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An Integrated Approach with Group Decision-Making for Strategy Selection in SWOT Analysis

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Abstract

The main aim of this study was to improve the analytical dimension of SWOT (strengths, weaknesses, opportunities and threats) analysis with group decision-making, which underlines the analysis of internal and external environments that in turn, will improve the definition of corporate strategy within the strategic planning process. The main issue of the study was how to select the most appropriate strategy by taking into consideration different effects of each factor of SWOT analysis on strategy selection. The proposed model addresses strengths and opportunities as benefits and weaknesses and threats as costs. The model was solved with analytic network process (ANP) and fuzzy technique for order performance by similarity to ideal solution (TOPSIS) technique with group decision-making. The integrated ANP and Fuzzy TOPSIS model proposed at the end of the present study has been shown to be applicable to SWOT analysis and strategy selection.

Keywords: Strategic planning, SWOT analysis, Multi-criteria decision analysis, Group decision-making, ANP, Fuzzy TOPSIS

Introduction

SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis is one of the approaches used in the analysis of the strategic position of a company as part of the strategic planning process. The concept of SWOT analysis was introduced into the literature in the 1960s, following the work at the Business Policy School at Harvard Business School and American Business Schools (Hill & Westbrook, 1997). SWOT analysis enables identification of the strengths, weaknesses, opportunities and threats of a company (Dyson, 2004). In other words, SWOT analysis is the process of identifying the factors playing a key role in a company's success and interpreting these factors to serve as a basis for strategic decisions (Dinçer, 2004). According to SWOT analysis, the core of any strategy is to direct the resources and capabilities of a company to the external environmental opportunities of the company, because any opportunities emerging in the external environment are meaningless as long as the resources and capabilities of the company are insufficient. Therefore, the relationship between the company and environment in terms of strategic management refers to external environmental conditions and internal environment (resources and capabilities) factors (Dinçer, 2004).

Companies systematically arrange the information they obtain after analyzing internal (strengths and weaknesses) and external environmental (opportunities and threats) factors. Thus, they systematically organize, within a matrix, the opportunities and threats created by the external environment as well as the internal strengths and weaknesses offered by the resources and capabilities of the company. This matrix, developed at the end of the analysis to inform the strategic decisions of the company, includes SWOT group and factors (Ülgen & Mirze, 2007). A company identifies the possible strategies in light of the four SWOT groups produced by the matrix. These strategies are composed of different combinations of these SWOT groups (Houben, Lenie & Vanhoof., 1999; Dinçer, 2004). In this way, SWOT analysis is used as a method for the formulation of the company strategy (Dyson, 2004).

However, for the first time in the literature, Hill and Westbrook (1997) and Kurttila, Pesonen, Kangas, and Kajanus (2000) suggested that SWOT analysis, although widely used in the strategic planning process, has a set of analytical deficiencies. Some integrated studies have been conducted with multi-criteria decision-making techniques in order to eliminate these analytical and systematic deficiencies and to improve the effectiveness of SWOT analysis (Kurttila et al., 2000; Stewart, Mohamed & Daet, 2002; Kangas, Kurtila, Kajanus & Kangas, 2003; Shresta, Alavalpati & Kalmbacher, 2004; Masozera, Alavalpati, Jacobson & Shresta, 2006; Yüksel & Dağdeviren, 2007; Arslan & Er, 2008; Zaerpour, Rabbani, Gharehgozli, & Tavakkolil-Moghaddem, 2008).

The main analytical issues addressed by previous studies of SWOT can be listed as follows: The first issue is how to calculate SWOT group and factor weights. The studies pioneered by Kurttila et al. (2000) integrated SWOT analysis with specific techniques (Pesonen, Kurttila, Kangas, Kajanus & Heinonin, 2000; Stewart et al., 2002; Kangas et al., 2003; Shresta et al., 2004; Kajanus, Kangas & Kurttila, 2004; Masozera et al., 2006; Arslan & Er, 2008; Zaerpour et al., 2008) to show how to calculate SWOT group and factor weights quantitatively in a uni-directional hierarchical structure. The second issue is how to calculate SWOT group and factor weights in case of an interaction between SWOT groups and factors. In addition, analytical detection of the best strategy on the basis of SWOT factors is also an important issue. Yüksel & Dağdeviren (2007) proposed possible solutions to these issues. For this, they conducted a case study on how to select the best strategy on the basis of SWOT analysis, taking into consideration the interaction between SWOT groups and factors. The third issue is the difficulty of using definite numbers in complex and uncertain cases. In this scope, Zaerpour et al. (2008) assumed a uni-directional structure for SWOT groups and factors and applied a fuzzy AHP technique to define the relative importance of only the SWOT factors. Lu (2010) showed the applicability of SWOT analysis within the context of maximum sub array and fuzzy set theory in a study of an international construction company. However, the method of defining the preferred strategy on the basis of strengths, weaknesses, opportunities and threats was not addressed in that study. Ghazinoory, Zadeh & Memariani (2007) also used the fuzzy theory concept to examine the SWOT analysis in an Iranian food corporation. In their study, the optimal strategy area was determined based on internal and external factors. Internal factors were determined as strengths and weaknesses, and external factors as threats and opportunities. Also, the study did not provide definitions of strategies. Therefore, the approaches that provided the optimal strategy area are not known, and only a strategy area, geometrically based on internal and external factors, was determined.

Studies conducted to eliminate the deficiencies related to the measurement and evaluation dimension of SWOT analysis and to improve SWOT analysis in analytical terms have made remarkable contributions in the related literature; however, some issues remain unresolved. The first issue is that, despite their superiorities, AHP and ANP techniques may lead to some deficiencies in the case of some difficulties that potentially arise in SWOT analysis. For example, only up to nine alternatives or criterion may be evaluated in these techniques. In cases with more than nine SWOT factors or strategies, it is not possible to use AHP and ANP techniques. Another issue is that AHP and ANP techniques assume factors to have a homogenous structure. However, factors effective on strategy selection may have different structures and effects. For instance, within strengths, weaknesses, opportunities and threats, the factors have different effects in terms of realization of company performance and objectives; strengths and opportunities influence the company in a positive direction, whereas weaknesses and threats do so in a negative way. This situation has not been considered in previous studies within the literature. However, quantitative techniques used in SWOT analysis should have a structure that enables the consideration of both the negative effects of weaknesses and threats and the positive effects of strengths and opportunities.

The present study addresses the above-listed deficiencies with the TOPSIS (technique for order performance by similarity to ideal solution) method. TOPSIS does not limit the number of factors included in the model. Moreover, it enables evaluation of the factors as costs (negative) and benefits (positive). In addition, calculation weight encountered, when the alternatives are ordered according to AHP or ANP techniques, can possibly be minimized with TOPSIS.

In light of the information given above, the aim of this study was to prioritize and determine company strategies with the fuzzy TOPSIS technique, which depends on the strengths and weaknesses within the internal environment, and opportunities and threats of the external environment. The present study has used a fuzzy approach, as the factors serving as the basis for strategy selection generally have a vague and complex structure, and are therefore evaluated on the basis of data and information that may not be absolute and definite.

