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Strategy development with SWOT analysis on manufacturing companies in rapid growth: A ceramic industry application

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Abstract

Decision-making is important for organisations, since the consequences of given decisions are identified among the major risk factors for organisations' future. This study aims to prove the importance of using combined decision-making methods for a successful decision-making for managers. In a ceramics company, multi-criteria decision-making processes were applied for taking quick action for future strategies. SWOT analysis was used for determining potential strategies. After then, multi-criteria decision-making methods were used to determine the importance of each potential strategy.

Keywords: Multi-criteria decision-making, SWOT analysis, strategy management.

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1. Introduction

Decision-making has always been a tough process for organisations. The process of decision-making is one of the most complex mechanisms of human thinking, as various factors and courses of action intervene in it, with different results (Lizarraga, Baquedano & Cardelle-Elawar, 2007). Particularly in situations where the possible effects of decision-making process are major, making decision is crucial. For centuries, people and corporations study on method development to obtain more effective decision-making process and make the most appropriate decisions. In a decision-making process, all the factors that take decision makers to the result are investigated well. Some of the time, the decision is emerged clearly, while the decision is still not very clear at other times. In the past decades, unclear factors were considered and heuristic decisions were made. Today, the unclear factors are tried to formulate and solved in a clear way.

In this study, a combined method including ELECTRE is developed for a better decision-making process of a SWOT analysis. The results getting from all these methods are analysed and ranked for choosing best strategy according to SWOT. These multi-criteria decision-making methods and results of strategic analysis were used for future plans of a company which operates in ceramics industry in Turkey.

Ceramics industry is among the three most active industries in Turkey with regard to the trading volume, rapid growth and challenging competition. In industry, there are many new companies to enter into the market. The company in this research needs assistance for decision-making due to industry's challenging situation. The main purpose is being sure that the possible strategies derived from SWOT analysis suits well for organisations' future plans.

2. Literature

Strategic management includes decisions and action plans that determine long-term activities of organisations (Houben, Lenie & Vanhoof, 1999). In decision-making process, the most creative work is choosing important factors for decision-making (Ucar & Dogru, 2005). As choosing these factors, the managers must consider some issues. SWOT analysis helps to define information needed and make possible decisions (Balamuralikrishna & Dugger, 1995). SWOT analysis is actually a basic list; it doesn't have any specific knowledge in it (Pickton & Wright, 1998). Essentially, SWOT is a tool that categorises external factors as opportunities and threats, and internal factors as strengths and weaknesses (Chang & Huang, 2006). Potential strategies are determined by considering internal and external factors. By analysing these factors, decision makers able to consider reasons that take decision maker to result by different angles. This helps decision makers to reach the result quicker and easier, making mistakes as deciding gets tougher.

SWOT analysis contains reasonable symbolic transactions, complexity, judgement and uncertainty. SWOT analysis does not contain so many numerical transactions. Thus, it constitutes a convenient environment for classic data processing methods (Houben, Lenie & Vanhoof, 1999).

Decision-making used for obtaining much of information, come up to a mathematical science these days (Figuera, Greco & Ehrgott, 2005). If we make our decisions intuitively, we tend to think every information is useful and more amount of information is better (Saaty, 2008). However, this is not true. According to Saaty, there are so many examples that show too much information is as bad as little information. In many industrial engineering applications, the final decision depends on improvement of many alternative criteria. These criteria can be expressed as various scales or convenient data can be too hard to digitalise, thus this problem turns into a tough problem (Triantaphyllou & Mann, 1995).

The ELECTRE method was developed for choosing the best action from a given set of actions in 1965. ELECTRE is a well-known multi-criteria decision-making method for its success in real life applications. It has been applied in the past in various types of decision-making situations (Kaya &

Kahraman, 2011). The method uses the concept of 'outranking relations'. ELECTRE requires an input of criteria evaluations for the alternatives, called decision matrix, preference information, expressed as weights, thresholds and other parameters (Sevkli, 2009). In the ELECTRE method, discordance and concordance sets of alternatives are determined, and then discordance and concordance index values are calculated. Best alternative is chosen after ranked index values.

While making SWOT analysis, decision makers prefer to combine it with other multi-criteria decision-making methods. Decision makers can reach certain results faster than normal SWOT by combining it with multi-criteria decision-making methods. There are many studies using multi-criteria decision-making methods with SWOT in the literature; they inspired us while making this study.

