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Application of Combined SWOT and AHP: A Case Study for a Manufacturing Firm

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Abstract

Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis is a commonly used tool which examines strengths and weaknesses (internal factors) of a company or industry together with opportunities and threats (external factors) of the marketplace environment. SWOT analysis provides the basic outline in which to perform analysis of decision situations. In this study, the lack of determination of the importance ranking for the SWOT factors, we proposed to enhance SWOT analysis with multicriteria decision making technique called Analytic Hierarchy Process (AHP). AHP approach achieves pairwise comparisons among factors or criteria in order to prioritize them using the eigenvalue calculation. The aim of applying the combined method is to improve the quantitative side of strategic planning.

Keywords: SWOT, AHP, Manufacturing

1. Introduction

Good performance within a corporation is the result of correct interaction of business management with its internal and external environment. The descripton of internal strengths and weaknesses, as well as external opportunities and threats, takes place on the basis of a well-known technique called SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis [1]. SWOT analysis is a generally applying method for analyzing both environments in order to attain a systematic approach and support for a decisions. Moreover, SWOT includes no means of analytically determining the importance of the factors or of assessing the decision alternatives with respect to the factors [4].

In this study, a quantitative AHP based SWOT analysis has been proposed to determine priorities among SWOT factors systematically. The proposed method is obtained by performing pairwise comparisons between identified SWOT factors [12]. After that, comparison matrices analyzed by the

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eigenvalue method applied in the Analytic Hierarchy Process (AHP) for calculate priorities and assign the relative importance of each SWOT factor. This paper results show the usefulness of the SWOT-AHP technique in studying strategic decisions.

2. SWOT and AHP Model

2.1. SWOT Analysis

SWOT analysis is a commonly used tool for analyzing external and internal environments simultaneously in order to acquire a systematic approach and support for a decision situation [3, 4, 5].

The internal and external factors most considerable for the company's future are referred to as strategic factors. In SWOT these factors are grouped into four parts called SWOT groups: strengths, weaknesses, opportunities, and threats. By applying SWOT in strategic decisions, the purpose is to select or constitute and implement a strategy resulting in a good fit between the internal and external factors [9]. Moreover, the chosen strategy has also to be in line with the current and future purposes of the decision makers [10]. SWOT analysis involves systematic thinking and comprehensive diagnosis of factors relating to a new product, technology, management, or planning. Figure 1 shows how SWOT analysis fits into an environment scan [29].

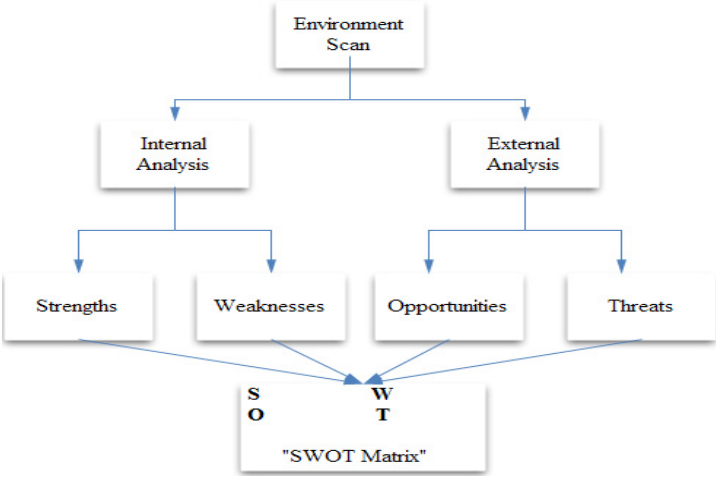

Fig. 1. SWOT analysis framework [29]

2.2. Analytic Hierarchy Process

AHP is a multicriteria decision making technique that can help express the general decision operation by decomposing a complicated problem into a multilevel hierarchical structure of objective, criteria and alternatives [21]. AHP performs pairwise comparisons to derive relative importance of the variable in each level of the hierarchy and / or appraises the alternatives in the lowest level of the hierarchy in order to make the best decision among alternatives. AHP is a effective decision making method especially when subjectivity exists and it is very suitable to solve problems where the decision criteria can be organized in a hierarchical way into sub-criteria [22]

AHP is used to determine relative priorities on absolute scales from both discrete and continuous paired comparisons in multilevel hierarchic structures [23]. The prioritization mechanism is accomplished

by assigning a number from a comparison scale (see Table 1) developed by Saaty (1980) to represent the relative importance of the criteria. Pairwise comparisons matrices of these factors provide the means for calculation of importance [21].

