

SWOT ANALYSIS EVALUATIONS ON THE BASIS OF UNCERTAINTY – CASE STUDY

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Abstract: *Choosing effective strategy is the main factor in running a successful enterprise, organization. The first step is to understand the organization with respect to its environment, which could be done using SWOT analysis. The main factor in performing SWOT analysis is selecting influential criteria. These criteria could be a long list and difficult to analyse depending on the organization. One way to analyse these criteria is to divide them in sub groups under strength, weakness, opportunity and threat. What is proposed in this paper is a value chain with different primary activities based on the organization, and to evaluate the each primary activity using SWOT analysis and multi criteria decision making (MCDM) to find the best strategy. The aim is to evaluate each process and the value, it is adding to the final outcome and the overall success of the organization. A tile company was analysed by dividing the processes in the company as product, promotion and customer relation using Choquet integral, Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) and fuzzy TOPSIS based on opinions of experts.*

Keywords: *Fuzzy Integral, Quantitative Evaluation, SWOT Analysis, TOPSIS, Value Chain, Weighted Sum Average.*

JEL Classification: *C02, C18, C38, C4, M10*

Introduction

Strategic management is the comprehensive collection of ongoing activities and processes that corporations use to systematically coordinate and align resources and actions with mission, vision and strategy throughout an organization (Aaker & Moorman, 2017; Alkafaji, 2003; Johnson, Whittington & Scholes, 2011). There are different models, which are used to represent strategic management process, proposed by different researchers. Hunger and Wheelen's strategic management model has four inter connected elements: Environmental scanning, strategy formulation, implementation and evaluation and control (Hunger & Wheelen, 2011). Strategy evaluation and control is crucial to effective functioning of an organization. The success of an organization greatly depends on the effective strategies and evaluation control systems in place. Strategy evaluation should be on going in an organization. Strategic evaluation refers to a process of evaluating the effectiveness of a strategy identified and applied by business in an attempt to achieve its overall objectives and take corrective action.

While evaluating a strategy the main aspects that should be considered are evaluation of both internal and external factors that form the basis of the strategy and evaluation of its performance. SWOT analysis is a commonly used tool for analysing an organization with respect to its internal and external environment. Strength and weakness are most often viewed from the organization's point of view whereas opportunities and threats are external environmental factors. Strength is what an organization has or what it can offer that others of its type do not. Weakness in opposite is what an organization does not have or does not offer others of its type do. Opportunities are advantages in the

environment that an organization could use. Threats are situations in an organization's environment that could compromise the organization's success (Hill & Westbrook, 1997; Humphrey, 2005; 2012; Lawrence, 2009).

The aim of the article is to propose and analyse the possibility of using the methods of MCDM with uncertainty for a quantitative evaluation of the SWOT analysis. The value chain method divides SWOT criteria into categories of processes (primary activities of value chain) based on a real-life case study, for recommendations in the selection of an 'optimal' strategy.

1 Problem formulation

SWOT analysis is an analysis compiles the factors of the internal and external environment and it has evolved since 1960's. The SWOT analysis is an excellent tool for coaching, which helps to identify the most notable activities, affecting the success of business (Morison, 2016). This analysis is also a certain output, which summarizes the output from other, analyses. Frequently, PESTLE analyses, Porter's analysis of five forces, competitive analysis, customer (ie, determining, customer lifetime, and analysis), suppliers and customers are often used for SWOT analysis input data. Internal analysis include, product analysis (Boston Consulting Group, McKinsey matrix or GE matrix, P-Q analysis or Pareto analysis, RFM (recency, frequency, monetary) analysis, ...), marketing mix analyses, which, in addition to product, include communication, distribution and price manipulation. Internal analysis can be also used to analyse the internal processes of the organization, the vision, mission, goals and continuity of subsequent processes towards achieving the objectives, including control mechanisms (Grasseová, 2006).