Hatami-Marbini *et al.* (2013) used TOPSIS and fuzzy set theory used with SWOT analysis. Model is applied to a producer for decision-making process. Kajanus et al. (2012) studied on the analysis of the differences in MCDS methods from the perspective of the planning situation approached by SWOT. SWOT analysis combined with AHP is used in four different cases to reach compared results. Yavuz and Baycan (2013) used a combined multi-criteria decision-making using AHP and SWOT at the same time. The method is applied to an organisation to obtain better results. Sevkli et al. (2012) used SWOT and fuzzy ANP methodology in the Turkish airline industry. The results give an opinion about the SWOT-fuzzy ANP's effects for decision-making process in the Turkish airline industry. In his study, Bas (2013) developed an integrated SWOT-fuzzy TOPSIS methodology combined with AHP to prioritise the defined SWOT factors and to formulate a strategy with top priorities; while Kandakoglu et al. (2009) used combined SWOT, AHP and TOPSIS. The approach also provided a relatively simple and well-suited decision-making tool for this type of strategic decision-making problem. Seker and Ozgurler (2012) used an SWOT-AHP method to analyse and develop strategies for a Turkish consumer electronics company. Gallego-Ayalaa and Juízob (2011) also used the AHP-SWOT combined method to obtain effective strategic management process for integrated water resources management. Wei's (2011) study investigated the problems which the attribute values take the form of real numbers, interval numbers and triangular fuzzy number at the different periods. Then, three different GRA models were utilised. Hamzaçebi and Pekkaya (2011) used grey relational analysis for ordering some financial firms' stocks that are in Financial Sector Index of Istanbul Stock Exchange. In Mehrjerdi's study (2014), a case study on system selection comprised of 12 attributes and 7 alternatives was constructed and solved by the proposed method and the results were compared with the results obtained from QSPM, TOPSIS and SAW approaches for analysis purposes. Zavadskas et al. (2011) proposed a methodology for determining management strategies in construction enterprises using SWOT, AHP, expert judgment and permutation method. Erdil and Erbiyik (2015) determined the best strategy and developed small business management via SWOT and AHP used in combination. Shakerian et al. (2016) used a combination of the SWOT analysis and Fuzzy TOPSIS analysis for identifying the organisational environment and ranking the available organisational strategies.

3. Application

In this study, SWOT analysis is used for a factory operating in the ceramics industry to obtain effective future strategies. For the factory management itself, it is hard to decide future strategies clearly. It is because the lack of experience, it needs guidance for analysing all the processes right and determining future strategies. In the study, after SWOT factors and possible strategies are determined, ELECTRE is applied. The most eligible strategies are obtained as the results are derived from multi-criteria decision-making methods and ELECTRE. The needed guidance for the factory is provided, and thus the factory is able to select more effective strategies for its future.

3.1. SWOT Analysis

SWOT factors (strengths, weaknesses, threats and opportunities) are determined for a ceramics factory with the help of its managers. Strengths and weaknesses are internal, and opportunities and

threats are external factors. By determining them, factory's present situation is considered carefully. After SWOT factors are determined, possible strategies are determined.

Three of the determined strengths, weaknesses, opportunities and threats are given as examples below. There are 10 sub-criteria for all strengths, weaknesses, opportunities and threats. Three of them are given below.

(i). Strengths

(a) Making quick decisions
(b) Resolving problems rapidly
(c) Fulfillment of various customer demands

(ii) Weaknesses

(a) Lack of Research Development department
(b) Using success factor without benchmarking
(c) Insufficient domestic marketing network

(iii) Opportunities

(a) Plenty of closed ceramic factories
(b) Promotion laws for industry
(c) Economic restoration in Middle East area

(iv) Threats

(a) High energy costs in Turkey
(b) Factory's distance to other factories in industry and raw material source
(c) Economic recession

Possible strategies are determined after SWOT factors considered well. Strategies below are those most convenient ones after consideration of all factors.

(i) Possible strategies:

(a) Setting an effective research development structure for independency of production technology
(b) Setting an online sale system to empower marketing network
(c) Improvement of quality control department
(d) Setting an advanced performance evaluation system for more effective evaluations
(e) Creating a platform for staff to communicate and send their suggestions and offers to management board
(f) Selecting method of production with lower costs and more qualified
(g) Using management power for effective communication to staff and setting an effective communication network

3.2. AHP

In AHP method, comparison matrices are generated between groups and components of each group, and thus weights for each matrix are calculated.

Comparison matrix for SWOT factors is shown in Table 1. The ranking is between 1 and 9; 9 means strongly preferred, while 1 means equally important. For example, the *opportunities* factor is strongly preferred to threats factor; 1 is used for comparing the same SWOT factors like S and S.