Methods

The ANP Method

The initial study identified the multi-criteria decision technique known as the AHP to be the most appropriate method for solving complicated problems. AHP was first introduced by Saaty (1980) and used in different decision-making process related to production (Dağdeviren & Eren, 2001; Bozdağ, Kahraman & Ruan, 2003; Büyüközkan, Ertay, Kahraman & Ruan, 2004), energy (Xiaohua & Zhenmin, 2002; Yedla & Shresta, 2003; Aras, Erdoğmus & Koc, 2004), investment (Tolga, Demircan & Kahraman, 2005), location (Kim, Lee & Lee, 1999; Kuo, Chi & Kao, 2002) and agricultural activities (Wolfslehner, Vecik & Lexer, 2005). AHP is a comprehensive framework that is designed to cope with the intuitive, the rational, and the irrational when we make multi-objective, multi-criterion, and multi-actor decisions, with or without certainty for any number of alternatives. An advantage of the AHP over other multi-criteria decision making methods is that AHP is designed to incorporate tangible as well as intangible criteria, especially, where the subjective judgments of different individuals constitute an important part of the decision process (Erdoğmuş, Aras & Koc, 2006). The basic assumption of AHP is the functional independence of an upper part or cluster of the hierarchy from all its lower parts, the criteria and items in each level. Many decision-making problems cannot be structured hierarchically because they involve the interaction and dependence of higher level elements on lower level elements (Saaty, 1996; Saaty & Takizawa, 1986). Structuring a problem involving functional dependence allows for feedback among clusters. This is a network system. Saaty suggested the use of AHP to solve the problem of independence on alternatives or criteria, and the use of ANP to solve the problem of dependence among alternatives or criteria (Yüksel & Dağdeviren, 2007).

The ANP, also introduced by Saaty, is a generalization of the analytic hierarchy process (AHP) (Saaty, 1996). Whereas AHP represents a framework with a uni-directional hierarchical AHP relationship, ANP allows for complex interrelationships among decision levels and attributes. The ANP feedback approach replaces hierarchies with networks in which the relationships between levels are not easily represented as higher or lower, dominant or subordinate, direct or indirect (Meade & Sarkis, 1998). For instance, not only does the importance of the criteria determine the importance of the alternatives as in a hierarchy, but also the importance of the alternatives may have impact on the importance of the criteria (Saaty, 1996). Therefore, a hierarchical structure with a linear top-to-bottom form is not suitable for a complex system. There are many studies in the literature using ANP to solve different decision making process (Ayağ & Özdemir, 2009; Lee, Lee & Park, 2009; Boran & Göztepe, 2010; Vinodh, Ramiya & Gautham, 2011).

The process of ANP involves three substeps and is shown as follows (Shyur, 2006):

Step 1: Without assuming the interdependence among criteria, the decision makers are asked to evaluate all proposed criteria pairwise. They responded questions such as: “*which criteria should be emphasized more, and how much more*?” The responses were presented numerically and scaled on the basis of Saaty’s 1-9 scale (Table 1). Each pair of criteria is judged only once. A reciprocal value will be automatically assigned to the reverse comparison. Once the pairwise comparisons are completed, the local weight vector w_1 is computed as the unique solution to

$$\boldsymbol{A}w_1 = \lambda_{max} w_1 \quad (1)$$

where λ_{max} is the largest Eigen value of pairwise comparison matrix $\boldsymbol{A}$. The obtained vector is further normalized by dividing each value by its column total to represent the normalized local weight vector w_2.

Table 1: Saaty's 1-9 scale for AHP (Saaty, 1996)

Intensity of importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate importance	experience and judgment slightly favor one over another
5	Strong importance	experience and judgment strongly favor one over another
7	Very strong importance	activity is strongly favored and its dominance is demonstrated in practice
9	Absolute importance	importance of one over another affirmed on the highest possible order
2,4,6,8	Intermediate values	used to represent compromise between the priorities listed above
Reciprocal of above non-zero numbers	if activity *i* has one of the above non-zero numbers assigned to it when compared with activity *j*, then *j* has the reciprocal value when compared with *i*	

Step 2: Next to resolve the effects of the interdependence that exists between the evaluation criteria. The decision makers examine the impact of all the criteria on each other by using pairwise comparisons as well. Questions such as: "*which criterion will influence criterion 1 more: criterion 2 or criterion 3 and how much more*?" are answered. Various pairwise comparison matrices are formed for each of the criterion. These pairwise comparison matrices are needed to identify the relative impacts of criteria interdependent relationships. The normalized principal Eigen vectors for these matrices are calculated and shown as column component in interdependence weight matrix of criteria B, where zeros are assigned to the Eigen vector weights of the criteria from which a given criterion is given.
Step 3: Now we can obtain the interdependence weights of the criteria by synthesizing the results from previous two steps as follows:

$$w_c = Bw_2^T. \qquad (2)$$

The Fuzzy TOPSIS Method

The TOPSIS (technique for order performance by similarity to ideal solution) was first developed by Hwang and Yoon (1981). According to this technique, the best alternative would be the one that is nearest to the positive ideal solution and farthest from the negative ideal solution (Ertuğrul & Karakasoğlu, 2007). The positive ideal solution is a solution that maximizes the benefit criteria and minimizes the cost criteria, whereas the negative ideal solution maximizes the cost criteria and minimizes the benefit criteria (Wang & Elhag, 2006). In short, the positive ideal solution is composed of all the best values attainable from the criteria, whereas the negative ideal solution consists of all the worst values attainable from the criteria (Wang, 2008). There have been lots of studies in the literature using TOPSIS for the solution of MCDM problems (Lai, Liu & Hwang, 1994; Chen, 2000; Chu, 2002; Chu & Lin, 2002; Wang, Liu & Zang, 2005). Despite its popularity and simplicity in the concept, this method is often criticized for its inability to adequately handle the inherent uncertainty and imprecision associated with the mapping of the decision-maker's perception to crisp values. In the traditional formulation of the TOPSIS, personal judgments are represented with crisp values. However, in many practical cases, the human preference model is uncertain and decision-makers might be reluctant or unable to assign crisp values to the comparison judgments (Chan & Kumar, 2007). Having to use crisp values is one of the problematic points in the crisp evaluation process. One reason is that decision-makers usually feel more confident to give interval judgments rather than expressing their judgments in the form of single numeric values. As some criteria are difficult to measure by crisp values, they are usually neglected during the evaluation. Another reason is mathematical models that are based on crisp value. These methods cannot deal with decision-makers' ambiguities, uncertainties and vagueness which cannot be handled by crisp values. The use of fuzzy set theory (Zadeh, 1965) allows the decision-makers to incorporate unquantifiable information, incomplete information, non-obtainable information and partially ignorant facts into decision model (Kulak, Durmusoglu & Kahraman, 2005). As a result, fuzzy TOPSIS and its extensions are developed to solve ranking and justification problems (Yong, 2006; Wang & Elhag, 2006; Yang & Hung, 2007; Kahraman, Büyüközkan & Ates, 2007; Büyüközkan, Feyzioğlu & Nebol, 2008; Önüt & Soner, 2008; Chen & Tsao, 2008).

This study uses triangular fuzzy number for fuzzy TOPSIS. The reason for using a triangular fuzzy number is that it is intuitively easy for the decision-makers to use and calculate. In addition, modeling that is using triangular fuzzy numbers has proven to be an effective way for formulating decision problems where the information available is subjective and imprecise (Zimmermann, 1996; Chang & Yeh, 2002; Kahraman, Beşkese & Ruan, 2004; Chang, Chung & Wang, 2007). In practical applications, triangular form of the membership function is used most often for representing fuzzy numbers (Karsak & Tolga, 2001; Ding & Liang, 2005; Kahraman et al., 2004; Xu & Chan, 2007). In the following, some basic important definitions of fuzzy sets are given (Zimmermann, 1996; Chen, 1996; Raj & Kumar, 1999; Cheng & Lin, 2002; Chen, Lin & Huang., 2006; Wang & Chang, 2007; Önüt & Soner, 2008).

Definition 1: A fuzzy set $\tilde{A}$ in a universe of discourse *X* is characterized by a membership function $\mu_{\tilde{A}}(x)$ which associates with each element x in X, a real number in the interval [0, 1]. The function value $\mu_{\tilde{A}}(x)$ is termed as the grade of membership of x in $\tilde{A}$.