There are following steps in the right procedure of SWOT analysis: 1st Specification for SWOT analysis; 2nd Assembling a team of specialists; 3rd Defining the internal and external environment; 4th Specifying factors in the individual quadrants of a SWOT matrix; 5th Proof of evidence to individual factors; 6th Selection of the most important factors; 7th Define key success/failures factors; 8th Selection of the SWOT strategy (Max-Max, Min-Max, ...); 9th Creating a company strategy and 10th Creating a plan to implement the strategy. The SWOT analysis includes strategically important facts that are both realistic and valid in the range of about 6 months to 2 years. Within the SWOT analysis, it is also important to look at the interrelationships between strengths and weaknesses, opportunities and strengths. This is mostly the case as part of the comparison of processed data. These synergies can be used to determine the company's strategy and development. The SWOT analysis can be used as a tool to determine and optimize a company's strategy, project, or decision-making to improve the current state of the organization or its individual processes. Based on the outcome of the comparison of the internal and external environment, it is possible to decide which basic strategy is most important for the investigated entity. SWOT analysis offers the following strategic options (Hanzelová, 2017; Jakubíková, 2008; Sackett, Jones & Erdley, 2005).

The organization's success often lies in effectively managing strategic situations. Take advantage of the opportunities that come from outside, if the company has appropriate resources for them. Generates S O strategies (Max-Max). The opportunity is useful if it help eliminate the weaknesses of the company – W O (Min-Max) strategy. The organization usually chooses one of these strategies to take the opportunity. In the

event that an organization is seriously threatened, which the SWOT analysis may reveal, it will choose the S T (Max-Min) strategy - it will use its strengths to control threats. The W T (Min-Min) strategy is useful if it has significant problems and rescues it, it can significantly strengthen those weaknesses that are direct attack on threats. Leaders typically choose the S O strategy and benefit from opportunities based on their strengths. Average businesses often choose S T or W O strategy or a combination of these (Tomek, 2001; Molnár, 2012, pp. 101-102). The way to identify these strategy options is to weigh important criteria and evaluate a business with respect to these criteria and their weight. Nevertheless, the SWOT analysis has criticisms and limitations. The main criticism is that it relies on subjective judgments (Hindle, 2008) and other limitations are described in (Pickton & Wright, 1998), (Wasike et al, 2011), (Haile & Krupka, 2016).

Different approaches can be used for a quantitative evaluation of SWOT analysis and choice of 'optimal' strategy, e.g.: weighting and rating individual SWOT factors, pairwise comparison (Molnár, 2012); knowledge-based system working with a vague description of competitive strengths, weaknesses, opportunities and threats (Houben, Lenie & Vanhoof, 1999);21-24 combining qualitative evaluation with analytical hierarchy process (Santopuoli, Marchetti & Giongo, 2016; Tugrul & Cimen, 2016; Wasike et al, 2011); application of a quantification SWOT analytical method (Chang & Huang, 2006). Some authors have proposed novel methods (approaches) to quantify results of a SWOT analysis: Analytic Network Process (Yuksel & Dagdeviren, 2007), fuzzy Analytic Network Process (Sevкли et al. 2012), theory of fuzzy sets (Li & Liu, 2010; Liao, 2017), fuzzy integral and fuzzy measures (Haile & Krupka, 2016; Haile, Krupka & Mastalka, 2016), fuzzy TOPSIS (Zare, Mehri-Tekmeh & Karimi, 2015) and fuzzy ELECTRE (Gürbüz & Pardalos, 2016) etc.

2 Methods

System approach, logic methods (analysis and synthesis, induction and deduction), Value chain, Weighted sum average method (WSAM), TOPSIS, fuzzy TOPSIS, fuzzy integral, SWOT analysis and Case study method are applied in this paper.

The system approach tries to achieve application of functional analysis concept and general systems theory in management, too. It is characterized by complex view of objective reality that is assessed as a multi-dimensional organized unit. Its contribution for management development is based on inner relations management system analysis, in acceptance of importance of both mutual influences of inner factors and interaction of the system with its environment It endeavours for a complex understanding of all phenomena and deeper expression of internal and external factors (Gallopín, 2003; Coffey, 2010).