The normalisation matrix of comparison matrix is created after simple comparison matrix is created. The normalisation matrix is in Table 2. Each SWOT factor's own weight is calculated after weights are gained from normalisation matrix. Each weight could be seen in the column AVG.

After SWOT factors' weights are calculated, objects of each SWOT factors' comparison matrix are created. Group weight is calculated for each factor object; these weights are multiplied with average weight calculated in normalisation matrix before and then final average weight for each factor object is found.

Table 1. Comparison matrix of SWOT

	S	***W***	***O***	***T***
S	1	5	1/5	5
W	1/5	1	1/7	7
O	5	7	1	9
T	1/5	1/7	1/9	1
Total	6.4	13.14	1.45	22

Examples of a comparison matrix and the normalisation matrix for objects are shown in Tables 2 and 3.

Table 2. Comparison matrix of strength factors

	S1	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**S10**
S1	1	5	1/7	1/9	3	1/5	1/7	1/5	3	1/5
S2	1/5	1	1/7	1/9	1/3	1/7	1/9	1/9	5	1/9
S3	7	7	1	1/7	5	1/3	1/3	1/3	5	1/7
S4	9	9	7	1	9	7	5	1/3	5	3
S5	1/3	3	1/5	1/9	1	1/5	1/3	1/9	1/3	1/9
S6	5	7	3	1/7	5	1	3	1/3	3	1/5
S7	7	9	3	1/5	3	1/3	1	1/5	5	3
S8	5	9	3	3	9	3	5	1	9	3
S9	1/3	1/5	1/5	1/5	3	1/3	1/5	1/9	1	1/7
S10	5	9	7	1/3	9	5	1/3	1/3	7	1
	39.86667	59.2	24.68571	5.352381	47.33333	17.54286	15.45397	3.066667	43.33333	10.90794

Table 3. Normalisation matrix of strength factors

	S1	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**S10**	**AVG**
S1	0.025	0.084	0.006	0.021	0.063	0.011	0.009	0.065	0.069	0.018	0.037
S2	0.005	0.017	0.006	0.021	0.007	0.008	0.007	0.036	0.115	0.010	0.023
S3	0.176	0.118	0.041	0.027	0.106	0.019	0.022	0.109	0.115	0.013	0.074
S4	0.226	0.152	0.284	0.187	0.190	0.399	0.324	0.109	0.115	0.275	0.226
S5	0.008	0.051	0.008	0.021	0.021	0.011	0.022	0.036	0.008	0.010	0.020
S6	0.125	0.118	0.122	0.027	0.106	0.057	0.194	0.109	0.069	0.018	0.094
S7	0.176	0.152	0.122	0.037	0.063	0.019	0.065	0.065	0.115	0.275	0.109
S8	0.125	0.152	0.122	0.560	0.190	0.171	0.324	0.326	0.208	0.275	0.245
S9	0.008	0.003	0.008	0.037	0.063	0.019	0.013	0.036	0.023	0.013	0.022
S10	0.125	0.152	0.284	0.062	0.190	0.285	0.022	0.109	0.162	0.092	0.148
	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Group weight and average weight calculated from matrices of SWOT factor objects are shown in Table 4. The biggest value of average weight for each object is the most effective object for each factor.

Table 4. Average weights of factors

			Group weight	Average weight
Strengths	0.225	S1	0.037	0.008
		S2	0.023	0.005
		S3	0.074	0.017
		S4	0.226	0.051
		S5	0.020	0.004
		S6	0.094	0.021
		S7	0.109	0.025
		S8	0.245	0.055
		S9	0.022	0.005
		S10	0.148	0.033
Weaknesses	0.131	W1	0.125	0.016
		W2	0.109	0.014
		W3	0.012	0.002
		W4	0.032	0.004
		W5	0.157	0.021
		W6	0.055	0.007
		W7	0.037	0.005
		W8	0.280	0.037
		W9	0.093	0.012
		W10	0.101	0.013
Opportunities	0.603	O1	0.116	0.070
		O2	0.026	0.015
		O3	0.017	0.010
		O4	0.088	0.053
		O5	0.042	0.025
		O6	0.038	0.023
		O7	0.191	0.115
		O8	0.080	0.048
		O9	0.245	0.148
		O10	0.157	0.094
Threats	0.041	T1	0.119	0.005
		T2	0.088	0.004
		T3	0.054	0.002
		T4	0.158	0.006
		T5	0.146	0.006
		T6	0.084	0.003

	T7	0.116	0.005
	T8	0.090	0.004
	T9	0.114	0.005
	T10	0.030	0.001

According to SWOT model, there is a requirement for setting each possible strategy's comparison matrices with respect to SWOT factor objects.