Table 1. Pairwise comparison scale [5, 19]

Importance	Explanation
1	Two criterion contribute equally to the objective
3	Experience and judgement slightly favor one over another
5	Experience and judgment strongly favor one over another
7	Criterion is strongly favored and its dominance is demonstrated in practice
9	Importance of one over another affirmed on the highest possible order
2, 4, 6, 8	Used to represent compromise between the priorities listed above

The AHP method is based on three principles: first, structure of the model; second, comparative judgment of the criteria and/or alternatives; third, synthesis of the priorities. In the literature, AHP, has been widely used in solving many decision making problems [2, 3, 9, 10, 11, 16, 18, 24]. In the first step, a decision problem is structured as a hierarchy [25]. AHP initially breaks down a complex multicriteria decision making problem into a hierarchy of interrelated decision elements (criteria, decision alternatives). With the AHP, the objectives, decision criteria and alternatives are arranged in a hierarchical structure similar to a family tree. A hierarchy has at least three levels: overall goal of the problem at the top, multiple criteria that define alternatives in the middle, and alternatives at the bottom level [26].

In this study, we use the AHP for prioritization of SWOT elements. Once the problem has been decomposed and the hierarchy is constructed, prioritization procedure starts in order to determine the relative importance of the criteria. In each level, the criteria are compared pairwise according to their levels of influence and based on the specified criteria in the higher level. In AHP, multiple pairwise comparisons are based on a standardized comparison scale of nine levels [26].

Let $C = \{C_j \mid j = 1, 2, \ldots, n\}$ be the set of criteria. The result of the pairwise comparison on n criteria can be summarized in an (n x n) evaluation matrix A in which every element a_{ij} ($i, j = 1, 2, \ldots, n$) is the quotient of weights of the criteria. This pairwise comparison can be shown by a square and reciprocal matrix, (see Eq. (1)).

$$A = \left(a_{ij}\right)_{nxn} = \begin{bmatrix} a_{11} & a_{12} & \ldots & a_{1n} \\ a_{21} & a_{22} & \ldots & a_{2n} \\ . & . & . & . \\ . & . & . & . \\ . & . & . & . \\ a_{n1} & a_{n2} & . & a_{nn} \end{bmatrix} \tag{1}$$

At the last step, each matrix is normalized and be found the relative weights. The relative weights are given by the right eigenvector (w) corresponding to the largest eigenvalue (λ_{max}), as:

$$A_w = \lambda_{max}.w \tag{2}$$

If the pairwise comparisons are completely consistent, the matrix A has rank 1 and $\lambda_{max} = n$. In this case, weights can be obtained by normalizing any of the rows or columns of A [26, 27, 28]. It should be noted that the quality of the output of the AHP is related to the consistency of the pairwise comparison

judgments. The consistency is defined by the relation between the entries of A: a_{ij} x a_{jk} = a_{ik} [25]. The Consistency Index (CI) can be calculated, using the following formula [6]:

$$CI = \frac{\lambda_{\max} - n}{n-1} \tag{3}$$

Using the final consistency ratio (CR) can conclude whether the evaluations are sufficiently consistent. The CR is calculated as the ratio of the CI and the random index (RI), as indicated in Eq. 4 [27].

$$CR = \frac{CI}{RI} \tag{4}$$

The number 0.1 is the accepted upper limit for CR. If the final consistency ratio exceeds this value, the evaluation procedure has to be repeated to improve consistency [27].

Table 2. Random index [6, 20]

n	1	2	3	4	5	6	7	8	9	10
RI	0,00	0,00	0,58	0,90	1,12	1,24	1,32	1,41	1,45	1,49

2.3 SWOT-AHP Model

AHP performs pairwise comparisons between evaluation factors in order to prioritize them using the eigenvalue calculation. In typical SWOT analysis, the weightiness of the factors is not quantified to determine the effect of each factor on the proposed strategy alternatives [5]. SWOT analysis does not provide means of systematically determining the relative importance of the criteria or to assess decision alternatives according to the these criteria. In order to handle this insufficiency, the SWOT framework is converted into a hierarchic structure and the model is integrated and analyzed using the AHP with its eigenvalue calculation method [9, 10].

The objective in utilizing the AHP within SWOT framework is to systematically qualify SWOT factors and equate their intensities [8]. The proposed method is applied in three steps [18]:

-The first step is to list the considerable internal (strengths and weaknesses) and external (opportunities and threats) factors for the strategic planning, making-up the SWOT analysis.

-The second step applies the pairwise comparisons to capture the weights of each SWOT group.