An organization is a system with interconnected departments (processes). The success or failure of departments affect other departments and the overall success of the organization. A value chain charts the path by which products and services are created and eventually sold to customers. The term value chain reflects the fact that, as each step of this path is completed, the product becomes more valuable than it was at the previous step (Ketchen & Short, 2011). Value chain analysis describes the activities within and around an organization, and relates them to an analysis of the competitive strength of the organization (Porter, 1985). Therefore, it evaluates which value each particular activity adds to the organizations products or services. This idea was built upon the

insight that an organization is more than a random compilation of machinery, equipment, people and money. Only if these things are arranged into systems and systematic activates it will become possible to produce something for which customers are willing to pay a price. Porter argues that the ability to perform particular activities and to manage the linkages between these activities is a source of competitive advantage. Value chains include both primary and secondary (support) activities. Their detail description is in (Porter, 1985, cited in Ketchen & Short, 2011, p. 150-151).

MCDM methods are represented by WSAM, TOPSIS and fuzzy TOPSIS. The WSAM is probably the most commonly used approach, if there are m alternatives and n criteria then the best alternative is the one that satisfies most. The assumption that governs this model is the additive utility assumption. That is the total value of the alternative is equal to the sum of the products (Panos, 2000). In this paper it was used to aggregate the total evaluation of each category of the SWOT analysis. The TOPSIS calls for ordinal information on attributes of variants as well as the criteria preference expressed in weight vector and is based on measuring distance from the ideal and negative-ideal solution. TOPSIS assumes that each attribute takes the monotonically increasing or decreasing utility. One approach is to take an alternative which has the weighted minimum Euclidean distance to the ideal solution (Panos, 2000). Since the last decade TOPSIS has been applied for analysing SWOT analysis among those the recent ones include application of TOPSIS and SWOT analysis for supplier selection and order allocation problems (Arabzad et al, 2015), a combination TOPSIS and AHP entropy in research of development strategy (Xu, Feng & Yang, 2016) and in evaluating and ranking of human resource and business strategy (Shakerian, Dehnavi & Ghanad, 2016). The fuzzy TOPSIS is an extension of TOPSIS with where fuzzy set theory is incorporated in the fuzzy set to deal with uncertainty and vagueness in data collection. The decision-maker is supposed to judge the relative importance of each pair of criteria. The elements of matrix are considered to be an estimation of importance of i -th and j -th criteria. The Saaty scale of relative importance (Saaty, 1996) is used for the proposal of the Saaty matrix that the matrix has all positive and reciprocal elements. The criteria weights or variant values are computed on the basis of eigen values and vectors or geometrical mean (Geomean) of Saaty matrix lines (Saaty, 2008) and then normalized.

Fuzzy integrals are tools used to summarize all the pieces of information provided by a function in a single value; this value could be a sort of average of the function, in terms of the underlying fuzzy measure (Haile & Krupka, 2016; Sugeno, 1977; Wei, Liou & Lee, 2008). Measure in its classic definition uses additive property, but most real world problems cannot be measured using additive measures. In most of the cases fuzzy measure has applications in many fields such as data mining, image processing and so on (Sugeno, 1974). Fuzzy integrals are integrals of a real function with respect to a fuzzy measure, by analogy with Lebesgue integral which is defined with respect to an ordinary (i.e. additive) measure. There are several definitions of fuzzy integrals, among which the most representatives are those of Sugeno fuzzy integral (Sugeno, 1974) and Choquet fuzzy integral. In this paper Choquet fuzzy integral was chosen for its unique solution (Choquet, 1953; Haile, Krupka & Mastalka, 2016).

A case study method will be used for explanation of using methods in the model and its verification. The Case study method is a common method used among researchers. Eisenhardt and Graebner (2007) recommended case study as a suitable method for

