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Competitive Strategy Decision Making Based on the Five Forces Analysis with AHP/ANP Approach

Abstract

The paper deals with a strategy making process on an example of high-tech firm. The strategy making process is the key task of any organization but especially in the fast changing environment of a high-tech firms it is crucial to also look ahead be able to differentiate the strategy approach. The strategic thinking is a structured decision making process that requires an assessment and evaluation of a large number of factors, criteria and data. When dealing with innovative approaches to decision making and strategic thinking it is necessary to follow a standardized structure. Contemporary knowledge society is determined by scattered information that can be accessed by a large number of subjects. This gives a great possibility to an independent subject to gather large intelligence about the business environment and all other related issues. This large quantity of information has to be structured in a hierarchical manner with interrelations. Even with this access to extensive intelligence the decision making process is always biased by some degree of subjectivity because it is made by people even with high competency. The paper presents an approach to strategic decision making process that uses well known Porter's Five Forces Analysis amplified by application of multiple attribute decision making decomposition methods Analytic Hierarchy Process and Analytic Network Process. The aim of the paper is to present both methods and compare the results of the competitive strategy decision making process using these methods also with the traditional approach. The first part of this paper includes an introduction to the strategic decision making and five forces analysis. The next part deals with multiple attribute decision making methods especially with the AHP and ANP with short review of up to date references. Following part is concerned with the methodology and general approach. The results are presented in the final part together with discussion and further applications.

Key Words

AHP, ANP, Five Forces Analysis, multiple attribute decision making, strategic management, strategic decision making

JEL Classification: M10, C44

Introduction

Contemporary business environment is facing a very challenging period. The levels of uncertainty are changing but they still seem to have and upward trend. Businesses are having a difficult period when long term strategies are hard to establish. Large numbers of firms have their own vision and mission but means of getting towards them are hard to implement. Strategic thinking has to adapt. It is necessary to evaluate more variables

then before but at the same time the schedules and resources are stretched and product cycles are also getting shorter. Larger companies have the upper hand in this resource based competition and thus smaller firms have to look for affordable services or have to cooperate in order to compete. This is getting common in all aspects of the business life.

The purpose of this paper is to implement AHP and ANP methods within the Five Forces Analysis framework and show its implication for strategic decision making. Presented approach is illustrated on a decision making problem of a high-tech manufacturing company, see [19], [23].

1. Literature review

Scholars in [4], [7], [18] have given evidence that business environment is going through a period of development of the knowledge society that has influenced decision making processes of firms, organizations and individuals. However many important strategic decisions are made on the basis of self evidence, intuition and not fully comprehend relationships among evaluated criteria. In recent years there has been a shift towards more frequent use of decision support tools and methods see [17]. Unfortunately their implementation is still not widespread among small and medium-sized companies. There have been efforts to implement more innovative tools to firms but they are mostly used for supportive tasks not for actual decision making [7]. However, small and medium sized firms do not have to purchase expensive software or implement sophisticated decision support processes but just understand some basic decision making methods that can help to make their work more effective. Among the most practical and useful Analytic Hierarchy Process (AHP) and Analytic Network Process (ANP) can be named. These methods represent a group of decomposition multiple attribute decision making approaches that were developed by Saaty, see [11], [12], [13].

There is little doubt that contemporary economy and entrepreneurial environment is going through a very turbulent time [14]. There is a constant need for evaluation and assessment of vast number of key business elements [16]. Businesses are pushed for faster innovation as the product and service life cycles are shortening especially in the industrial sector [1]. In order to face such critical period firms have to be aware of their competitive position. It is not necessary to investigate complicated approaches just to focus on those that can be adapted to any business environment and case such as well known Porter's Five Forces Analysis see [8], [9]. Application this analysis leads to strategic decision making where three main strategies can be differentiated: cost leadership, differentiation and focus. Recently there have been numerous application of such strategic analyses combined with decision making methods in [2], [3], [10], [13] with practical results. Some of these cases were also combined with a use of specialized software for AHP/ANP decision making. This paper focuses on ordinary use that can be performed using MS Office software.

2. Strategic decision making

Strategic decision making is a tool for steering the company towards its vision and long term goals. Medium-sized or small firms have to use this instrument as effective as possible. Hence they do not possess resources that can be allocated to a larger number of efforts made towards the strategy development and implementation. They should select one or two alternative scenarios of strategic development to follow. Therefore allocation of resources plays a crucial part of their strategic management.

