

Determination of the weights of criteria of a company's environment for the development of an effective company strategy

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Abstract The successful development of a company's strategy, which determines the best corporate performance, is mainly affected by its environment which is defined by multidimensional assessment criteria acting in different directions. The incorporation of all such criteria into one generalising and complex dimension is enabled by multi-criteria assessment methods. The article examines the theoretical substantiation of the application of multi-criteria assessment techniques and their practical adaptation in determining the criteria weights of a company's environment so as to develop an effective strategy.

Index Terms: company's environment, company's strategy development, multi-criteria methods, determination of the weights of criteria.

JEL: M2, O10.

I. INTRODUCTION

For a company to develop in a successful manner, it has to continuously adapt to the ever-changing environment, and to understand the potential impact of environmental factors on the performance results of the company as early as possible. It is critical that the company's environment be fully assessed in order to develop an effective strategy. This assessment of where the company is now in terms of its environment determines the choice of strategy. The aim of the article is to determine the weights of the criteria of a company's environment for the development of an effective strategy using the techniques of multi-criteria assessment.

A company's environment is a complicated and complex phenomenon from the point of view of developing an effective strategy. To evaluate it quantitatively a hierarchy-based system of criteria (Ginevičius, 2007) must be developed. To this end the criteria used in theoretical models (Bocken et al., 2015; O'Shaughnessy, 2014; Evans & Short 2013; Everett, 2014; Zavadskas & Turskis, 2011 and others) which affect the corporate environment in terms of strategy development were analysed. A company's environment was defined in an objective and structured manner using a hierarchical system of 43 different criteria, with different impact on a common result (Table 4).

As criteria are multi-dimensional and act in different directions, multi-criteria assessment techniques enable them to be merged into one complex dimension which can then be used to develop a strategy. Values and weights must be set for the criteria of the company's environment for the application of these methods.

II. RANKING OF CORPORATE ENVIRONMENT CRITERIA AND DETERMINATION OF WEIGHTS FOR THE DEVELOPMENT OF A COMPANY STRATEGY

To set weights for the criteria subjective methods are used where specialists' (experts') opinions constitute the basis of assessment (Ginevičius & Podvezko, 2003; 2004a; 2004b; Zavadskas et al., 2004; Hokkannen & Salminen, 1997; Ginevičius et al., 2004) as well as objective ones – where specific values of weights depend on the structure of the block of criteria details (Ustinovičius, 2001; Hwang & Yoon 1981). Furthermore, subjective and objective weights can be generalised and combined in an integral manner (Fan et al., 1977; Beuthe & Scanella, 2001; Ustinovičius, 2001). Of these three, the subjective measurement is the main one; however, it requires high expert qualification since it determines the accuracy of their evaluation. Besides, if they are not sufficiently qualified, contradictory results may be obtained. For this reason, criteria weights may be adjusted to the multi-criteria assessment, if the degree of compatibility of expert assessment is fixed. This is determined by the coefficient of concordance which is calculated on the basis of ranking the compared objects. The result of expert evaluations is the matrix $E = \|c_{ij}\|$ ($i=1, \dots, m; j=1, \dots, r$), where m is the number of compared criteria (objects), and r is the number of experts. Experts can assess the expected value in different ways. For the assessments, any scale of measurement can be applied, for example, measuring in criteria units, percentage, unit fractions, ten-grade system or Saaty's pair-wise comparison scale (Saaty, 2008). To calculate the dispersal coefficient of concordance, however, only the ranking of expert criteria can be used. Ranking is the procedure where the most important criterion is attributed the rank which is equal to one point, the second criterion in terms of importance is given two points, etc. and the least important criterion is given rank m ; where m is the number of compared criteria. Equivalent criteria are

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attributed the same value, namely, the arithmetic mean of ordinary ranks.

The results of the determination of criteria ranks can be applied in practice, if a sufficient level of compatibility of expert opinions is set. Expert opinions and attitudes to the problem being solved often differ and can even be controversial. The compatibility of opinions is determined by the coefficient of concordance which is calculated on the basis of the ranking of compared criteria. The dispersal coefficient of concordance was defined by M. Kendall (1970). The idea of the coefficient was linked to the number of ranks of each criterion c_i with regard to all experts:

$$c_i = \sum_{j=1}^r c_{ij}, \tag{1}$$

to be precise, (it was linked) to the variation of dimensions c_i from the total mean \bar{c} by the total sum of squares S (the analogue of dispersion):

$$S = \sum_{i=1}^m (c_i - \bar{c})^2. \tag{2}$$

The total mean value \bar{c} is calculated according to the formula:

$$\bar{c} = \frac{\sum_{i=1}^m c_i}{m} = \frac{\sum_{i=1}^m \sum_{j=1}^r c_{ij}}{m}. \tag{3}$$