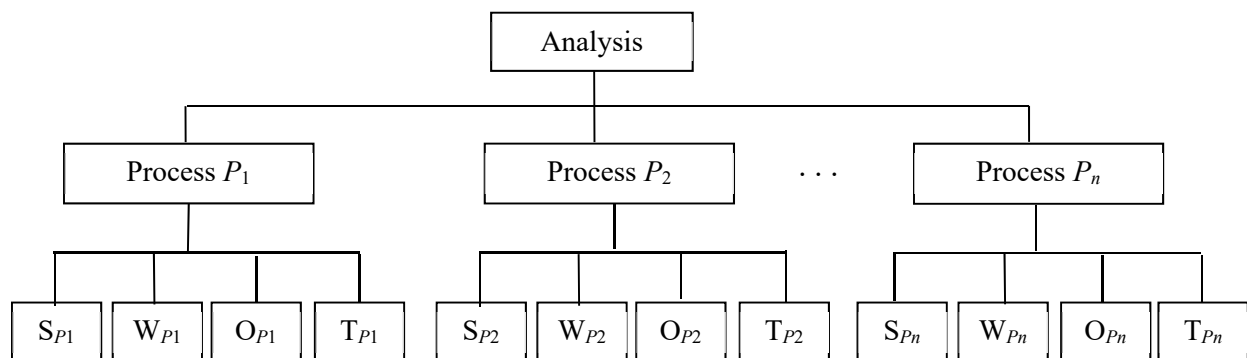
illuminating and extending relationships that provide understanding of complex phenomena (Eisenhardt & Graebner, 2007; Yin, 2009); this approach offers the possibility to address the dynamic interactions (Langfield-Smith, 1997) and helps maintain the validity of the obtained results (Fisher & Ziviani, 2004; Hyett, Kenny & Dickson-Swift, 2014).

3 Discussion and results

The value chain framework can be modified for different areas (Hutaibat, 2011; Normann & Ramírez, 1993; Pil & Holweg, 2006; Sison & Pablo, 2000). The approach to an analysis of value chain framework on the basis of MCDM is used in (Igbinovia & Krupka, 2017; Liao, 2014).

The value chain's different primary activities are based on the organization and an evaluation of the each primary activity can be realized on the basis of SWOT analysis and MCDM methods that it can find the best strategy. Since the aim is to evaluate each process in primary activities and the value it is adding to the final product and over all the success of the organization. Secondary activities are not evaluated as processes. The MCDM evaluation of processes will be done on the basis of hierarchical analyses of primary activities (Fig. 1).

Fig. 1: Hierarchical analyses of primary activities



Source: Authors

For instance: ATEMIT, Ltd. takes raw material for flooring and provides customer with quality tiled floor. The main output of this business is service. To provide this service the production department as the process, has to work on providing customers quality flooring where the promotion department works to get customers attention and customer relation is another department in this business that directly provides service for customers.

The surveyed business ATEMIT, Ltd. offers services in industrial markets. It mainly focuses on wall covering and laying of floor coverings. Operates on a saturated market. It is the exclusive representative of Densit (extremely resistant cast floor). It offers its services in the building industry, the food industry and in the engineering industry. The number of employees ranges from 25 to 49. The company is very successful. It reaches high turnover, belongs to the top 10% of companies in the Czech Republic (CR). In the last period, the company has stagnated year-on-year. Process of data collection started in the end of 2015. The internal and external influences of the company were identifying during the spring and autumn 2016. During the year 2017, consultations were carrying

out with the company representatives and options for setting of qualitative assessment and performing of analyses were looking for.

It has been found to have well-engineered internal guidelines and standards, actively using communication mix tools, and building long-term relationships with customers. It primarily uses personal sales, sales promotion, and advertising. The company did not work with an analytical apparatus that would give it a wider view of the overall situation within the business with the link to its surroundings.

SWOT analysis for the ATEMIT, Ltd. was performed by external experts based on the assessment of the internal staff. These characteristics (factors) were classified into Strength (S), Weakness (W), Opportunity (O) and Threat (T) based on the values provided by experts. As discussed in the text above the aim of this paper is to show a modified application of SWOT analysis using the value chain method to sub classify characteristics in this case as Product (in the following text only *P*), Customer relation (only *C*) and Promotion (only *PM*) it means that the primaries activities (processes) for ATEMIT, Ltd. are *P*, *C* and *PM*.