Definition 2: A triangular fuzzy number $\tilde{a}$ can be defined by a triplet (a_1, a_2, a_3) shown in Figure 1. The membership function $\mu_{\tilde{a}}(x)$ is defined as Eq. (3).

$$\mu_{\tilde{a}}(x)=\begin{cases}0, & x<a_1\\ \dfrac{x-a_1}{a_2-a_1}, & a_1\le x\le a_2\\ \dfrac{x-a_3}{a_2-a_3}, & a_2\le x\le a_3\\ 0, & x>a_3\end{cases} \qquad (3)$$

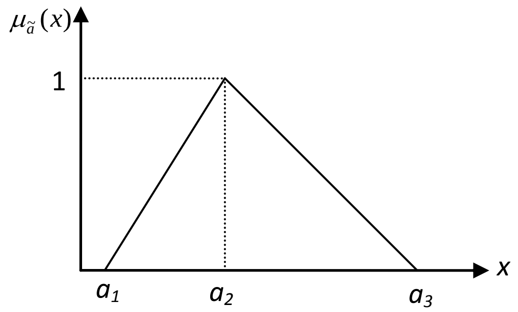

Figure 1: Triangular fuzzy number $\tilde{a}$

Let $\tilde{a}$ and $\tilde{b}$ be the two triangular fuzzy numbers parameterized by the triplet (a_1, a_2, a_3) and (b_1, b_2, b_3) respectively, then 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) (4)

$\tilde{a}\,(-)\,\tilde{b}$ = (a_1,a_2,a_3) (-) (b_1,b_2,b_3) = (a_1- b_3, a_2-b_2, a_3-b_1) (5)

$\tilde{a}\,(\times)\,\tilde{b}$ = (a_1,a_2,a_3) (×) (b_1,b_2,b_3) = (a_1.b_1, a_2.b_2, a_3.b_3) (6)

$\tilde{a}\,(/)\,\tilde{b}$ = (a_1,a_2,a_3) (/) (b_1,b_2,b_3) = (a_1/b_3, a_2/b_2, a_3/b_1) (7)

$k.\ \tilde{a}$ = (ka_1, ka_2, ka_3) (8)

Definition 3: A linguistic variable is a variable values of which are in linguistic terms (Zadeh, 1975; Chen, 2000). The concept of linguistic variable is very useful in dealing with situations which are too complex or too ill-defined to be reasonably described in conventional quantitative expressions (Zadeh, 1975; Chen, 2000). For example, “weight” is a linguistic variable; its values are very low, low, medium, high, very high, etc. These linguistic values can also be represented by fuzzy numbers.

Definition 4: Let $\tilde{a}=$(a_1, a_2, a_3) and $\tilde{b}=$(b_1, b_2, b_3) be two triangular fuzzy numbers, then the vertex method is defined to calculate the distance between them as Eq. (9).

$$d(\tilde{a},\tilde{b})=\sqrt{\frac{1}{3}\left[(a_1-b_1)^2+(a_2-b_2)^2+(a_3-b_3)^2\right]} \qquad (9)$$

Definition 5: Considering the different importance values of each criterion, the weighted normalized fuzzy-decision matrix is constructed as Eq. (10).

$\tilde{V}=[\tilde{v}_{ij}]_{n\times J}$, *i*= 1, 2,…,*n*, *j*=1, 2,…,*J* (10)

Where

- $\tilde{v}_{ij}=\tilde{x}_{ij}\times w_i$

- A set of performance ratings of A_j (j=1,2,…,J) with respect to criteria C_i (i=1,2,…,n) is called $\tilde{X} = \{\tilde{x}_{ij}, i = 1,2,...,n, J = 1,2,..., J\}$.
- A set of importance weights of each criterion w_i (i=1, 2,…,n).

According to briefly summarized fuzzy theory above, fuzzy TOPSIS steps can be outlined as follows (Önüt & Soner, 2008):
Step 1: Choose the linguistic values $(\tilde{x}_{ij}, i = 1,2,...,n, J = 1,2,..., J)$ for alternatives with respect to criteria. The fuzzy linguistic rating $(\tilde{x}_{ij})$ preserves the property that the ranges of normalized triangular fuzzy numbers belong to [0, 1]; thus, there is no need for normalization.
Step 2: Calculate the weighted normalized fuzzy decision matrix. The weighted normalized value $\tilde{v}_{ij}$ will be calculated by Eq. (10).
Step 3: Identify positive ideal (A^*) and negative ideal (A^-) solutions. The fuzzy positive-ideal solution (FPIS, A^*) and the fuzzy negative-ideal solution (FNIS, A^-) are shown in the following equations:

$$A^* = \{\tilde{v}_1^*, \tilde{v}_2^*, ..., \tilde{v}_i^*\} = \left\{\left(\max_j v_{ij} \middle| i \in I'\right), \left(\min_j v_{ij} \middle| i \in I''\right)\right\}, \quad i = 1,2,...,n \quad j = 1,2,..., J \tag{11}$$

$$A^* = \{\tilde{v}_1^-, \tilde{v}_2^-, ..., \tilde{v}_i^-\} = \left\{\left(\min_j v_{ij} \middle| i \in I'\right), \left(\max_j v_{ij} \middle| i \in I''\right)\right\}, \quad i = 1,2,...,n \quad j = 1,2,..., J \tag{12}$$

Where I' is associated with benefit criteria and I'' is associated with cost criteria.
Step 4: Calculate the distance of each alternative from A^* and A^- using the following equations:

$$D_j^* = \sum_{j=1}^{n} d(\tilde{v}_{ij}, \tilde{v}_i^*) \qquad j = 1,2,..., J \tag{13}$$

$$D_j^- = \sum_{j=1}^{n} d(\tilde{v}_{ij}, \tilde{v}_i^-) \qquad j = 1,2,..., J\,. \tag{14}$$

Step 5: Calculate similarities to ideal solution.

$$CC_j = \frac{D_j^-}{D_j^* + D_j^-} \qquad j = 1,2,...J\,. \tag{15}$$

Step 6: Rank preference order. Choose an alternative with maximum CC_j^* or rank alternatives according to CC_j^* in descending order.

The Proposed Integrated Model for SWOT Analysis

The proposed integrated model for SWOT analysis consists of three basic stages: (1) Identify the SWOT sub-factors and alternative strategies to be used in the model, (2) ANP computations, (3) Evaluation of alternative strategies with fuzzy TOPSIS and determination of the final rank.

In the first stage, alternative strategies and the SWOT sub-factors, which will be used in their evaluation, are determined and the decision hierarchy is formed. Integrated model is structured such that the goal is in the first level, SWOT factors are in the second level with inner dependences, SWOT sub-factors are in the third level and alternative strategies are on the last level. In the last step of the first stage, the decision hierarchy is approved by decision making team. After the approval of decision hierarchy, SWOT factor weights were calculated with the ANP technique. Firstly, assume that there is no dependence among the SWOT factors; determine the importance degrees of the SWOT factors with a 1-9 scale. These weights were then multiplied by the inner dependence matrix, developed with analysis of the inner dependence among SWOT factors, in order to obtain the interdependent weights of the SWOT factors. Next, SWOT sub-factors used in strategy evaluation are assigned weights using Saaty's 1-9 scale in the second stage. In this phase, pairwise comparison matrices are formed to determine the sub-factors weights. The experts from decision making team make individual evaluations using the scale provided in Table 1, to determine the values of the elements of pairwise comparison matrices. Computing the geometric mean of the values obtained from individual evaluations, a final pairwise comparison matrix, on which there is a consensus, is found. The weights of the sub-factors are calculated based on this final comparison matrix. In the last step of this phase, calculated weights of the sub-factors are approved by expert team. Alternative strategies ranks are determined by using fuzzy TOPSIS method in the third stage. Linguistic values are used for evaluation of alternative strategies in this step. The membership functions of these linguistic values are shown at Figure 2, and the triangular fuzzy numbers related with these variables are shown at Table 2.