-Finally the third step uses the AHP to derive the relative priorities of each factor within the SWOT groups. Then, the overall factor weight rank is obtained by multiplying the factors local weights by the specific group weight.

Kurttila et al. [3] developed a integrated SWOT analysis with AHP to make factors commensurable and to support a more quantitative basis in the strategic planning [7]. This enhanced method has been broadly applied and studied in miscellaneous areas: from the view of applications, the integrated SWOT-AHP method has been used to determine the outsourcing decisions for sport marketing [2], evaluate the management strategies of a forestland estate [4], evaluate the tourism revival strategic marketing plan for Sri Lanka [8], strategic planning of natural resource management [11], analyze the global competitiveness of manufacturers of machine tools [12], formulate the strategy of the safe carriage of bulk liquid chemicals in tankers [13], determine the business strategy in textile firm [14], establish the strategy for

Turkish chemicals industry [15], analytical investigation of marine casualties at the Strait of Istanbul[16], shipping registry selection in maritime transportation industry [17], strategic implementation of integrated water resources management in Mozambique [18].

3. Methodology and Application

The main idea in utilizing the AHP within the SWOT frame is to systematically appraise the SWOT factors and make them commensurable as regards their weightiness [4]. In this study, the AHP structure results from the SWOT matrix and is separated in three parts: (a) goal to be achieved by the decision, (b) the SWOT groups and (c) the factors included within each SWOT group (sub-criteria). The hierarchical representation of the SWOT structure is shown in Fig. 2. [18].

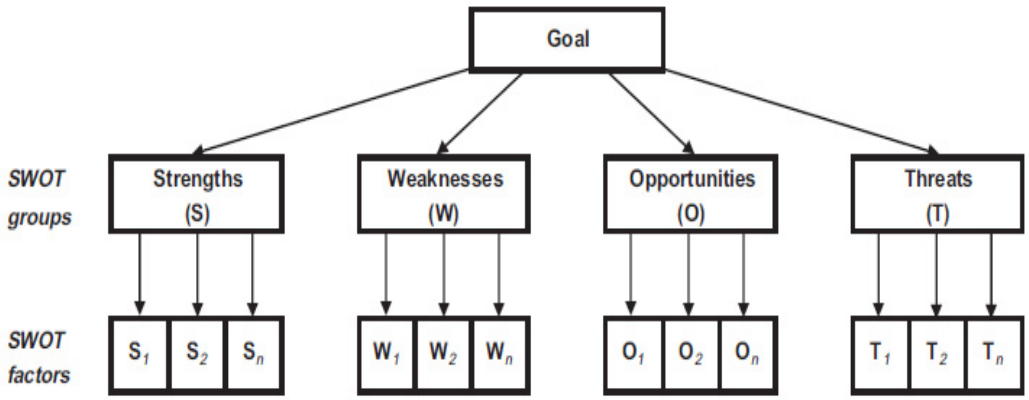

Fig. 2. Hierarchical structure of the SWOT matrix [18].

In the following case study, SWOT analysis enhanced the AHP is performed on a firm which produces cooker hoods in Istanbul, Turkey. The company usually exports its products over 50 countries all around the world. We conducted the Saaty's comparison scale to carry out pairwise comparisons and determined the relative importance between each pair of SWOT factors. After the digitizing SWOT frame via AHP, with the obtained aggregated matrix it was possible to derive the vector weights or priorities for the groups and factors analysed.

To create a SWOT-AHP based strategic management model, we designed the following three phases model: building initial task; modifying factors, and building an evaluation model (Figure 1).

Firsty, SWOT analysis is carried out and matrix is structured. The relevant factors of firm's external and internal environment are defined and built in the SWOT matrix.

