1}^{n} Xi = 1 \qquad (1)$$

As it is seen in the application (Table 14), manufacture and technology main criterium is the most important with the share of 31 %. It is followed by economy main criterium with the share of 26 % and market main criterium with the share of 21 %. The sum of these three criteria' importance is 78 %.

Table 14. MACLOW Values calculated in application

	MACLOW
S	0,06915
M&T	0,31133
EN	0,147
EC	0,26233
M	0,21019
	1

STEP 13: Calculation of Local Weights According to Sub-Criteria Evaluator Groups

Calculations, which are made in step 12, are valid for sub-criteria too. 500 matrixes were applied fuzzy AHP procedure. As a result, local weight matrix is found for five main criteria.

STEP 14: Calculation of Local Weights of Sub-Criteria

Calculations, which are made in step 13, are valid for sub-criteria too.

Y_p= p. SUCLOW value belonging to sub-criterium. The sum of SUCLOW values are one **(2)**.

$$\sum_{i=1}^{p} Y = 1 \qquad (2)$$

SUCLOW values are calculated seperately for all the sub-criteria belonging to main criterium (Table 15). The sum of all the SUCLOW values (Y_p) are equal to the number of main criteria (3).

$$\sum_{I=1}^{N}\sum_{j=1}^{P} Y_{ij} = 1*n \qquad (3)$$

Table 15. SUCLOW General calculation matrix

SUCLOW	
Y_1	$e_1 s_{11} + e_2 s_{12} + e_3 s_{13} + \ldots + e_k s_{1k}$
Y_2	$e_1 s_{21} + e_2 s_{22} + e_3 s_{23} + \ldots + e_k s_{2k}$
Y_3	$e_1 s_{11} + e_2 s_{12} + e_3 s_{13} + \ldots + e_k s_{3k}$
..	……
..	……
Y_p	$e_1 s_{p1} + e_2 s_{p2} + e_3 s_{p3} + \ldots + e_k s_{pk}$

STEP 15: Calculation of Sub-criteria Global Weight (SUCGOW)

Sub-criteria Global Weight value is obtained by the multiplication of Sub-criteria local Weight and main criteria local Weight which it belongs (4).

SUCGOW = MACLOW * SUCLOW (4)

Z_{np}=n. Sub-criteria Global Weight (SUCGOW) value of the sub-criteria belonging to main criterium

$$Z_{np} = X_n * Y_{np} \qquad (5)$$

$$\sum_{İ=1}^{n}\sum_{j=1}^{P} X_i * Yij = 1 \qquad (6)$$

In table 16, the sum of SUCGOW values are 1, as it is seen in formula 6. Actually, SUCGOW value presents to us a classification that shows us which priority we need to head to.

STEP 16: Calculation of Priority Grades of Criteria:

SUCGOW values are converted into priority points in table 16. As it is seen in the chart, importance degrees of manufacture and technology and economy main criteria are high (33% and 26%).Same criteria are on the starting course for the sub criteria.

STEP 17: Ranking and focusing on SSWOT analysis

When seven values are taken in the classification sub-criteria belonging to four main criteria are involved (Table 17).

Table 16. Sample application SUCGOW value priority points

MAIN CRITERIA	SUB CRITERIA	MACLOW	SUCLOW	SUCGOW	PRIORITY POİNT
S		0,069147			
	E C S		0,289971	0,020051	2,01
	F E S		0,449333	0,03107	3,11
	P E S		0,260696	0,018026	1,8
M&T		0,311331			
	L F		0,131511	0,040944	4,09
	P		0,158275	0,049276	4,93
	T R&D		0,333165	0,103725	**10,37**
	D		0,377049	0,117387	**11,74**
EN		0,147004			
	F S E		0,379053	0,055722	5,57
	T S E		0,356467	0,052402	5,24
	S S E		0,26448	0,03888	3,89
EC		0,262328			
	A S		0,169963	0,044586	4,46
	A C		0,276306	0,072483	**7,25**
	E S C		0,553731	0,145259	**14,53**
M		0,21019			
	L M		0,485817	0,102114	**10,21**
	F M		0,514183	0,108076	**10,81**
		1		1	100

Table 17. Sample Application Priority Classification

Priority	MAIN CRITERIA	SUB CRITERIA	SUCGOW*100
1	Economy (EC)	Economical Stability of the Country (E S C)	14,53
2	Manufacture and Technology(M&T)	Design (D)	11,74
3	Market (M)	Foreign Market F M)	10,81
4	Manufacture and Technology(M&T)	Technology and R&D (T R&D)	10,37
5	Market (M)	Local Market (L M)	10,21
6	Economy (EC)	Aspect of Consumer (A C)	7,25
7	Environment (EN)	Fuel Sensitive to Environment (F S E)	5,57
8	Environment (EN)	Technology Sensitive to Environment (T S E)	5,24
9	Manufacture and Technology(M&T)	Production (P)	4,93
10	Economy (EC)	Aspect of Manufacturer (A S)	4,46
11	Manufacture and Technology(M&T)	Labor force (L F)	4,09
12	Environment (EN)	Society Sensitive to Environment (S S E)	3,89
13	The Society (S)	Family structure and Economical Situation of the Society (F E S)	3,11
14	The Society (S)	Education and culture of the society (E C S)	2,01
15	The Society (S)	Perception and Expectation of the Society (P E S)	1,8

STEP 18: Determining Strategy

SWOT analysis of economic stability sub-criterium which is in the first rank, is examined and these results are obtained. It is certain that car manufacture of a Turkish patented brand will contribute positively to the economic structure and aconomic stability of the country. Import of foregin brand cars raises the expectation of the consumer but makes a negative impact on the economy. For this reason, the new patented brand is ought to be more preferabl than the imported cars.