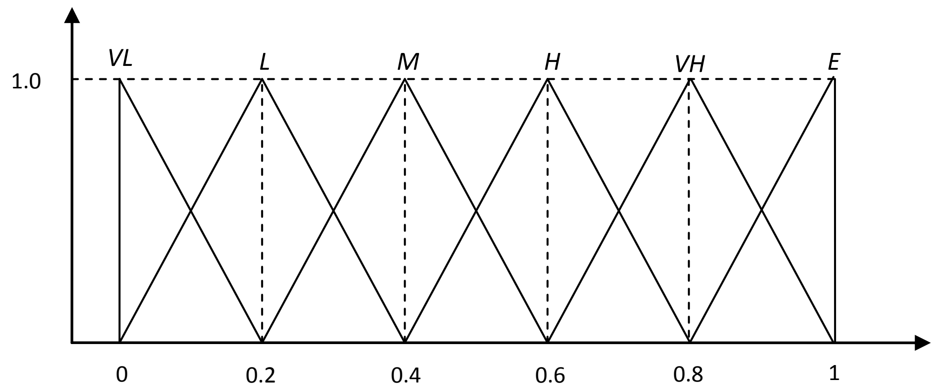

Figure 2: Membership functions of linguistic values for criteria rating

Table 2: Linguistic values and fuzzy numbers

Linguistic values	Fuzzy numbers
Very low (VL)	(0,0,0.2)
Low (L)	(0,0.2,0.4)
Medium (M)	(0.2,0.4,0.6)
High (H)	(0.4,0.6,0.8)
Very high (VH)	(0.6,0.8,1)
Excellent (E)	(0.8,1,1)

The strategy having the maximum CC_j^* value is determined as the best strategy according to the calculations by Fuzzy TOPSIS. Ranking of the other strategies is determined according to

CC_j^* in descending order. Schematic diagram of the proposed integrated model for SWOT analysis is provided in Figure 3.

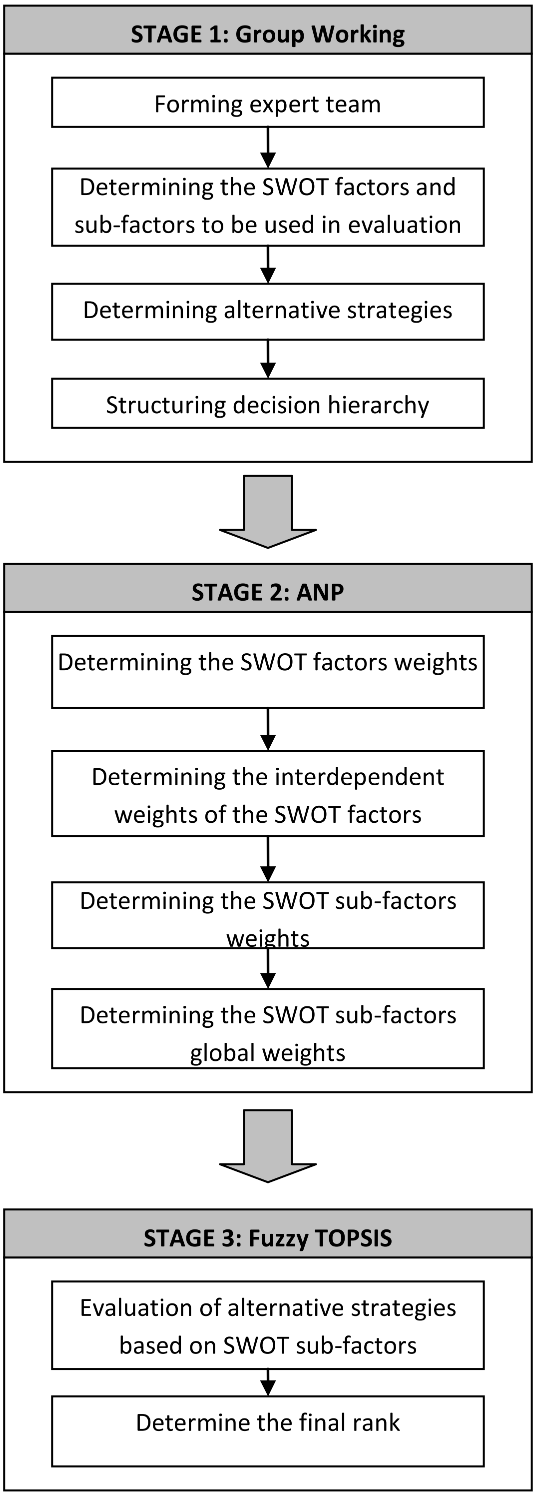

Figure 3: Schematic diagram of the proposed integrated model for SWOT analysis

A Numeric Application of Proposed Model

The proposed model was applied according to the stages given in Figure 3. The model was applied to the case of a metal company who was producing and exporting durable consumer goods in Turkey.

Group working

For the application, an expert team was formed from three junior managers of the firms and the authors of this paper. The alternative strategies, SWOT factors and SWOT sub-factors to be used in the model were determined by the expert team. Pairwise comparison matrices used to calculate criteria weights were also formed by the same team. An external environment analysis is performed with an expert team familiar with the operation of the organization. In this way, SWOT factors, which affect the success of the organization but cannot be controlled by the organization, are identified. In addition, an internal analysis is performed to determine the factors which, again, affect the success of the organization but can be controlled by the organization.

The strengths and weaknesses used in the internal environmental analysis and opportunities and threats used in the external environmental analysis of the company were defined as the SWOT factors. SWOT sub-factors, on the other hand, were defined with detailed analysis made on the basis of each factor; A set of 6 sub-factors were defined for strengths, weaknesses and threats factors and 4 sub-factors for the opportunities factor. Table 3 summarizes the SWOT factors and sub-factors defined with internal and external analysis of the company.

Table 3: SWOT factors and sub-factors

Strengths (S)	**Weaknesses (W)**
Strengths sub-factors: S1- manufacturing according to market demand S2- customer loyalty S3- organizational commitment of workers S4- skills of the management S5- organizational knowledge accumulation S6- the manufacturing technology used	*Weaknesses sub-factors*: W1-deficient capital structure W2- requirement for qualified workers W3- inadequate advertising W4- incomplete capacity use W5- excessive indebtedness W6- cost of borrowing
Opportunities (O)	**Threats (T)**
Opportunities sub-factors: O1- abolishment of visa with neighbor country O2- increase in domestic consumption O3- loan offer O4- proposal of partnership	*Threats sub-factors*: T1- political conflicts in Turkey T2- excessively low exchange rates T3- negative development in the Middle East T4- excessively high real interest rates

	T5- cost of energy T6- Unstability in input costs

In the following stage, SWOT factors and sub-factors which were defined with internal and external environmental analysis; these were then taken into consideration in developing alternative strategies for the company. At the end of this process, the following alternative strategies were developed for the company:

- increasing seller's margin of profit (A1)
- discarding the activities which do not produce value (A2)
- making effective advertising activities (A3)
- decreasing labor costs (A4)
- selling out unused immovables (A5)
- decreasing the margin of profit (A6)
- outsourcing for after-sales service (A7)

Decision hierarchy structured with the determined SWOT factors, sub-factors and alternative strategies is provided in Figure 4.