The possible combination of strategic options for the company are discussed below:

- Under SO strategy there are *P* means: Independence from Denzit's temperature fluctuations in conjunction with Competitors does not offer comparable quality and application at different temperatures. Here we do not derive from the highest value in terms of opportunities, but from what is in relation to that strong side; *C* means: To take advantage of the opportunity to contact designers of new buildings to incorporate quality floor into their designs the unsatisfied market of CR in relation to Employee Orientation per customer, Network of Trained Traders; *PM* means: Willingness to confirm and boast a new floor in reference to the Reference Sheets
- Under ST strategy there are *P* means: The threat of addiction to poor quality. Suppliers and Competition is achieved (in reasons no longer a competitive advantage); Competitiveness innovations (resin is no longer a competitive advantage, Denzit touches); To compensate for the development of new products; *C* means: Customer tries to save and crisis economies in the context of Employee Orientation on Customer and Personal Meetings and Customer Relationship Dealer (trained business skills plus knowledge of customer needs) In order to save costs by convincing the customer that cheap is not necessarily the most effective
- Under WO strategy there are *C* means: To buy a new database and that the market is unsatisfied, it is recording that it will use larger database for the future. This will be an important investment if the company decide to expand the market geographically.

The WSAM method, Saaty method, TOPSIS and fuzzy integral were used for the quantitative evaluation of SWOT analysis and recommendation for the choice of best strategy.

Based on the figure above (Fig. 1) the processes of the studied company, ATEMIT, Ltd., were divided in to three processes namely *P*, *PM* and *C*. Each of these processes was then evaluated using the proposed methods WSAM, fuzzy TOPSIS and fuzzy integral and TOPSIS with input data normalized by Saaty matrix.

The Table 1 shows the WSAM analysis of the strength of P of the tile company. The P strength is described by i -characteristic. The weight w_E was suggested and discussed by the internal staff and external experts. The performance, is the status of the company, was calculated using fuzzy trapezoidal membership function of experts linguistic variables ‘not satisfactory’, ‘satisfactory’ and ‘very satisfactory’, for the Universe $\in [1, 10]$, and was defuzzified.

Tab. 1: Characteristic weights w_W of Strength of P on the basis of WSAM

Strength i -characteristic of product S_{P, Ch_i}	w_E	Performance	w_W
Product quality (density) of exclusive representation S_{P, Ch_1}	0.5	9.5	0.714
Development of new products S_{P, Ch_2}	0.5	9.5	0.714
Density dependent on temperature fluctuations during application S_{P, Ch_3}	0.6	5.5	0.86
Offers comprehensive solutions - design, applications, customer service S_{P, Ch_4}	0.5	9.5	0.714
Weighted sum / Weighted sum average	17.55 / 8.36		

Source: Authors

The results in the table (Table 1) 8.36 show the total value derived for the Strength of P process in the ATEMIT, Ltd.

The Table 2 shows the pair-wise comparison of each P characteristic (criteria) S_{P, Ch_1} , S_{P, Ch_2} , S_{P, Ch_3} and S_{P, Ch_4} of SWOT analysis using Saaty matrix S . The result on the basis of Saaty method is the normalized weight w_i .

Tab. 2: Characteristic weights w_i of Strength of P on the basis of Saaty matrix

Characteristics S_{P, Ch_i}	w_E	S (CR is $1.65 \cdot 10^{-16}$)				Geomean	w_i
S_{P, Ch_1}	0.5	1	1	1/3	1	0.75	0.17
S_{P, Ch_2}	0.5	1	1	1/3	1	0.75	0.17
S_{P, Ch_3}	0.6	3	3	1	3	2.27	0.5
S_{P, Ch_4}	0.5	1	1	1/3	1	0.75	0.17

Source: Authors

The resulted w_i was used to calculate fuzzy aggregate value that is the overall evaluation of the strength of product of the company. First the Lambda that is the combined effect of weights was calculated then the aggregate evaluation was obtained using Choquet fuzzy integral. The resulted value from this evaluation for the Strength of P was 7.489.

After analysing each category of processes P , C and PM (it means Product, Customer relation and Promotion) with respect to weights provided by experts the TOPSIS method was used to choose the best strategy using Min-Min, Min-Max, Max-Min and Max-Max.

From the results obtained using WSAM, Choquet fuzzy integral and TOPSIS experts derived a suggestion of possible strategies. The following tables show the resulted evaluation of S O, W O, S T and W T using TOPSIS and fuzzy TOPSIS.