All businesses must be able to evaluate their competitive market position. There are several instruments that can be employed. To assess the competitive position from a competitive advantage perspective Porter [8] have developed the Five Forces analysis that helps a firm to understand its business environment in relation to current competitors, its customers, suppliers, substitute products and threats of a new competition. Based on this analysis the firm can develop strategies that would be more appropriate for future situation of the competitive environment.

In developing the five forces model Porter [8] and [9] applied microeconomic principles to business strategy and analyzed the strategic requirements of industrial sectors, not just specific companies. The five forces are competitive factors which determine industry competition and include: suppliers, rivalry within an industry, substitute products, customers or buyers, and new entrants. Although the strength of each force can vary from industry to industry, the forces, when considered together, determine long-term profitability within the specific industrial sector. The strength of each force is a separate function of the industry structure, which Porter defines as "the underlying economic and technical characteristics of an industry." Collectively, the five forces affect prices, necessary investment for competitiveness, market share, potential profits, profit margins, and industry volume. The key to the model is to analyze continuous dynamics within and between the five forces. The model's specific characteristics are advantageous towards multiple attribute decision making approach.

3. Multi level decomposition decision making methods

The fundamental advantages of multi-criteria decision making methods can be found in the decision maker's ability to evaluate each alternative using a large number of criteria. Alternatives are the possible courses of action in a decision problem. It is important that every attempt is made for the development of all possible alternatives. Failure to do so may result in selecting an alternative for implementation that is inferior to other unexplored ones. Attributes are the traits, characteristics, qualities, or performance parameters of the alternatives. Attributes, from the decision making point of view, are the descriptors of the alternatives. For MADM, attributes usually form the evaluation criteria. Criteria (Evaluation) can be perceived as the rules of acceptability or standards of judgment for the alternatives. Therefore, criteria encompass attributes, goals, and objectives.

3.1 Description and methodology of the Analytic Hierarchy Process (AHP)

The problem of multiple attribute evaluation of alternatives is foremost a task of finding of optimal (best) alternative and raking of these alternatives from the best to the worst plausible. In short it is the optimization problem. Decomposing multiple attribute methods are well suited for evaluation of finite number of alternatives. One the most widely used methods is the Analytic Hierarchy Process. The theoretical procedure of the AHP method consists of four steps: (i) hierarchy design (goal definition, identification of alternatives, identification of evaluation factors, assignment of criteria and factor relationships and finishing of the hierarchy), (ii) identification of priorities (application of pair-wise comparison, point evaluation of significance, repeating of the procedure for all hierarchy levels), (iii) combination and (iv) evaluation (weighted values of alternative solutions). Simultaneously with the creation of structured hierarchy a system of criteria groups (sub-criteria) and alternatives. The most widely employed illustration of the hierarchy is a diagram. The Saaty's method of pair-wise comparison [11] has to be applied on each level of the hierarchy structure. The first level of the hierarchy is the goal of the evaluation (selection of the best alternative, rank of alternatives, etc.). The second level of the hierarchy represents evaluation criteria (the goal of the evaluation depends on which evaluation criteria will be used). The third level of the hierarchy is made of evaluation sub-criteria. And finally the fourth level of the hierarchy includes alternatives which utility depends on their relationship towards evaluation criteria and sub-criteria. Saaty approach deals with the notion that human perception of the decision making problem can be hierarchically structured in order to minimize the scope of criteria comparisons to the suggested limit of 7. It is also best to use proposed comparison scale for the pair-wise comparison matrixes see Tab. 1.

Tab. 1 Saaty's comparison fundamental scale

Degree	Descriptor
1	Criteria *i* and *j* are equal
3	Low preference of criteria *i* before *j*
5	Strong preference of criteria *i* before *j*
7	Very strong preference of criteria *i* before *j*
9	Absolute preference of criteria *i* before *j*
2, 4, 6, 8	Medium values for more precise preference determination.