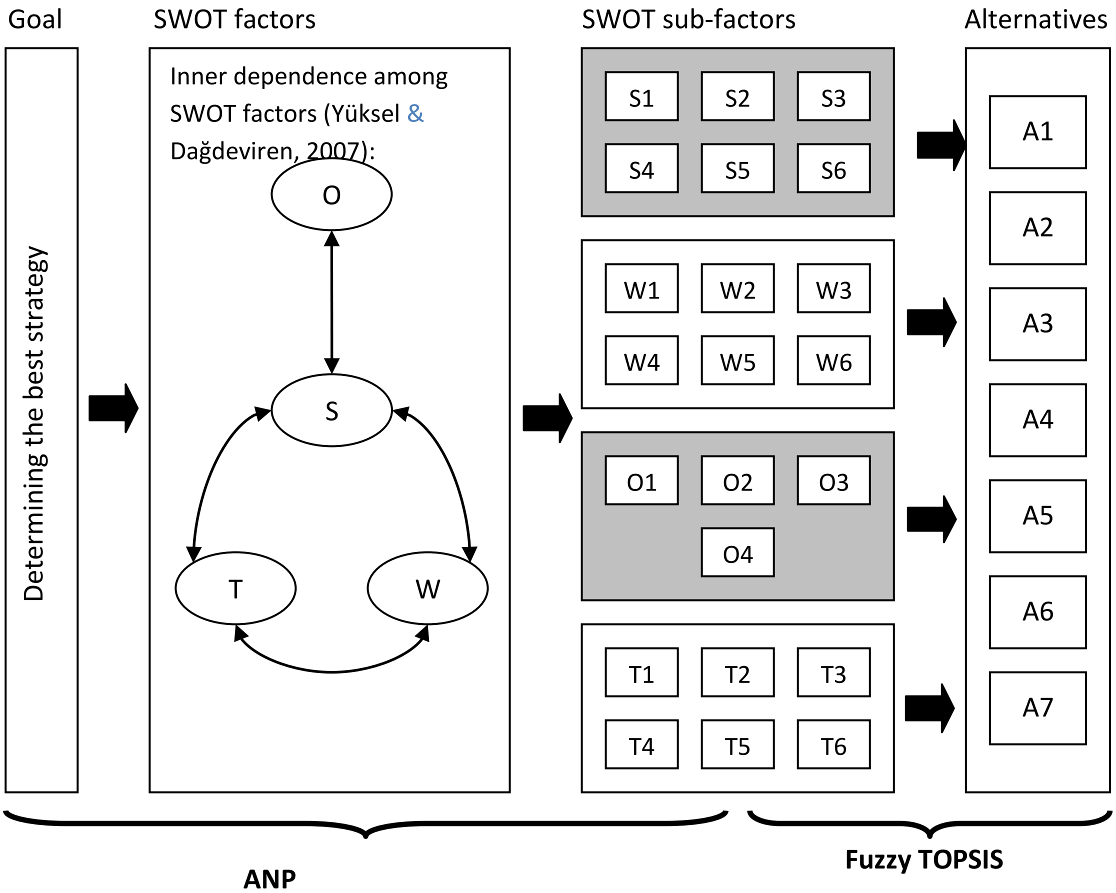

Figure 4: Decision hierarchy for proposed model

There are four levels in the decision hierarchy structured for SWOT analysis. The overall goal of the decision process determined as "*determining the best strategy*" is in the first level of the hierarchy. SWOT factors are placed at the second level of the hierarchy. In the introduction section of this study, declaration was made that it is not always possible to assume SWOT factors to be independent and to substitute the strategies subsequently. It is claimed that more appropriate and realistic results can be obtained by using both SWOT analysis and ANP technique (Yüksel & Dağdeviren, 2007). According to the analysis of both internal and external environments of the organization, the dependencies among the SWOT groups, which are presented schematically in Figure 4 (level 2), are determined. SWOT sub-factors are placed at the third level of the hierarchy. At this level, strengths and opportunities sub-factors were evaluated as benefit factors while weaknesses and threats sub-factors were regarded as cost factors. The fourth level of the hierarchy includes alternative strategies offered for the company. The second level of the decision hierarchy shows the ANP process performed to calculate the dependent weights of the SWOT factors, while the third and fourth levels show the fuzzy TOPSIS process evaluating alternatives according to SWOT sub-factors.

ANP Calculation

Firstly, assume that there is no dependence among the SWOT groups, the pairwise comparison of the SWOT groups, by using 1-9 scale, is made with respect to the goal. The comparison results are as shown in Table 4. The pairwise comparison matrix, given in Table 4, is analyzed by using Expert Choice software and the weights are obtained. In addition, the consistency ratio (CR) is provided in the last row of the matrix.

Table 4: Pairwise comparison of SWOT factors by assuming that there is no dependence among them

	S	W	O	T	Weights
S	1.0	1/2	2	1/2	0,191
W	2	1.0	3	1/2	0,300
O	½	1/3	1.0	1/2	0,126
T	2	2	2	1.0	0,383

CR=0.05

According to the inner dependencies presented in Figure 4 (level 2), pairwise comparison matrices are formed for the groups (Tables 5-7). The following question may arise in pairwise comparisons: "*What is the relative importance of strengths when compared with threats on controlling weaknesses?*" resulting in 9 (absolute importance) as denoted in Table 6. The weights obtained from Tables (5-7) are presented in the last columns of Tables (5-7).

Table 5: The inner dependence matrix of the SWOT factors with respect to "Strengths"

Strengths	W	O	T	Weights
Weaknesses (W)	1	1/9	1/4	0.068
Opportunities (O)		1	3	0.681
Threats (T)			1	0.249

CR= 0.00

Table 6: The inner dependence matrix of the SWOT factors with respect to "Weaknesses"

Weaknesses	S	T	Weights
Strengths (S)	1	9	0.900
Threats (T)		1	0.100

CR=0.000

Table 7: The inner dependence matrix of the SWOT factors with respect to "Threats"

Threats	S	W	Weights
Strengths (S)	1	6	0.857
Weaknesses (W)		1	0.142

CR=0.00

Using the computed weights, the inner dependence matrix of the SWOT groups is formed. As opportunities are affected only from the Strengths, no pairwise comparison matrix is formed for this group.

$$\begin{bmatrix} 1.000 & 0.900 & 1.000 & 0.857 \\ 0.068 & 1.000 & 0.000 & 0.142 \\ 0.681 & 0.000 & 1.000 & 0.000 \\ 0.249 & 0.100 & 0.000 & 1.000 \end{bmatrix}$$

The interdependent weights of the SWOT factors are calculated as follows:

$$w = \begin{bmatrix} S \\ W \\ O \\ T \end{bmatrix} = \begin{bmatrix} 1.000 & 0.900 & 1.000 & 0.857 \\ 0.068 & 1.000 & 0.000 & 0.142 \\ 0.681 & 0.000 & 1.000 & 0.000 \\ 0.249 & 0.100 & 0.000 & 1.000 \end{bmatrix} \times \begin{bmatrix} 0.191 \\ 0.300 \\ 0.126 \\ 0.383 \end{bmatrix} = \begin{bmatrix} 0.457 \\ 0.184 \\ 0.129 \\ 0.230 \end{bmatrix}$$

After, the determined interdependent weights of the SWOT factors, the local weights of SWOT sub-factors are calculated with the pairwise comparison matrix (Table 8-11).

Table 8: The pairwise comparison matrix for Strengths sub-factors

	S1	S2	S3	S4	S5	S6	Weights
S1	1.0	2	1/2	1/2	1/3	1/3	0,089
S2	½	1.0	1/3	1/4	1/4	1/2	0,057
S3	2	3	1.0	1/4	1/2	2	0,152
S4	2	4	4	1.0	1/2	3	0,269
S5	3	4	2	2	1.0	3	0,310
S6	3	2	1/2	1/3	1/3	1.0	0,123

CR=0.06

Table 9: The pairwise comparison matrix for Weaknesses sub-factors

	W1	W2	W3	W4	W5	W6	Weights
W1	1.0	6	5	3	4	2	0,362
W2	1/6	1.0	2	1/4	1/3	1/6	0,053
W3	1/5	½	1.0	1/5	1/3	1/4	0,044
W4	1/3	4	5	1.0	2	2	0,213
W5	¼	3	3	½	1.0	1/5	0,101
W6	1/2	6	4	1/2	5	1.0	0,227

CR=0.07

Table 10: The pairwise comparison matrix for Opportunities sub-factors

	O1	O2	O3	O4	Weights
O1	1.0	4	3	2	0,458
O2	1/4	1.0	3	1/2	0,166
O3	1/3	1/3	1.0	1/4	0,091
O4	1/2	2	4	1.0	0,286

CR=0.07

Table 11: The pairwise comparison matrix for Threats sub-factors

	T1	T2	T3	T4	T5	T6	Weights
T1	1.0	4	3	2	3	4	0,333
T2	¼	1.0	1/4	1/3	1/2	2	0,073
T3	1/3	4	1.0	1/4	2	4	0,168
T4	½	3	4	1.0	3	4	0,269
T5	1/3	2	½	1/3	1.0	2	0,103
T6	1/4	½	1/4	1/4	1/2	1.0	0,054

CR=0.06

At the final step of this stage, the global weights of SWOT sub-factors are calculated. Global weights of SWOT sub-factors are calculated by multiplying the interdependent weights of

SWOT groups with the local weights of SWOT sub-factors. The computations are provided in Table 12.