If S is a real amount of squares calculated in accordance with formula (2), the concordance coefficient W is calculated in accordance with the following formula (Kendall, 1970):

$$W = \frac{12S}{r^2 m(m^2 - 1)}. \tag{4}$$

If the opinions of experts are harmonised, the value of the concordance coefficient W is close to 1, whereas, if the assessment differ considerably, the value of W is close to zero.

Kendall proved that (Kendall, 1970) if the number of objects $m > 7$, the significance of the concordance

coefficient may be determined using the criterion χ^2 :

$$\chi^2 = Wr(m-1) = \frac{12S}{rm(m+1)}. \tag{5}$$

A random value is distributed according to the distribution χ^2 with the degree of freedom $\nu = m - 1$. The number of freedom degrees ν of distribution χ^2 does not depend on the number of experts r because it is used to measure the difference between the total number of rankings only. The critical value χ_{kr}^2 is determined according to the level of importance α (in practice, the value α usually equals to 0.05 or 0.01) chosen from the table of the distribution χ^2 with the degree of freedom $\nu = m - 1$. If the value of χ^2 calculated according to formula (5) is higher than χ_{kr}^2 , then the evaluations of the experts are coordinated (Podvezko, 2005).

The hierarchical structure of the system of the company's environment criteria in order to develop an effective strategy provided in Table 4 was used to draw up a ranking questionnaire which had to be completed by highly qualified experts of strategic management who had to evaluate the significance of the rankings of the environment criteria (internal and external, competitive advantage, financial situation, structure of the industry, economic, technological, social and political environment. The importance of the company's environment criteria was measured by 10 highly qualified specialists. Every criterion was given a rank from 1 (to the first most significant) to m (to the least significant). The compatibility of experts' opinions was also verified.

The ranking results of the criteria of the company's competitive advantage are provided in Table 1.

TABLE I
THE COMPETITIVE ADVANTAGE CRITERIA – RANKING RESULTS

Seq. No	Expert Criterion											The total of the rankings	Ranking
		1	2	3	4	5	6	7	8	9	10		
1	The share taken by the industry	8	6	9	3	9	1	1	1	6	4	48	6
2	The general level of the company's competences	7	7	3	7	2	5	2	9	4	6	52	7
3	Technological advantage of the company	6	4	1	4	1	7	4	2	3	2	34	1
4	Flexibility	3	3	2	2	3	6	3	6	2	9	39	2
5	The potential to compete by means of price and quality	2	5	6	5	4	3	5	5	5	1	41	3
6	The strength of the brand	9	2	4	6	7	2	6	3	1	3	43	4
7	The level of client satisfaction	1	1	7	1	5	4	7	7	7	5	45	5
8	The potential of the manufacturing capacity	4	8	8	8	8	8	9	4	8	7	72	8
9	The company's access to funding	5	9	5	9	6	9	8	8	9	8	76	9

Referring to Table 1, it was determined that the sum of the variations of squares S , which was calculated according to formula (2), amounts to $S = 1700$, the coefficient of

concordance W calculated according to formula (3) amounts to $W = 0.283$, the value of χ^2 according to

formula (5), which is $\chi^2 = 22.667$, exceeds the critical $\chi^2 = 15.507$ with the level of importance $\alpha = 0.05$ and degree of freedom $v = 9 - 1 = 8$. All this shows that the opinions of

the experts were harmonised. The criteria defining the financial situation of the company are provided in Table 2.

TABLE II
THE FINANCIAL SITUATION CRITERIA – RANKING RESULTS

Seq. No	Criterion \ Expert	Expert										The total of the rankings	Ranking
		1	2	3	4	5	6	7	8	9	10		
1	Return on investment	4	4	7	4	1	3	7	5	4	3	42	4
2	Profit margin	3	2	4	3	7	2	3	4	3	2	33	3
3	Debt-to-equity ratio	5	5	1	6	6	4	6	6	7	6	52	5
4	Sales	1	6	3	1	5	6	1	1	2	4	30	2
5	Profitability	2	1	2	2	2	1	2	3	1	1	17	1
6	Asset strength index	6	8	8	5	4	5	8	7	8	7	66	7
7	Revenue by product	7	7	6	7	3	7	4	2	5	5	53	6
8	Ratio between fixed and variable costs	8	3	5	8	8	8	5	8	6	8	67	8