Source: see [11]

The rank of alternatives and selection of the optimal one is based on weighted sum criteria (total weighted utility) of the alternative. Then for the weighted sum criteria of normalized weights following formula can be applied:

$$U(a_i) = \sum_{j=1}^{m} w_j \cdot x_{i,j}, \tag{1}$$

where x_{ij} represents the evaluation of the *i*th alternative according to the *j*th criterion. the w_j represents the normalized weight of the *j*th criteria. The weights w_j can be obtained through an algorithm based on the geometric mean method (method of least logarithmic squares) under the same necessary condition then the solution is a normalized geometrical mean of the matrix as follows

$$w_i = \frac{\left[\prod_{j=1}^{k} s_{ij}\right]^{1/k}}{\sum_{i=1}^{k}\left[\prod_{j=1}^{k} s_{ij}\right]^{1/k}}, \text{ for } i = 1,\ldots,k \tag{2}$$

The geometrical mean can be calculated using MS Excel function *GEOMEAN*. This function will be employed for calculations in the application part. In the AHP method, decision makers or experts who make judgments or preferences must go through the consistency test. In order to determine that if the judgment of the respondents satisfies the consistency, which are conducted based on the consistency ratios (*CR*) of the comparison matrixes. *CR* is calculated using following formulas:

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

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

where *RCI* is a random index [11] . When $CR \leq 0.1$, it can be regarded as the valuation process satisfies the consistency. To calculate *CR* it is necessary to calculate the consistency index *CI* first. If CI = 0, satisfies the consistency. If $CI > 0$, means the experts have conflicting judgments. If $CI \leq 0.1$, a reasonable level of consistency. The practical AHP procedure consist of: (i) creation of the hierarchy, weight quantification for each criteria (sub-criteria), (ii) comparison of alternatives according to identified criteria, analysis of consistency (C.R.) and (iii) finding of the optimal alternative (with the highest value of utility function $U(a_i)$).

3.2 Description and methodology of the Analytic Network Process (ANP)

The ANP structures the problem related to options in reverse logistics in a hierarchical form. With the ANP, the interdependencies among criteria, sub-criteria and determinants for the options can be considered. The original analytical network process (ANP) was proposed in [12]. ANP is the extension of analytic hierarchy process (AHP) and is a more general form of AHP. ANP can involve the representation of relationships hierarchically, but it does not need as strict a hierarchical structure as AHP. Many decision problems cannot be structured hierarchically because they involve the interaction and dependence of higher level elements on low level elements. Saaty in [12] applied ANP to handle dependence among criteria and alternatives without assuming independent decision criteria. The ANP feedback approach replaces hierarchies with networks, and emphasizes interdependent relationships among various decision-making also interdependencies among the decision criteria and permit more systematic analysis. For pair-wise comparison Saaty's comparison fundamental scale is widely considered as a default, see Table 1. The ANP uses the "supermatrix" to performance the relationships of criteria and the degree of importance. The supermatrix *W* can be observed in (5). To obtain global priorities in a system with interdependencies, the

supermatrix lists down all the sub-matrixes consisting of all criteria and necessary elements. They are put in order on the left and upper sides of the matrix, where W_{ij} represents all possible and logical pair-wise comparisons as follows:

$$W = \begin{matrix} goal \\ criteria \\ sub-criteria \\ alternatives \end{matrix} \begin{bmatrix} W_{11} & \cdots & \cdots & W_{1n} \\ W_{21} & W_{ij} & \cdots & W_{2n} \\ \vdots & \cdots & \cdots & \vdots \\ W_{m1} & W_{n2} \cdots & W_{n(n-1)} & W_{n,n} \end{bmatrix} \tag{5}$$

For calculation of limited supermatrices of the noncyclical ANP according to [13] can be applied:

$$\overline{W}^{\infty} = \lim_{k \to \infty} \overline{W}^{k} \tag{6}$$

where $\overline{W}^{\infty}$ is the limited supermatrix, $\overline{W}^{k}$ is the supermatrix without a cycle powered k-times. In the case of the cyclic matrix following formula should be applied [13]:

$$\overline{W}^{N} = \frac{1}{N} \sum_{k}^{N} \overline{W^{k}} \tag{7}$$

4. Five Forces Analysis with strategic decision making using AHP and ANP

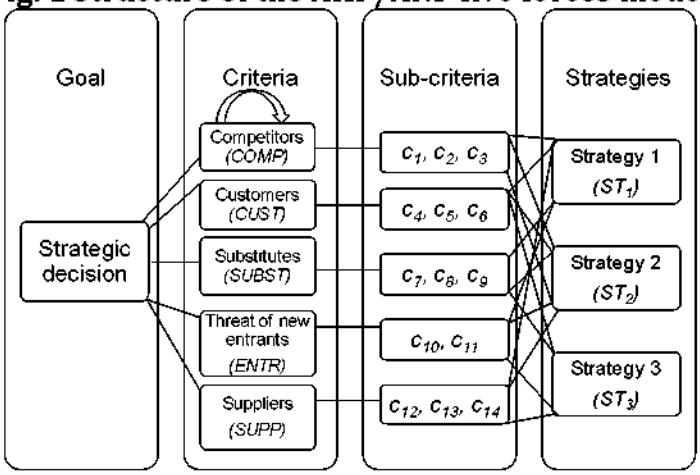
The proposed framework utilizes Porter's five competitive forces as shows Fig. 2. According to this structure, the relative importance of the competitive forces (criteria) in terms of their influence on market performance and competitive advantage of the firm (goal), and the relative importance of the competitive market strategies (alternatives) with respect to the competitive forces must be acquired through performing pair wise comparisons by asking the following questions, respectively: Which competitive force has more impact on the firm's market performance and competitive advantage, and how much more? Which competitive market strategy is more dominant with respect to impeding a particular competitive force, and how much more?

4.1 Model design

The difference between AHP and ANP approach resides in the structure where the characteristic ANP loop (feedback) is missing in the AHP model. Based on the structure on the Figure 1 both methods were applied and results calculated. The procedure of the AHP/ANP model application involves 7 steps that begin with the actual five forces analysis and ends with strategic decision: (i) five forces analysis of the business environment; (ii) creation of a structured decision making model with 5 criteria and relevant sub-criteria; (iii) pair-wise comparisons using Saaty method and pair-wise comparison matrices; (iv) application of the AHP, calculation of weights and utility

function; (v) pair-wise comparison of criteria with regard to each criteria; (vi) creation of ANP supermatrix and calculation of the limited supermatrix; (vii) comparison of AHP and ANP results and strategic decision.

Fig. 1 Structure of the AHP/ANP five forces model



Source: own elaboration.

4.2 Application of the model on a case study

The decision-making criteria were identified in particular forces and were available for actual analysis. The data about the monitored company were taken from following sources [19], [20], [21], [22], [23]. The five forces analysis has identified 14 criteria (c_1,...,c_{14}) and three generic strategies (ST_1, ST_2, ST_3, resp. cost leadership, differentiation and focus). The goal of the following AHP method is the strategic decision making between proposed strategies. All criteria were pair-wise compared and weights have been calculated. Next the utility function $U_1(a_i)$ was estimated as shown on the Tab. 2.

Tab. 2 Utility function estimation by AHP

Criteria	c_1	c_2	c_3	c_4	c_5	c_6	c_7	c_8	c_9	c_{10}	c_{11}	c_{12}	c_{13}	c_{14}	$U_1(a_i)$
Weights	0.292	0.070	0.101	0.127	0.052	0.021	0.037	0.059	0.016	0.044	0.015	0.100	0.033	0.033	
ST_1	0.661	0.466	0.143	0.140	0.128	0.359	0.687	0.113	0.405	0.630	0.117	0.709	0.637	0.558	*0.450*
ST_2	0.208	0.433	0.286	0.333	0.276	0.517	0.127	0.379	0.481	0.151	0.268	0.113	0.105	0.122	*0.251*
ST_3	0.131	0.100	0.571	0.528	0.595	0.124	0.186	0.508	0.114	0.218	0.614	0.179	0.258	0.320	*0.298*

Criteria	c_1	c_2	c_3	c_4	c_5	c_6	c_7	c_8	c_9	c_{10}	c_{11}	c_{12}	c_{13}	c_{14}	$U_1(a_i)$
Equal Weights	0.126	0.030	0.044	0.127	0.052	0.021	0.067	0.106	0.028	0.150	0.050	0.120	0.040	0.040	
ST_1	0.661	0.466	0.143	0.140	0.128	0.359	0.687	0.113	0.405	0.630	0.117	0.709	0.637	0.558	*0.438*
ST_2	0.208	0.433	0.286	0.333	0.276	0.517	0.127	0.379	0.481	0.151	0.268	0.113	0.105	0.122	*0.240*
ST_3	0.131	0.100	0.571	0.528	0.595	0.124	0.186	0.508	0.114	0.218	0.614	0.179	0.258	0.320	*0.322*

Source: own elaboration.