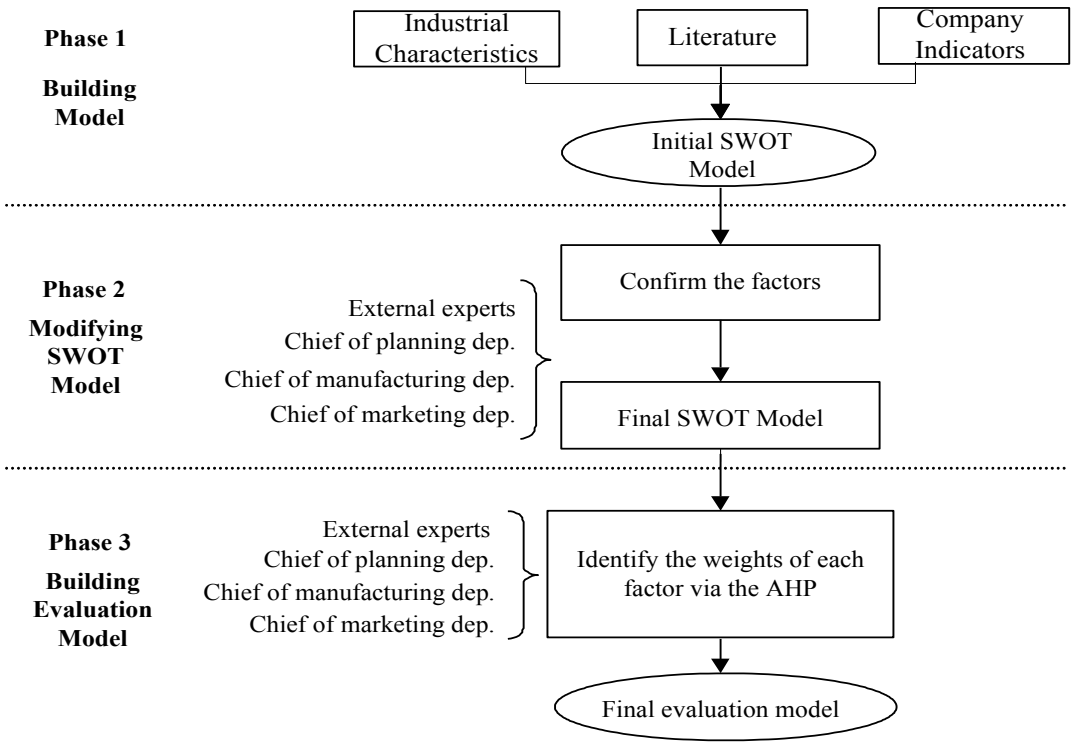

Fig. 3. Phases of proposed methodology

Table 3. SWOT matrix

Strengths (S)	**Weaknesses (W)**
(S1) Innovative capacity **(S2)** Availability of resources and skills **(S3)** Quality of the product **(S4)** Expert management staff **(S5)** Reliability in marketplace	**(W1)**Lack of performance measurement systems **(W2)**Non flexible organizational structure **(W3)** Energy costs **(W4)** Labor costs **(W5)** Lack of accurate forecasting capability **(W6)** High logistics costs **(W7)** Lack of well-known own brands
Opportunities (O)	**Threats (T)**
(O1) Rising living standarts and increasing modern buildings **(O2)** Globalization and the decreased trade barrier **(O3)** New foreign markets	**(T1)**Macroeconomic instability in Turkey **(T2)**Competition **(T3)**Political instability and possible problems in regional geographical area, especially Middle East **(T4)**Different and changing international market mechanisms **(T5)** Strengthening environmental pressures **(T6)**Different standardization request of international customers **(T7)** Low income per unit

AHP is applied to SWOT matrix. Firstly, pairwise comparisons of the SWOT groups, using a 1-9 Saaty's (1980) comparison scale, are made. The comparison results are shown in Table 4. Secondly, SWOT matrices' elements are compared considering every SWOT group. All pairwise comparisons in the application are performed by the team of experts. Expert team was constituted from three department managers of the firm and the authors of this paper.

Table 4. Pairwise comparisons of SWOT factors

SWOT Groups	S	W	O	T	Importance Degrees of SWOT Groups
Strengths (S)	1.000	3.000	1.000	3.000	0.367
Weaknesses (W)	0.333	1.000	0.250	2.000	0.146
Opportunities (O)	1.000	4.000	1.000	2.000	0.365
Threats (T)	0.333	0.500	0.500	1.000	0.123
CR = 0.06					

Table 5. Comparison Matrix of Strengths Group

Strengths	S1	S2	S3	S4	S5	Importance Degrees
(S1) Innovative capacity	1.000	0.500	0.200	0.500	0.167	0.057
(S2) Availability of resources and skills	2.000	1.000	0.167	0.200	0.167	0.065
(S3) Quality of the product	5.000	6.000	1.000	3.000	2.000	0.400
(S4) Expert management staff	2.000	5.000	0.333	1.000	0.200	0.144
(S5) Reliability in marketplace	6.000	6.000	0.500	4.000	1.000	0.334
CR = 0.08						