Referring to Table 2, the sum of variations of squares S calculated according to formula (2) was determined to be $S = 2279$, the coefficient of concordance W calculated according to formula (3) was determined to be $W = 0.543$, it was determined that the value of χ^2 calculated according to formula 5, namely, $\chi^2 = 37.984$ exceeded the critical $\chi^2 = 14.067$ with the level of importance $\alpha = 0.05$ and the degree of freedom $v = 8 - 1 = 7$. This shows that the opinions of the experts were harmonised.

The criteria of the structure of the industry, economic environment, technological environment, social environment, political environment, internal and external environment were ranked in the same way.

Following the check of the compatibility of the experts' opinions according to the collected data of the ranking

questionnaire, a second questionnaire was designed for highly qualified experts to determine the values of the analysed criteria weights by fractions of a unit and the technique of direct assessment was adapted.

The weights of the criteria defining the competitive advantage of a company by fractions of a unit specified by the ten experts are provided in Table 3. The criteria of the company's technological advantage, flexibility, potential to compete by means of price and quality and the strength of a brand were measured as the most important ones, meanwhile, the weights of other criteria differ only slightly. The criteria of the potential of the manufacturing capacity and the company's access to funding were indicated as having the least significance.

TABLE III
THE WEIGHTS OF CRITERIA OF COMPETITIVE ADVANTAGE

Seq. No	Criterion \ Expert	Expert										Mean of weights
		1	2	3	4	5	6	7	8	9	10	
1	The share taken by the industry	0.1	0.12	0.04	0.09	0.09	0.06	0.08	0.07	0.04	0.1	0.079
2	The general level of the company's competences	0.06	0.08	0.02	0.08	0.08	0.05	0.07	0.06	0.03	0.06	0.059
3	Technological advantage of the company	0.2	0.17	0.3	0.16	0.2	0.3	0.2	0.21	0.5	0.19	0.243
4	Flexibility	0.19	0.16	0.3	0.15	0.19	0.29	0.15	0.2	0.15	0.18	0.196
5	The potential to compete by means of price and quality	0.15	0.15	0.2	0.15	0.15	0.08	0.14	0.2	0.1	0.17	0.149
6	The strength of the brand	0.14	0.15	0.06	0.14	0.1	0.08	0.13	0.09	0.1	0.15	0.114
7	The level of client satisfaction	0.13	0.14	0.05	0.11	0.1	0.07	0.12	0.08	0.05	0.12	0.097
8	The potential of the manufacturing capacity	0.02	0.02	0.02	0.07	0.05	0.04	0.06	0.05	0.02	0.02	0.037
9	The company's access to funding	0.01	0.01	0.01	0.05	0.04	0.03	0.05	0.04	0.01	0.01	0.026

The weights of the criteria of the company's environment for the development of a strategy were measured in the same way; they are provided in Table 4 below.

TABLE IV
WEIGHTS OF CRITERIA OF CORPORATE ENVIRONMENT FOR THE DEVELOPMENT OF AN EFFECTIVE STRATEGY

	Criterion	Weight	Criterion	Weight	Criterion	Weight
	Corporate environment for the development of an effective strategy	Internal environment	0.387	Competitive advantage	0.418	The share taken by the industry
The general level of the company's competences						0.059
Technological advantage of the company						0.243
Flexibility						0.196
The potential to compete by means of price and						0.149
The strength of the brand						0.114
The level of client satisfaction						0.097
The potential of the manufacturing capacity						0.037
The company's access to funding						0.026
Financial situation				0.582	Return on investment	0.109
					Profit margin	0.142
					Debt-to-equity ratio	0.089
					Sales	0.214
					Profitability	0.264
					Asset strength index	0.064
					Revenue by product	0.078
					Ratio between fixed and variable costs	0.040
					The company's susceptibility to R&D	0.068
External environment		0.613	Structure of the industry	0.250	Entrance barriers	0.190
					Elasticity of demand	0.076
					Seasonality of the industry	0.038
					Level of competition	0.223
					Price level	0.056
					Size of the industry	0.143
					General risk level	0.088
					Level of profitability of the industry	0.118
					Economic environment	0.304
			Government expenditure	0.077		
			Economic growth	0.275		
			Unemployment	0.180		
			Inflation	0.211		
			Economic recession and its effects	0.147		
			Technological environment	0.204	Patent protection	0.139
					IT developments	0.240
					R&D activity	0.184
					Energy resource prices	0.112
					Technology transfer level	0.324
			Social environment	0.133	Purchasing power	0.317
					Income distribution	0.338
					Pace of population growth	0.196
					Supply of labour power	0.149
			Political environment	0.109	R&D regulation	0.301
Government regulation	0.699					

Following the determination of ranks and weights which define the environment of a company, it is possible to carry out the quantitative assessment of the criteria of the corporate environment for the development of an effective strategy using multi-criteria assessment techniques.