The results were compared with utility function $U_2(a_i)$ that was using equal weights among Porter's five forces. Decision making criteria according to Five forces model:

- Competitors: market share (c_1), product range(c_2), distribution channels (c_3);

- Customers: relationship with current customers (c_4), customer sensitivity on changes and quality of products and services (c_5), potential of new customers (c_6);
- Substitutes: quality of substitutes (c_7), availability of substitutes (c_8), upcoming substitutes (c_9);
- Threat of new entrants: estimated costs of entrance to the market (c_9), other barriers to the entrance (c_{10});
- Suppliers: costs of raw materials (c_{11}), currency risk (c_{12}), reliability of suppliers (c_{13}).

The following Tab. 3 shows weighted supermatrix used for ANP method. This matrix has to be normalized and the calculated in iterations using (7).

Tab. 3 Unweighted supermatrix for ANP method

	GOAL	COMP	CUST	SUBST	ENTR	SUPP	c_1	c_2	c_3	c_4	c_5	c_6	c_7	c_8	c_9	c_{10}	c_{11}	c_{12}	c_{13}	c_{14}	ST_1	ST_2	ST_3
GOAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMP	0.464	1.000	0.196	0.292	0.517	0.294	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.464	0.464	0.464
CUST	0.200	0.306	1.000	0.146	0.238	0.137	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.200	0.200	0.200
SUBST	0.112	0.087	0.435	1.000	0.077	0.069	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.112	0.112	0.112
ENTR	0.058	0.466	0.299	0.471	1.000	0.500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.058	0.058	0.058
SUPP	0.166	0.140	0.070	0.091	0.168	1.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.166	0.166	0.166
c_1	0	0.630	0	0	0	0	1.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0.479	0.595	0.230
c_2	0	0.152	0	0	0	0	0	1.000	0	0	0	0	0	0	0	0	0	0	0	0	0.380	0.128	0.122
c_3	0	0.218	0	0	0	0	0	0	1.000	0	0	0	0	0	0	0	0	0	0	0	0.140	0.276	0.648
c_4	0	0	0.637	0	0	0	0	0	0	1.000	0	0	0	0	0	0	0	0	0	0	0.184	0.600	0.400
c_5	0	0	0.258	0	0	0	0	0	0	0	1.000	0	0	0	0	0	0	0	0	0	0.584	0.200	0.200
c_6	0	0	0.105	0	0	0	0	0	0	0	0	1.000	0	0	0	0	0	0	0	0	0.232	0.200	0.400
c_7	0	0	0	0.332	0	0	0	0	0	0	0	0	1.000	0	0	0	0	0	0	0	0.605	0.582	0.332
c_8	0	0	0	0.528	0	0	0	0	0	0	0	0	0	1.000	0	0	0	0	0	0	0.291	0.109	0.528
c_9	0	0	0	0.140	0	0	0	0	0	0	0	0	0		1.000	0	0	0	0	0	0.105	0.309	0.140
c_{10}	0	0	0	0	0.750	0	0	0	0	0	0	0	0	0	0	1.000	0	0	0	0	0.250	0.833	0.750
c_{11}	0	0	0	0	0.250	0	0	0	0	0	0	0	0	0	0		1.000	0	0	0	0.750	0.167	0.250
c_{12}	0	0	0	0	0	0.600	0	0	0	0	0	0	0	0	0	0	0	1.000	0	0	0.582	0.168	0.600
c_{13}	0	0	0	0	0	0.200	0	0	0	0	0	0	0	0	0	0	0	0	1.000	0	0.109	0.484	0.200
c_{14}	0	0	0	0	0	0.200	0	0	0	0	0	0	0	0	0	0	0	0	0	1.000	0.309	0.349	0.200
ST_1	0	0	0	0	0	0	0.661	0.466	0.143	0.140	0.128	0.359	0.687	0.113	0.405	0.630	0.117	0.709	0.637	0.558	1.000	0	0
ST_2	0	0	0	0	0	0	0.208	0.433	0.286	0.333	0.276	0.517	0.127	0.379	0.481	0.151	0.268	0.113	0.105	0.122	0	1.000	0
ST_3	0	0	0	0	0	0	0.131	0.100	0.571	0.528	0.595	0.124	0.186	0.508	0.114	0.218	0.614	0.179	0.258	0.320	0	0	1.000

Source: own elaboration.