Table 12: Global weights of the SWOT sub-factors

Factors	Factors Weights	Sub-factors	Sub-factors weights	Global weights
S	0,457	S1	0,089	0,041
		S2	0,057	0,026
		S3	0,152	0,069
		S4	0,269	0,123
		S5	0,310	0,142
		S6	0,123	0,056
W	0,184	W1	0,362	0,067
		W2	0,053	0,009
		W3	0,044	0,008
		W4	0,213	0,039
		W5	0,101	0,019
		W6	0,227	0,042
O	0,129	O1	0,458	0,059
		O2	0,166	0,021
		O3	0,091	0,012
		O4	0,286	0,037
T	0,230	T1	0,333	0,076
		T2	0,073	0,017
		T3	0,168	0,039
		T4	0,269	0,062
		T5	0,103	0,024
		T6	0,054	0,012

Fuzzy TOPSIS Calculation

At this stage of the decision procedure, the team members were asked to establish the decision matrix by comparing alternative strategies under each of the SWOT sub-factors separately. Fuzzy Evaluation Matrix established by the evaluation of alternative strategies by linguistic variables in Table 2, is presented in Table 13. Linguistic variables are in the upper section of Table 13, the lower section is composed of the triangular fuzzy numbers which are equivalent of Linguistic variables.

After the fuzzy evaluation matrix was determined, the second step is to obtain a fuzzy weighted decision table. Using the criteria weights calculated by ANP (Table 12) in this step, the Weighted Evaluation Matrix is established with Eq. (10). The resulting fuzzy weighted decision matrix is shown in Table 14. According to Table 14, it is seen that the elements $\tilde{v}_{ij}$, $\forall i, j$ are normalized positive triangular fuzzy numbers and their ranges belong to the closed interval [0, 1]. Thus, we can define the fuzzy positive-ideal solution (FPIS, A^*) and the fuzzy negative-ideal solution (FPIS, A^-) as $\tilde{v}_i^* = (1,1,1)$ and $\tilde{v}_i^- = (0,0,0)$ for benefit criterion, and $\tilde{v}_i^* = (0,0,0)$ and $\tilde{v}_i^- = (1,1,1)$ for cost criterion. In this problem, weaknesses and threats sub-factors are cost sub-factors whereas strengths and opportunities sub-factors are benefit sub-factors. The distance of each alternative from D^* and D^- can be currently calculated using Eq. (13) and Eq. (14). The next step solves the similarities to an ideal solution by Eq. (15) (Yang & Hung, 2007).

Table 13: Fuzzy evaluation matrix for the alternative strategies

	S1	S2	S3	S4	S5	S6	W1	W2	W3	W4	W5
*A*1	Very low	Excellent	Low	Low	Medium	Medium	Very low	Medium	Excellent	High	Low
*A*2	Excellent	High	Low	Very high	Excellent	Very high	Excellent	Excellent	Very high	Very high	Excellent
*A*3	Very high	Very high	Low	High	Very high	High	Medium	Low	Excellent	Medium	Low
*A*4	Very high	Very high	Medium	Very high	High	Medium	Very high	High	Medium	Very high	Very high
*A*5	Low	Medium	Low	Medium	Medium	Medium	Excellent	Very low	Low	High	High
*A*6	Excellent	Excellent	Medium	Very high	High	High	Very low	Low	Very low	Very high	Very high
*A*7	Medium	High	Medium	Medium	Very high	Excellent	High	Excellent	High	Medium	Medium
*A*1	(0,0,0.2)	(0.8,1,1)	(0,0.2,0.4)	(0,0.2,0.4)	(0.2,0.4,0.6)	(0.2,0.4,0.6)	(0,0,0.2)	(0.2,0.4,0.6)	(0.8,1,1)	(0.4,0.6,0.8)	(0,0.2,0.4)
*A*2	(0.8,1,1)	(0.4,0.6,0.8)	(0,0.2,0.4)	(0.6,0.8,1)	(0.8,1,1)	(0.6,0.8,1)	(0.8,1,1)	(0.8,1,1)	(0.6,0.8,1)	(0.6,0.8,1)	(0.8,1,1)
*A*3	(0.6,0.8,1)	(0.6,0.8,1)	(0,0.2,0.4)	(0.4,0.6,0.8)	(0.6,0.8,1)	(0.4,0.6,0.8)	(0.2,0.4,0.6)	(0,0.2,0.4)	(0.8,1,1)	(0.2,0.4,0.6)	(0,0.2,0.4)
*A*4	(0.6,0.8,1)	(0.6,0.8,1)	(0.2,0.4,0.6)	(0.6,0.8,1)	(0.4,0.6,0.8)	(0.2,0.4,0.6)	(0.6,0.8,1)	(0.4,0.6,0.8)	(0.2,0.4,0.6)	(0.6,0.8,1)	(0.6,0.8,1)
*A*5	(0,0.2,0.4)	(0.2,0.4,0.6)	(0,0.2,0.4)	(0.2,0.4,0.6)	(0.2,0.4,0.6)	(0.2,0.4,0.6)	(0.8,1,1)	(0,0,0.2)	(0,0.2,0.4)	(0.4,0.6,0.8)	(0.4,0.6,0.8)
*A*6	(0.8,1,1)	(0.8,1,1)	(0.2,0.4,0.6)	(0.6,0.8,1)	(0.4,0.6,0.8)	(0.4,0.6,0.8)	(0,0,0.2)	(0,0.2,0.4)	(0,0,0.2)	(0.6,0.8,1)	(0.6,0.8,1)
*A*7	(0.2,0.4,0.6)	(0.4,0.6,0.8)	(0.2,0.4,0.6)	(0.2,0.4,0.6)	(0.6,0.8,1)	(0.8,1,1)	(0.4,0.6,0.8)	(0.8,1,1)	(0.4,0.6,0.8)	(0.2,0.4,0.6)	(0.2,0.4,0.6)
Weight	0,041	0,026	0,069	0,123	0,142	0,056	0,067	0,009	0,008	0,039	0,019

	W6	O1	O2	O3	O4	T1	T2	T3	T4	T5	T6
*A*1	Low	Low	Very high	Medium	High	Low	Low	Very low	Low	Very low	High
*A*2	Excellent	Very high	Excellent	Very high	Excellent	Very high	Excellent	Excellent	Very high	Excellent	Very high
*A*3	Medium	Medium	High	High	Very high	High	Medium	Medium	Low	Low	Very low
*A*4	Excellent	Low	Very high	Very high	Excellent	Excellent	Very high	High	Very high	Very high	Excellent
*A*5	Very high	Low	Medium	Medium	Very high	Very high	Very high	Very high	Excellent	High	Very high
*A*6	Very low	Low	High	Medium	Medium	Medium	Low	Medium	Low	Low	High
*A*7	Medium	Medium	Medium	High	High	High	High	Very high	Excellent	High	Very high