III. CONCLUSION

An effective corporate strategy is developed after an objective assessment of its internal and external environment is carried out. For this, techniques which allow a phenomenon to be objectively evaluated and decisions to be made, which would ensure the best results of corporate performance, are required.

A company's environment is a complex phenomenon for the development of an effective strategy. To assess it in a quantitative manner, a hierarchical structure of the criteria of a company's environment intended for the development of an effective strategy was developed. The hierarchical structure of criteria describes the corporate environment in detail, and enables the most important aspects of the environment to be defined in a structured way, and the impact which the analysed criteria might have on the common result to be anticipated.

To assess the environment of a company in order to develop an effective strategy by applying the multi-criteria assessment techniques, all environmental criteria have to be incorporated into one generalising dimension, the weights and values of the analysed criteria have to be determined. The weights of criteria and their groups were defined following the determination of criteria rankings and the verification of their compatibility.

REFERENCES

- Beuthe M., & Scanella G. (2001). *Comparative analysis of UTA multicriteria methods*. European Journal of Operational Research, 130(2), 246-262.
- Bocken N. M. P., Rana P., & Short S. W. (2015). *Value mapping for sustainable thinking*. Journal of Industrial and Production Engineering, 32(1), 67-81.
- Evans S., & Short S. (2013). *A value mapping tool for sustainable business modelling*. Corporate Governance: The International Journal of business in Society, 13(5), 482-497.
- Fan Z., Ma J., & Tian P. A. (1977). *Subjective and objective integrated approach for the determination of attribute weights*, in 4th Conference of International Society for Decision Support Systems.
- Ginevičius R., & Podvezko V. (2003). *Quantitative evaluation of significance of hierarchically structured indexes*, in International Conference "Modelling and Simulation of Business Systems", May 13-14, 2003, Vilnius, Lithuania, 22-25.
- Ginevičius, R. (2007). *Hierarchical structuring of processes and phenomena*. Business: Theory and Practice, 8(1), 14-18.
- Ginevičius, R., & Podvezko, V. (2004a). *Complex evaluation of the use of information technologies in the countries of Easters and Central Europe*. Journal of Business Economics and Management, 5(4), 183-191. □
- Ginevičius, R., & Podvezko, V. (2004b). *Quantitative assessing the accuracy of expert methods*. Engineering Economics, 5(40), 7-12.
- Ginevičius, R., Podvezko, V., & Mikelis, D. (2004). *Quantitative evaluation of economic and social development of Lithuanian regions*. Economics, 65, 67-81. □
- Hokkannen J., & Salminen P. (1997). *ELECTRE III and IV decision aids in an environmental problem*. Journal of Multi-Criteria Decision Analysis, 5(6), 215-226.
- Hwang C. L., & Yoon K. (1981). *Multiple attribute decision making-methods and applications*. A State of the Art Survey. Berlin: Springer Verlag.
- Kendall, M. (1970). *Rank correlation methods*. London: Griffin.
- O'Shaughnessy J. (2014). *Competitive marketing: strategic approach*. Routledge, 766.
- Podvezko, V. (2005). *Experts estimate compatibility*. Technological and Economic Development of Economy, 9(2), 101-107. □
- Saaty T. (2008). *Decision making with the Analytical Hierarchy Process*. International Journal of Services Sciences, 1(1), 83-98.
- Ustinovičius L. (2001). *Determining integrated weights of attributes*. Statyba, 7(4), 321-326.
- Zavadskas E. K., Kazlauskas A., Banaitis A., & Kvedarytė N. (2004). *Housing credit access model: the case for Lithuania*. European Journal of Operational Research, 155, 335-352.
- Zavadskas E. K., & Turskis Z. (2011). *Multiple criteria decision making (MCDM) methods in economics: an overview*. Technological and Economic Development of Economy, 17(2), 397-427.