Each possible strategy's importance is determined by comparing them as pairs with respect to objects. There is an example for paired comparison matrices, and their normalisation matrices are shown in Tables 6 and 7.

Table 5. Comparison matrix of possible strategies

With respect to S1	P1	P2	P3	P4	P5	P6	P7
P1	1	5	3	3	1/3	1/5	3
P2	1/5	1	9	5	1/7	3	1/7
P3	1/3	1/9	1	5	1/3	3	1/9
P4	1/3	1/5	1/5	1	1/3	5	1/7
P5	3	7	3	3	1	3	1/5
P6	5	1/3	1/3	1/5	1/3	1	1/3
P7	1/3	7	9	7	5	3	1
	10.2	20.64444	25.53333	24.2	7.47619	18.2	4.930159

Table 6. Normalisation matrix of possible strategies

With respect to S1	P1	P2	P3	P4	P5	P6	P7	AVG
P1	0.098	0.242	0.117	0.124	0.045	0.011	0.608	0.178
P2	0.020	0.048	0.352	0.207	0.019	0.165	0.029	0.120
P3	0.033	0.005	0.039	0.207	0.045	0.165	0.023	0.074
P4	0.033	0.010	0.008	0.041	0.045	0.275	0.029	0.063
P5	0.294	0.339	0.117	0.124	0.134	0.165	0.041	0.173
P6	0.490	0.016	0.013	0.008	0.045	0.055	0.068	0.099
P7	0.033	0.339	0.352	0.289	0.669	0.165	0.203	0.293
	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Each object of strengths, weaknesses, opportunities and threats is considered for weight calculation of paired matrices. According to our model and number of objects, 40 matrices are created.

After a combination of all matrices are set and all calculations are made, a normalisation of decision matrix are created. An example of this normalisation decision matrix created for strength factors is shown in Table 8.

Table 7. Normalisation decision matrix for strength factors

SWOT factors	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
P1	0.0015	0.0010	0.0026	0.0123	0.0004	0.0017	0.0072	0.0118	0.0011	0.0087
P2	0.0010	0.0003	0.0033	0.0062	0.0006	0.0028	0.0049	0.0171	0.0002	0.0075
P3	0.0006	0.0001	0.0015	0.0107	0.0005	0.0022	0.0044	0.0072	0.0016	0.0038
P4	0.0005	0.0009	0.0020	0.0031	0.0002	0.0010	0.0007	0.0030	0.0003	0.0011
P5	0.0015	0.0010	0.0021	0.0016	0.0002	0.0008	0.0007	0.0021	0.0004	0.0006
P6	0.0008	0.0006	0.0013	0.0142	0.0011	0.0053	0.0058	0.0091	0.0003	0.0087
P7	0.0025	0.0013	0.0040	0.0028	0.0016	0.0075	0.0008	0.0049	0.0011	0.0030
	0.0084	0.0052	0.0168	0.0509	0.0044	0.0213	0.0245	0.0553	0.0051	0.0334

From the calculations made in the AHP method, possible strategies' average weights are calculated as shown in Table 9. According to results, the most important possible strategy is Strategy 1, with its weight calculated as 0.0051; and the less important possible strategy is strategy four as its weight as 0.0009.

Table 8. Result weights of strategies

P1	P2	P3	P4	P5	P6	P7
0.0051	0.0045	0.0043	0.0009	0.0014	0.0049	0.0038

3.3. ELECTRE

In the ELECTRE method, all factor's normalisation matrices derived from AHP calculations are used. According to Eqs. (1) and (2), concordance and discordance groups are calculated for each pair of criteria (Figuera, Greco & Ehrgott, 2005).

$$C(p,q)=\{j,v_{pj}\geq v_{qj}\}\sqrt{b^2-4ac} \tag{1}$$

$$D(p,q)=\{j,v_{pj}<v_{qj}\} \tag{2}$$

Concordance and discordance indexes of pairs are calculated according to Eqs. (3) and (4) (Figuera, Greco & Ehrgott, 2005):

$$C_{pq}=\sum_{j}^{\&} w_{j}^{\&} \tag{3}$$

$$D_{pq}=\frac{(\sum_{j^0}\left|v_{pj^0}-v_{qj^0}\right|)}{(\sum_{j}\left|v_{pj}-v_{qj}\right|)} \tag{4}$$