Design sub-criterium, which is of second priority, is an important factor of choosing a car. SWOT analysis of this sub-criterium is examined and these results are obtained. Lack of original design and foreign-source dependancy are present in the motor and drive-train technologies. Manufacturing abilities are need to be raised in this area.

For all the main criteria in the classification, analyses can be made by examining the sub-criteria SWOT analyses. Weaker links must be strenghtened.

4. CONCLUSION

The most prominent features of the real-life problems are multiple criteria, complexity and uncertainty. Benefiting from expert and stakeholder views help to reach optimal solutions of those problems. SFM aims to provide the most optimal possible (workable) solutions to real-life problem that require multi-criteria decision-making. In SFM, the views of stakeholders and strategist are input into the decision-making process. Model can be applied to all problems to focus on strategy.

The most obvious features of real life problems are multiple criteria, complexity and uncertainty. Utilizing expert and stakeholder views will help you achieve the best solutions to these problems. SFM aims to provide the most appropriate solutions to the real-life problem that requires

multi-criteria decision making. In SFM, the views of stakeholders and strategists are entered into the decision-making process. To focus the strategy, the model can be applied to all problems.

When the rankings of the criteria are examined, it is seen that the weight points of the first 5 are bigger than 10. While the consumer subcategories of the economy are in the 6th place with 7.25 points, scores of 5 and below continue from the 7th place in the Environmentally Sensitive Fuel subscale. The evaluator group was actually determined to be the first 5 sub measures, and the sixth criterion was undecided.

At the same time, it can be said that the measures after 7 are not too important. However, the 7th and 8th ranked environmental awareness is becoming increasingly important with the concept of sustainability, and it is borderline in terms of evaluation. For this reason, environmental sensitivity is taken into account as additional criteria for environmentally sensitive fuel and environmentally sensitive technology.

Taking the primary sub-criteria into consideration, the total score for each main criterion is calculated by summing the scores below the main criteria and the weight scores for each main criterion are about 22 points (or weight 0.22). The only environmental sensitivity is around 11 points (and weight 0.11). Strategies have been assessed for the first 8 criteria, which is about 76 points of the total criteria.

The four main criteria on establishing main strategy are the followings:

1. Manufacture and Technology

2. Economy

3. Market

4. Environment

Strategies are determined through the SSWOT analysis. The SSWOT analysis of the sub-criteria that are entered in the first sequence during each priority measure is examined.

Naturally, these criteria have strong and weak points, opportunities and threats associated with each other.

As an example, the "rapid development in the automotive sector", the "Economy" main measure is the opportunity on the subcriteria of " Aspect of Consumer on Economy"; The " Manufacture and Technology" main measure is threatened by the expression "rapid development in automobile design" on the sub-scale of "Design". In summary, rapid developments in the automotive sector naturally provide the development of automobile design. This presents a challenge as a threat to the opportunity for a subcriteria.

In the study, the strategy proposed was "to offer a suitable product to the market" and “to conduct field surveys involving cluster and consumer expectations with a common sense of four-way (ministries-university-industry-NGO)” in order to accomplish this. Thus, both consumer expectations will be determined and the direction to focus on design planning will be acquired.

When the 4 main criteria are evaluated, the common areas of intersecting strategies are formed. Therefeore strategies support and reinforce each other.

Strategies for the main criteria of " Manufacture and Technology ";

Strategy 1. The creation of "know-how" in design,

Strategy 2. It is proposed to provide state-level government support for R & D resources for TMPO production.

"Economy" is ranked second with 21.78 points as the main criterion and the proposed strategies are;

Strategy 3. Preparation of very detailed Action Plans that will contribute to the economic development of the country with the four-way (ministries-university-industry-NGO) collective intelligence (TMPO)

Strategy 4. It is proposed to conduct field surveys including three-way (ministries-university-industry) collective intelligence and cluster and consumer expectations.

The "market" got the main criterion 21.02 points and the proposed strategies were;

Strategy 5. Creation of very detailed external market action plans for the TMPO with the four-way (ministry-university-industry-NGO) Common Mindset,

Strategy 6. The state should produce policies to support TMPO production and to make legal arrangements.

According to this; "Sensitivity to the environment" received a total of 10,81 points in the 7th and 8th ranked sub-criteria. A single strategy for environmentally sensitive technology and environmentally sensitive fuel sub-criteria has

been identified and the recommended strategy for this;

Strategy 7. It is proposed that the environmentally sensitive technology design of TMPO production should be made using environmentally sensitive fuel.

As a result, in this study, SFM- Strategy Focused Model and SSWOT (Sectional SWOT) Analysis were developed and 2 field scientific contributions were made.

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