Table 6. Comparison Matrix of Weaknesses Group

Weaknesses	W1	W2	W3	W4	W5	W6	W7	Importance Degrees
(W1)Lack of performance measurement systems	1.000	3.000	0.200	0.200	0.500	0.250	0.500	0.055
(W2)Non flexible organizational structure	0.333	1.000	0.167	0.167	0.500	0.200	0.500	0.035
(W3) Energy costs	5.000	6.000	1.000	1.000	6.000	2.000	7.000	0.294
(W4) Labor costs	5.000	6.000	1.000	1.000	6.000	2.000	7.000	0.294
(W5) Lack of accurate forecasting capability	2.000	2.000	0.167	0.167	1.000	0.200	0.500	0.056
(W6) High logistics costs	4.000	5.000	0.500	0.500	5.000	1.000	7.000	0.204
(W7) Lack of well-known own brands	2.000	2.000	0.143	0.143	2.000	0.143	1.000	0.062
CR = 0.06								

Table 7. Comparison Matrix of Opportunities Group

Opportunities	O1	O2	O3	Importance Degrees
(O1) Rising living standarts and increasing modern buildings	1.000	2.000	3.000	0.539
(O2) Globalization and the decreased trade barrier	0.500	1.000	2.000	0.297
(O3) New foreign markets	0.333	0.500	1.000	0.164
CR = 0.08				

Table 8. Comparison Matrix of Threats Group

Threats	T1	T2	T3	T4	T5	T6	T7	Importance Degrees
(T1)Macroeconomic instability in Turkey	1.000	0.333	2.000	1.000	0.333	0.500	0.500	0.0946
(T2)Competition	3.000	1.000	1.000	2.000	4.000	3.000	1.000	0.2389
(T3)Political instability and possible problems in regional geographical area, especially Middle East	0.500	1.000	1.000	1.000	0.500	1.000	0.333	0.1006
(T4)Different and changing international market mechanisms	1.000	0.500	1.000	1.000	3.000	1.000	0.500	0.1240
(T5) Strengthening environmental pressures	3.000	0.250	2.000	0.333	1.000	0.250	0.250	0.0980
(T6)Different standardization request of international customers	2.000	0.333	1.000	1.000	2.000	1.000	0.333	0.1128
(T7) Low Income per Unit	2.000	1.000	3.000	2.000	2.000	3.000	1.000	0.2311
CR = 0.08								

Finally, the overall priority scores of the SWOT factors are calculated. Overall priorities are shown in Table 9.

Table 9. Overall Priority Scores of SWOT Factors.

Swot Group	Group Priority	Swot Factors	Factor Priority within the Group	Overall Priority of Factor
Strengths	0.367	Innovative capacity	0.057	0.021
		Availability of resources and skills	0.065	0.024
		Quality of the product	**0.400**	**0.147**
		Expert management staff	0.144	0.053
		Reliability in marketplace	0.334	0.122
Weaknesses	0.146	Lack of performance measurement systems	0.055	0.008
		Non flexible organizational structure	0.035	0.005
		Energy costs	**0.294**	**0.043**
		Labor costs	**0.294**	**0.043**
		Lack of accurate forecasting capability	0.056	0.008
		High logistics costs	0.204	0.030
		Lack of well-known own brands	0.062	0.009
Opportunities	0.365	**Rising living standarts and increasing modern buildings**	**0.539**	**0.197**
		Globalization and the decreased trade barrier	0.297	0.108
		New foreign markets	0.164	0.060
Threats	0.123	Macroeconomic instability in Turkey	0.095	0.012
		Competition	**0.239**	**0.029**
		Political instability and possible problems in regional geographical area, especially Middle East	0.101	0.012
		Different and changing international market mechanisms	0.124	0.015
		Strengthening environmental pressures	0.098	0.012
		Different standardization request of international customers	0.113	0.014
		Low Income per Unit	0.231	0.028

The AHP analysis results indicate that rising living standarts and increasing modern buildings are the most important issues considering a cooker hoods manufacturer's internal and external environments.

4. Conclusion

In this paper, we have determined significant strategic factors to manufacturing firm by combining SWOT with AHP techniques. The findings show the following ranking of each SWOT group priority: Strengths (group weight 36.7%), Opportunities (36.5%), Weaknesses (14.6%) and Threats (12.3%). According to the analysis, the most important factor in SWOT is "Rising living standarts and increasing modern buildings" from Opportunities group. This matter is the most important factor to be considered with an overall priority value of 0.197. Other considerable factors are ranked as follows according to priority: Quality of the product (14.7%), Energy costs (4.3%), Labor costs (4.3%) and Competition (2.9%) factors.

Using calculated priorities of SWOT factors could be developed a management approach or supported for a critical decisions. Additionally, this study's results can be used for the constitute of a set of appropriate strategy alternatives for organization. Future research could improve the using fuzzy logic framework with the AHP method to more effectively analyze cases having uncertainty. Furthermore, any multi-criteria decision making technique is applied instead of the AHP and results could be compared.

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