Tab. 3: Possible strategies on the basis of Choquet fuzzy integral and TOPSIS

S O		W O	
$S_C O_C$	0.325973	$W_C O_C$	0.176167
$S_P O_P$	0.325514	$W_P O_P$	0.175309
$S_{PM} O_{PM}$	0.264901	$W_{PM} O_{PM}$	0.182523
S T		W T	
$S_C T_C$	0.303291	$W_C T_C$	0.146453
$S_P T_P$	0.297977	$W_P T_P$	0.136871
$S_{PM} T_{PM}$	0.210666	$W_{PM} T_{PM}$	0.113021

Source: Authors

Tab. 4: Possible strategies on the basis of fuzzy TOPSIS

S O		W O	
$S_C O_C$	0.482343	$W_C O_C$	0.219256
$S_P O_P$	0.479021	$W_P O_P$	0.225212
$S_{PM} O_{PM}$	0.42855	$W_{PM} O_{PM}$	0.216885
S T		W T	
$S_C T_C$	0.434633	$W_C T_C$	0.167633
$S_P T_P$	0.392687	$W_P T_P$	0.098506
$S_{PM} T_{PM}$	0.342398	$W_{PM} T_{PM}$	0.096219

Source: Authors

Based on the results (Table 3 and Table 4) from the above tables the best strategy is $S_C O_C$; that is to use the strength of customer relation to utilize the opportunity in customer relation. The conclusions summarized in Table 3 and Table 4 show that the first three positions for strategy are $S_C O_C$, $S_P O_P$ and $S_C T_C$. The difference was only in the 4th and 5th positions and only in the change of their order and the other differences were reflected in other positions (namely 7th and 9th positions). However, the strategies listed in these positions are no longer included in the draft strategy. Expert with real-world knowledge had a peer-reviewed opinion and recommendations for the following company's strategy. The expert agrees on the strategic option $S_C O_C$ as discussed above so there are two options of $S_C O_C$ customer relation strategy:

- To take advantage of the opportunity to contact designers of new buildings to incorporate quality floor into their designs
- Unsatisfied market of CR in relation to Employee orientation per customer, Network of trained traders.

Based on the weights of these criteria the first choice of strategy option should be to take advantage of the opportunity to contact designers of new buildings to incorporate quality floor into their designs. However, the expert did agree with this choice not recommend this because of the fact that designers of new buildings are not willing to design such high-quality floors for their financial purposes for financial reasons and in this case, its advantage diminishes. We believe that this distinction has already occurred at the beginning when business representatives have erroneously identified this opportunity as being of high value.

This finding shows that the final calculation is always derived from the quality of the input data. Therefore, it is important, in quantification of input factors, to promptly ask the contracting authority how to determine the values. Again, the calculation must be checked and verified by an expert with real-world knowledge and cannot be 'blindly' implemented.

Conclusion

The aim of the article was to propose and analyse quantitative evaluation of the SWOT analysis based on a case study. The SWOT analysis works with a language description of input factors, fuzzy set theory was used to work with uncertainties, and fuzzy integrals and TOPSIS, and fuzzy TOPSIS were used to evaluate the characteristics (criteria) of the SWOT analysis. The chosen methods were used on the information of the selected real business ATEMIT, Ltd. It offers industrial floors on the market in the CR. The underlying information was collected in cooperation with the representatives of the company.

The qualitative data acquisition approach was chosen for the case study method. In this case, this was the explanatory case study that was used to describe and explain the use of uncertainty methods for working with SWOT analysis of the real organization. The same conclusion (Table 4) to choose the above S_cO_c strategy was obtained from the analysis using fuzzy TOPSIS method. Although not all the strategic options rank the same way from the two analyses there is a strong correlation between the rankings of the two methods.

Based on the above analysis, it can be stated that the advantage of using fuzzy methods is the ability to work with the vagueness, the uncertainty that is a natural component present when compiling the SWOT analysis. Achieved results can have an important place when considering the choice of the final strategy. However, the results obtained using fuzzy methods are only a recommendation to decide on the choice of an appropriate strategy.

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