After index values are calculated, net concordance and discordance index values are calculated by using the formula in Eqs. (5) and (6) (Figuera, Greco & Ehrgott, 2005).

$$C_p=\sum_{\substack{k=1\\k\neq p}}^{m} C_{pk}-\sum_{\substack{k=1\\k\neq p}}^{m} C_{kp} \tag{5}$$

$$D_p=\sum_{\substack{k=1\\k\neq p}}^{m} D_{pk}-\sum_{\substack{k=1\\k\neq p}}^{m} D_{kp} \tag{6}$$

An example of concordance and discordance groups for each pair of criteria is in Table 9. In the pair of C (1, 2), we see the *strengths* objects that is useful in the situation that preference of Strategy 1 against Strategy 2. Also in the pair of D (1, 2), we see the *strengths* objects that is not useful in the situation that preference of Strategy 1 against Strategy 2.

Table 9. An example of concordance and discordance groups

Concordance groups	*S*	*W*	*O*	*T*	Discordance groups	*S*	*W*	*O*	*T*
C(1, 2)	1, 2, 7, 8, 9	1,2,5,6,7,10	2,4,7, 8,10	8,9, 10	D(1, 2)	3, 4, 5, 6, 10	3, 4, 8, 9	1, 3, 5, 6, 9	1, 2, 3, 4, 5, 6, 7

Calculations for net concordance and discordance index values are below in Table 10.

Table 10. Net concordance and discordance index values

Net concordance values		Net discordance values	
C1	1.328205	D1	0.989275
C2	1.59671	D2	−2.92267
C3	2.025206	D3	1.458425
C4	−4.5163	D4	2.031032
C5	−2.48781	D5	1.908209
C6	1.887691	D6	−5.29294
C7	0.166302	D7	1.828665

After finding index values, values are ranked. For net concordance value, ranking should be from biggest to smallest, and for net discordance value, ranking should be from smallest to biggest. These ranked values are shown in Table 11.

Table 11. Ranked values

Ranking from biggest to smallest		Ranking from smallest to biggest	
C3	2.025206*	D6	−5.29294
C6	1.887691	D2	−2.92267
C2	1.59671	D1	0.989275
C1	1.328205	D3	1.458425
C7	0.166302	D7	1.828665
C5	−2.48781	D5	1.908209
C4	−4.5163	D4	2.031032

4. Results and discussion

In this study, at first, the possible strategies resulting from consideration of all SWOT factors is determined carefully. After that, AHP and ELECTRE multi-criteria decision-making methods are used for ranking of these possible strategies. Thus, selecting more effective strategies compared to all and applying them in first place might be more possible.

Decision-making process gets easier with these multi-criteria decision-making methods and decision maker could select the most convenient strategies and make decision more effectively.

According to results getting from AHP, the first, sixth and the second possible strategies are the most desirable strategies respectively. The results getting from ELECTRE shows that the third, the sixth

and the second strategies could be more important to factory. According to the results totally given in Table 12, we can say that sixth and second strategies are more important for the company. Also the first strategy is the first for AHP and third strategy is the first for ELECTRE.

Conversely, they are the fourth in order. On the other hand, according to AHP and ELECTRE results, seventh, fifth and fourth strategies have less importance than others.

The company must have an effective research development and improve the quality control process immediately. And then they must improve the production methods, have an online sale system. They can study on these problems firstly to have more efficient production for next years.

Table 12. Results of AHP and ELECTRE

Strategy ranking according to AHP method	1, 6, 2, 3, 7, 5, 4
Strategy ranking according to ELECTRE method	3, 6, 2, 1, 7, 5, 4

5. Conclusion

In this study, SWOT analysis data of a factory operating in ceramic industry are used for determining strategies and helping organisation to survive in sector. At first, possible strategies are determined as alternatives to use while processing multi-criteria decision-making methods. As multi-criteria decision-making methods, AHP and ELECTRE methods are used. Calculated results are considered and compared to each other for making more effective decisions.

Through using multi-criteria decision-making methods, the strategies derived from SWOT analysis are changed into numerical form and weighted. Strategies are evaluated by using these multi-criteria decision-making methods and ranked. While making decisions about strategies, AHP and ELECTRE methods play an effective part.

Comparison between different methods provides various points of view to decision makers. Thus, more efficient decision-making process could be handled. It easers reaching the factory's future goals. Decision-making process gets more objective due to using various methods and comparing them together. In future, different variety of multi-criteria decision-making and fuzzy methods might be integrated and used for determining SWOT factors and strategies and it is possible to make decision making processes optimised.

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