*A*1	(0,0.2,0.4)	(0,0.2,0.4)	(0.6,0.8,1)	(0.2,0.4,0.6)	(0.4,0.6,0.8)	(0,0.2,0.4)	(0,0.2,0.4)	(0,0,0.2)	(0,0.2,0.4)	(0,0,0.2)	(0.4,0.6,0.8)
*A*2	(0.8,1,1)	(0.6,0.8,1)	(0.8,1,1)	(0.6,0.8,1)	(0.8,1,1)	(0.6,0.8,1)	(0.8,1,1)	(0.8,1,1)	(0.6,0.8,1)	(0.8,1,1)	(0.6,0.8,1)
*A*3	(0.2,0.4,0.6)	(0.2,0.4,0.6)	(0.4,0.6,0.8)	(0.4,0.6,0.8)	(0.6,0.8,1)	(0.4,0.6,0.8)	(0.2,0.4,0.6)	(0.2,0.4,0.6)	(0,0.2,0.4)	(0,0.2,0.4)	(0,0,0.2)
*A*4	(0.8,1,1)	(0,0.2,0.4)	(0.6,0.8,1)	(0.6,0.8,1)	(0.8,1,1)	(0.8,1,1)	(0.6,0.8,1)	(0.4,0.6,0.8)	(0.6,0.8,1)	(0.6,0.8,1)	(0.8,1,1)
*A*5	(0.6,0.8,1)	(0,0.2,0.4)	(0.2,0.4,0.6)	(0.2,0.4,0.6)	(0.6,0.8,1)	(0.6,0.8,1)	(0.6,0.8,1)	(0.6,0.8,1)	(0.8,1,1)	(0.4,0.6,0.8)	(0.6,0.8,1)
*A*6	(0,0,0.2)	(0,0.2,0.4)	(0.4,0.6,0.8)	(0.2,0.4,0.6)	(0.2,0.4,0.6)	(0.2,0.4,0.6)	(0,0.2,0.4)	(0.2,0.4,0.6)	(0,0.2,0.4)	(0,0.2,0.4)	(0.4,0.6,0.8)
*A*7	(0.2,0.4,0.6)	(0.2,0.4,0.6)	(0.2,0.4,0.6)	(0.4,0.6,0.8)	(0.4,0.6,0.8)	(0.4,0.6,0.8)	(0.4,0.6,0.8)	(0.6,0.8,1)	(0.8,1,1)	(0.4,0.6,0.8)	(0.6,0.8,1)
Weight	0,042	0,059	0,021	0,012	0,037	0,076	0,017	0,039	0,062	0,024	0,012

Table 14: Weighted evaluation for the alternative strategies

S1	S2	S3	S4	S5	S6	W1	W2

*A*1	(0.000,0.000,0.003)	(0.008,0.010,0.010)	(0.000,0.006,0.012)	(0.000,0.010,0.020)	(0.012,0.024,0.035)	(0.005,0.009,0.014)	(0.000,0.000,0.022)	(0.003,0.006,0.010)
*A*2	(0.014,0.017,0.017)	(0.004,0.006,0.008)	(0.000,0.006,0.012)	(0.031,0.041,0.051)	(0.047,0.059,0.059)	(0.014,0.018,0.023)	(0.087,0.109,0.109)	(0.013,0.016,0.016)
*A*3	(0.010,0.014,0.017)	(0.006,0.008,0.010)	(0.000,0.006,0.012)	(0.020,0.031,0.041)	(0.035,0.047,0.059)	(0.009,0.014,0.018)	(0.022,0.044,0.065)	(0.000,0.003,0.006)
*A*4	(0.010,0.014,0.017)	(0.006,0.008,0.010)	(0.006,0.012,0.017)	(0.031,0.041,0.051)	(0.024,0.035,0.047)	(0.005,0.009,0.014)	(0.065,0.087,0.109)	(0.006,0.010,0.013)
*A*5	(0.000,0.003,0.007)	(0.002,0.004,0.006)	(0.000,0.006,0.012)	(0.010,0.020,0.031)	(0.012,0.024,0.035)	(0.005,0.009,0.014)	(0.087,0.109,0.109)	(0.000,0.000,0.003)
*A*6	(0.014,0.017,0.017)	(0.008,0.010,0.010)	(0.006,0.012,0.017)	(0.031,0.041,0.051)	(0.024,0.035,0.047)	(0.009,0.014,0.018)	(0.000,0.000,0.022)	(0.000,0.003,0.006)
*A*7	(0.003,0.007,0.010)	(0.004,0.006,0.008)	(0.006,0.012,0.017)	(0.010,0.020,0.031)	(0.035,0.047,0.059)	(0.018,0.023,0.023)	(0.044,0.065,0.087)	(0.013,0.016,0.016)
A^*	$\tilde{v}_3^* = (1,1,1)$	$\tilde{v}_3^* = (1,1,1)$	$\tilde{v}_3^* = (1,1,1)$	$\tilde{v}_4^* = (1,1,1)$	$\tilde{v}_5^* = (1,1,1)$	$\tilde{v}_6^* = (1,1,1)$	$\tilde{v}_1^* = (0,0,0)$	$\tilde{v}_1^* = (0,0,0)$
A^-	$\tilde{v}_3^- = (0,0,0)$	$\tilde{v}_3^- = (0,0,0)$	$\tilde{v}_3^- = (0,0,0)$	$\tilde{v}_4^- = (0,0,0)$	$\tilde{v}_5^- = (0,0,0)$	$\tilde{v}_6^- = (0,0,0)$	$\tilde{v}_1^- = (1,1,1)$	$\tilde{v}_1^- = (1,1,1)$

	W3	W4	W5	W6	O1	O2	O3	O4
A 1	(0.010,0.013,0.013)	(0.026,0.039,0.052)	(0.000,0.006,0.012)	(0.000,0.014,0.027)	(0.000,0.012,0.023)	(0.013,0.017,0.021)	(0.002,0.005,0.007)	(0.014,0.022,0.029)
A 2	(0.008,0.010,0.013)	(0.039,0.052,0.065)	(0.024,0.030,0.030)	(0.054,0.068,0.068)	(0.035,0.046,0.058)	(0.017,0.021,0.021)	(0.007,0.010,0.012)	(0.029,0.036,0.036)
A 3	(0.010,0.013,0.013)	(0.013,0.026,0.039)	(0.000,0.006,0.012)	(0.014,0.027,0.041)	(0.012,0.023,0.035)	(0.008,0.013,0.017)	(0.005,0.007,0.010)	(0.022,0.029,0.036)
A 4	(0.003,0.005,0.008)	(0.039,0.052,0.065)	(0.018,0.024,0.030)	(0.054,0.068,0.068)	(0.000,0.012,0.023)	(0.013,0.017,0.021)	(0.007,0.010,0.012)	(0.029,0.036,0.036)
A 5	(0.000,0.003,0.005)	(0.026,0.039,0.052)	(0.012,0.018,0.024)	(0.041,0.054,0.068)	(0.000,0.012,0.023)	(0.004,0.008,0.013)	(0.002,0.005,0.007)	(0.022,0.029,0.036)
A	(0.000,0.000,0.	(0.039,0.052,0.	(0.018,0.024,0.	(0.000,0.000,0.	(0.000,0.012,0.	(0.008,0.013,0.	(0.002,0.005,0.	(0.007,0.014,0.