Following Tab. 4 shows weights calculated by AHP and ANP methods. It can be seen that results are very similar and thus confirm that based on expert pair-wise comparisons there is a difference among courses of actions with regard to the strategic decision.

Tab. 4 Local and global priorities of criteria estimated using AHP and ANP methods

Five forces AHP						Five forces ANP				
Criteria	Criteria priorities	Sub-criteria	Local priorities	Global priories	Equal criteria priorities	Criteria	Criteria priorities	Sub-criteria	Global priorities	Local priorities
COMP	0.464	c_1	0.630	0.292	0.126	**COMP**	0.342	c_1	0.058	0.479
		c_2	0.151	0.070	0.030			c_2	0.026	0.214
		c_3	0.218	0.101	0.044			c_3	0.037	0.307
CUST	0.200	c_4	0.637	0.127	0.127	**CUST**	0.195	c_4	0.044	0.402
		c_5	0.258	0.052	0.052			c_5	0.038	0.348
		c_6	0.105	0.021	0.021			c_6	0.027	0.250
SUBST	0.112	c_7	0.333	0.037	0.067	**SUBST**	0.126	c_7	0.050	0.491
		c_8	0.528	0.059	0.106			c_8	0.035	0.345
		c_9	0.140	0.016	0.028			c_9	0.017	0.164
ENTR	0.058	c_{10}	0.750	0.044	0.150	**ENTR**	0.202	c_{10}	0.064	0.588
		c_{11}	0.250	0.015	0.050			c_{11}	0.045	0.412
SUPP	0.166	c_{12}	0.600	0.100	0.120	**SUPP**	0.137	c_{12}	0.052	0.499
		c_{13}	0.200	0.033	0.040			c_{13}	0.023	0.227
		c_{14}	0.200	0.033	0.040			c_{14}	0.028	0.274

Source: own elaboration.

There are no significant differences in priorities of model criteria. Estimated priorities from both methods are similar. Some difference can be perceived in the relative distribution of priorities but not in the overall ranking. Following Tab. 5 includes comparison of results for strategy decision making problem. Based on those results we can decide which strategy is more preferred based on expert (even subjective) opinion using AHP and ANP approaches. The strategy that has the highest value of utility is the cost leadership (low cost strategy with sustainable quality).

Tab. 5 Comparison of AHP and ANP results of the strategic decision making

Alternative generic strategies		ANP priorities	AHP $U_1(a_i)$	AHP $U_2(a_i)$
Low-cost strategy with sustainable quality	ST_1	0.431	0.450	0.438
Differentiation strategy to enhance the brand and address new customers	ST_2	0.247	0.251	0.240
Strategy of focus on high-tech products to gain and sustain technical superiority	ST_3	0.322	0.298	0.322

Source: own elaboration.

Conclusion

Proposed model of Porter's five forces analysis combined with decomposition multiple attribute decision making methods AHP and ANP enhances the original model with structured decision making hierarchy and process. The application can be developed further and could include more variables, levels (internal and external, industry and firm) and quantitative data. Illustrative case has shown that even simple AHP method can be applied. However the ANP approach gives more opportunities to put interrelation across selected criteria and sub-criteria. Another advantage of the ANP is also the supermatrix approach that describes relations among criteria and alternatives (strategies) better than sole AHP tables. On the other hand AHP can be also solved using supermatrix.

There are many decision making software available for strategic decision support. The main disadvantage in comparison with presented approach is their rigidness. In this case it is possible to change specification of the model, add more perspectives, factors, etc. After short tutorial managers should be able to use this model tool and apply it on ordinary decision-making tasks. Less complicated cases can be solved quickly using programmed sheets with AHP in MS Excel. Further research is expected into other strategic decision making processes in management models with application of other MADM methods and their combinations.

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