6	003)	065)	030)	014)	023)	017)	007)	022)
A7	(0.005,0.008,0.010)	(0.013,0.026,0.039)	(0.006,0.012,0.018)	(0.014,0.027,0.041)	(0.012,0.023,0.035)	(0.004,0.008,0.013)	(0.005,0.007,0.010)	(0.014,0.022,0.029)
A*	$\tilde{v}_1^* = (0,0,0)$	$\tilde{v}_1^* = (0,0,0)$	$\tilde{v}_1^* = (0,0,0)$	$\tilde{v}_1^* = (0,0,0)$	$\tilde{v}_5^* = (1,1,1)$	$\tilde{v}_6^* = (1,1,1)$	$\tilde{v}_5^* = (1,1,1)$	$\tilde{v}_6^* = (1,1,1)$
A-	$\tilde{v}_1^- = (1,1,1)$	$\tilde{v}_1^- = (1,1,1)$	$\tilde{v}_1^- = (1,1,1)$	$\tilde{v}_1^- = (1,1,1)$	$\tilde{v}_5^- = (0,0,0)$	$\tilde{v}_6^- = (0,0,0)$	$\tilde{v}_5^- = (0,0,0)$	$\tilde{v}_6^- = (0,0,0)$

	T1	T2	T3	T4	T5	T6
A1	(0.000,0.025,0.051)	(0.000,0.006,0.011)	(0.000,0.000,0.013)	(0.000,0.021,0.042)	(0.000,0.000,0.008)	(0.008,0.013,0.017)
A2	(0.076,0.102,0.127)	(0.022,0.028,0.028)	(0.051,0.064,0.064)	(0.062,0.083,0.104)	(0.031,0.039,0.039)	(0.013,0.017,0.021)
A3	(0.051,0.076,0.102)	(0.006,0.011,0.017)	(0.013,0.026,0.038)	(0.000,0.021,0.042)	(0.000,0.008,0.016)	(0.000,0.000,0.004)
A4	(0.102,0.127,0.127)	(0.017,0.022,0.028)	(0.026,0.038,0.051)	(0.062,0.083,0.104)	(0.023,0.031,0.039)	(0.017,0.021,0.021)
A5	(0.076,0.102,0.127)	(0.017,0.022,0.028)	(0.038,0.051,0.064)	(0.083,0.104,0.104)	(0.016,0.023,0.031)	(0.013,0.017,0.021)
A6	(0.025,0.051,0.076)	(0.000,0.006,0.011)	(0.013,0.026,0.038)	(0.000,0.021,0.042)	(0.000,0.008,0.016)	(0.008,0.013,0.017)
A7	(0.051,0.076,0.102)	(0.011,0.017,0.022)	(0.038,0.051,0.064)	(0.083,0.104,0.104)	(0.016,0.023,0.031)	(0.013,0.017,0.021)
A^*	$\tilde{v}_1^* = (0,0,0)$	$\tilde{v}_2^* = (0,0,0)$	$\tilde{v}_1^* = (0,0,0)$	$\tilde{v}_1^* = (0,0,0)$	$\tilde{v}_1^* = (0,0,0)$	$\tilde{v}_1^* = (0,0,0)$
A^-	$\tilde{v}_1^- = (1,1,1)$	$\tilde{v}_2^- = (1,1,1)$	$\tilde{v}_1^- = (1,1,1)$	$\tilde{v}_1^- = (1,1,1)$	$\tilde{v}_1^- = (1,1,1)$	$\tilde{v}_1^- = (1,1,1)$

The results of fuzzy TOPSIS analyses are summarized in Table 15. Based on CC_j values, the ranking of the alternatives in descending order are A6-A3-A1-A2-A7-A4 and A5. Proposed model results indicate that A6 is the best alternative strategy with CC value of 0.5554.

Table 15. Fuzzy TOPSIS results

Alternatives	D_j^*	D_j^-	CCj
A1	9.914	12,131	0,5503
A2	9,911	12,104	0,5498
A3	9,813	12,218	0,5546
A4	9,982	12,039	0,5467
A5	10,112	11,918	0,5410
A6	9,796	12,236	0,5554
A7	9,935	12,088	0,5489

In the present study, validation of the proposed model was evaluated in two dimensions: The first was evaluation of the context and results of the proposed model on the basis of the company where the study was conducted. In this approach, the significance of the proposed method or model in the studies dealing with validation of model issue (Ngai, 2003; Yüksel & Dağdeviren, 2007; Dağdeviren & Yüksel, 2008; Lu, 2010;) was analyzed in terms of the related case study. Thus, the managers of the corporation where the study was conducted confirmed that the internal and external factors covered by the proposed model, and the strategies based on these factors, accurately represented the environment of that corporation, and stated that they were acceptable. Again, the managers of the corporation stated that the strategies emerging from the proposed model were appropriate for the vision, mission and aims of the corporation and these strategies informed the subsequent strategies. The second dimension examining the issue of validation of model involves the techniques used in the study. The literature includes studies of model validation using this technique (Whitaker, 2007; Yüksel & Dağdeviren, 2007; Dağdeviren & Yüksel, 2008). The consistency ratios calculated from the consistency index and random index of paired comparison matrix (Tables 4-11) were observed to be lower than 0.10. This finding indicates that the pairwise comparisons used in the study are within the acceptable limits. These results support the validity of the model suggested in the study.

Conclusion

In terms of strategic management, the long-term sustainability of a company depends on the sectoral competitiveness of the company, based on the mission and vision it sets. Competitiveness is dependent on many other factors; however, competitiveness is possible when the company operates in line with strategies, developed by considering its' resources and capabilities as well as opportunities and threats to the company. Activities lacking strategic coherence, conflicting with pre-set strategies or not supporting these strategies, result in the irrational use of company resources. Therefore, setting, deciding on and prioritizing strategies are of great importance for the company. However, as emphasized within the Introduction section of the study, the findings of previous studies in the literature show that the identification, selection and prioritization of strategies is not an easy task. A number of approaches and techniques have made significant contributions to overcoming difficulties on this issue; however, some limitations and problems are encountered in implementation. The present study aimed to enable companies to overcome the difficulties encountered during strategy selection and to make more rational strategy selections.

It has been shown that the integrated ANP and Fuzzy TOPSIS technique proposed by the present study facilitates the strategy selection. Thus, the study demonstrates that issues discussed in the Introduction section are solvable with the proposed model. Firstly, the TOPSIS technique permits the analysis of differing effects on the potential company strategies of strengths, weaknesses, opportunities and threats factors included in the SWOT analysis. The model proposed by the present study addressed the strengths and opportunities as benefits and weaknesses, and addressed threats as costs, which were then solved with the TOPSIS technique. Grouping of the factors as benefits or costs within the SWOT analysis is of great importance in terms of the veridicality of the analysis, because strengths and opportunities provide the company with operational capability, while weaknesses and threats create a preventive or limiting situation. Therefore, the issue should be evaluated from this perspective and the appropriate corporate strategy should be selected on this basis during SWOT analysis.

The model proposed by the present study and the techniques used by this model have been shown to comply with the complex and holistic structure of SWOT analysis. The study has shown that the strategy selection and prioritization is possible if the model factors are weighted using the AHP technique, the interdependence is calculated using the ANP technique and the fuzzy TOPSIS technique is used in case of complexity and vagueness. Another advantage of the proposed integrated model is that it facilitates and eases the burden of the calculation process, particularly the selection and prioritization of alternatives during SWOT analysis.

The suggested model is applied in a specific area and is also adaptable to other sectors and corporations. In addition, the proposed model has important advantages in terms of results. Primarily, managers would be able to incorporate any number of factors within the SWOT analysis. Otherwise, internal and external factors that may be important for SWOT analysis might be excluded. Thus, the significance of a factor for a corporation depends on its simultaneous evaluation with all other factors. Another advantage of the proposed model is related to the content of the factors and their effects on the corporation. Within the literature on quantitative SWOT analysis, no previous studies have examined the negative effects of weakness from internal factors, and threats from external factors on a corporation; and the positive effect of strengths from internal factors and opportunities from external factors. Using the proposed model, managers are able to evaluate these factors in terms of their benefits or costs to their organization, and therefore make more rational strategic decisions. The complexities of the proposed model mean that it could not be used directly by all managers without a user- friendly software interface. Therefore, software support is required to increase the applicability of the model. This limitation of the present study will be the subject of future studies.

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