ANALYSIS OF THE FACTORS OF LOCALIZATION OF THE COMPANY DEVELOPMENT USING MCDM METHODS IN PRACTICE

Iveta Dočkalíková – Jana Klozíková

Abstract

When making a strategic decision with respect to the risk and uncertainty it is possible to use various methods and tools, whereas every one of these methodology elements have some advantages and disadvantages and their implementation in practice must correspond to the environment in which the company operates, to the character of industry, selected strategy and a management style. In present time it is very difficult for the companies to achieve their primary goal, that is a profit and other partial goals since the market environment in which the companies operates is constantly changing. The company has to respect the socio-economic conditions of the state, e.g. political, legal, tax and social norms. This paper presents a strategic decision making about the location of the affiliate of the company by using quantitative analytical methods. In the first phase the relevant criteria of the hiring process are structured and weights are estimated. Actual results of evaluation of particular applicant in all criteria are then summarized and the MADM method techniques are applied to determine the ranking of the whole list of the location of the affiliate of the company and both rakings are compared.

Key words: multicriteria decision-making methods, analytic hierarchy process, location, strategic decision-making

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Introduction

Dominant attribute of long term worldwide economy development is the globalization, which without a doubt, significantly influences the competition. Character of the 21st century and continuous changes, in micro and macro environment of the enterprise therefore create the necessity for the enterprises to continuously look for ways how to succeed on the market. Economical performance of company is very important for reach the profit. It is influenced by

companies position at the market, ensuring stability, prosperity and by getting to good companies reputation at the market. Influences of localization are constituent of primary decision making process in company, on which basis is making decision about localization of the company. Important factors are the geographic conditions, state legislation, employment and qualified workforce in the region and so on. So, we can say that, factors of localization affect management of the company. Therefore importance of these factors have to be allowed in the decision making process.

Decision making is important and significant part of business economics. When the decision making problem occurs there usually a limited number of possible variant s but also number of criteria according to which the optimal variant is selected. The popularity of multiple criteria decision making methods (MCDM) application has risen in recent decade (Ishizaka and Labib, 2011).

1 Multiple attribute decision making methods

The decision-making process can be described as a process, when we have to make a decision between minimally two or more variants (Brožová et al., 2014). In the multicriteria evaluation of variants models there is a final group *m* variants given, which are evaluated based on *n* criteria. Such decision situation can be described with criteria matrix, which follows (Fiala, Jablonský, Maňas, 1994).

$$\begin{array}{c} \quad A_1 \quad A_2 \quad \dots \quad A_n \\ \begin{array}{c} K_1 \\ K_2 \\ \vdots \\ K_m \end{array} \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{bmatrix} \end{array}, \tag{1}$$

Criteria can be either maximization or minimization type. Based on maximization criteria variants with higher criteria values are better evaluated, on the contrary based on minimization criteria variants with lower criteria values are evaluated better. Selection of criteria for variant's evaluation, own creation of variants and its evaluation represent the decision problem's solution phase and should be executed in a close connection. Basic guideline for the determination of criteria evaluating individual variants are primarily the objectives, which the decision maker wants to achieve from the problem's solution (Fiala,

Jablonský, Maňas, 1994) with the respect to sufficient information about criteria in decision process. Multicriteria decision problems can be divided based on type of information that represent criteria preferences or variants: they do not require information about criteria importance, require aspiration level of criteria, and require ordinal or cardinal information about criteria. The nature of decision problem „the location of the affiliate of the company" requires the utilization of methods with cardinal information about criteria, which will be further described in detail.

1.1 Overall criteria method with cardinal information about criteria

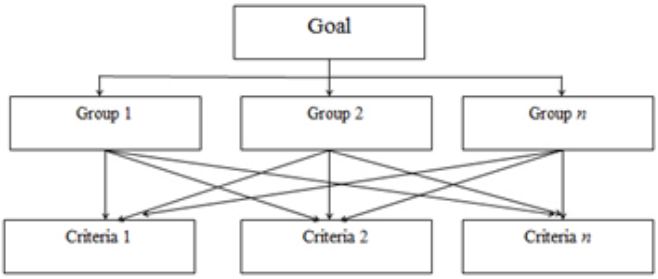
Individual methods, which require cardinal information about criteria, can be divided into three basic groups: methods based on maximization utility function (weighted sum approach WSA or AHP method), methods based on minimization distance (VIKOR method) and evaluation based on preference relation method.

The nature of the problem is to find the most suitable applicant by utilizing method based on utility maximization. Hsiao at. al. (2011) used analytic hierarchy process to analyze selection criteria for recruitment of five different roles in the area of information system.

1.2 Analytical hierarchy process (AHP)

The Analytic Hierarchy Process (AHP) is a multi-criteria decision-making approach and was introduced by Saaty (1980 and 1994). The AHP has attracted the interest of many researchers mainly due to the nice mathematical properties of the method and the fact that the required input data are rather easy to obtain. "Method of quantitative paired comparison – Saaty method presented subsequently is applied at each level of the hierarchical structure" (Zmeškal at al., 2013).

Fig. 1: Decision hierarchy in AHP



Source: Saaty, 1980

Many various methods exist for weight determination; the simplest ones are linear methods, in which are subjectively determined non-normalized weights of individual criteria in a priory agreed ranking scale. Second group includes so called non-linear methods e.g. pairwise comparison, where Fuller triangle method or more complex Saaty method belongs. In this paper the aforementioned Saaty's method is used. The criteria weights can be determined very easily by so called approximation methods, which are practically well solvable by determination of normalized weights, by the utilization of geometrical mean of lines

$$v_i = \frac{R_i}{\sum_{i=1}^{m} R_i} = \frac{\left[\prod_{j=1}^{m} s_{ij}\right]^{1/m}}{\left[\sum_{i=1}^{m}\prod_{j=1}^{m} s_{ij}\right]^{1/m}}, i = 1, 2, ..., m. \tag{2}$$

More information pertaining to the computation can be found in (Chalupková, Franek 2013). More detailed procedure of the calculation can be found in (Saaty, Vargas, 2006).

1.3 VIKOR method

VIKOR method was developed for multicriteria optimization of complex systems. It determines the compromise ranking-list, the compromise solution, and the weight stability intervals for preference stability of the compromise solution obtained with the initial (given) weights. This method focuses on ranking and selecting from a set of alternatives in the presence of conflicting criteria (Opricovic at. al., 2006).

1.4 WSA method

It is a method, which is based on the linear utility function construction at the scale 0 to 1. The worst variant based on given criteria will have utility 0; the best variant will have utility 1 and other variants will have utility between both extreme values. Weighted sum method derives from the principle of utility maximization; however the method presumes only linear utility function. More information pertaining to the computation can be found in (Dočkalíková, Kashi 2013).

2. Applicant's selection

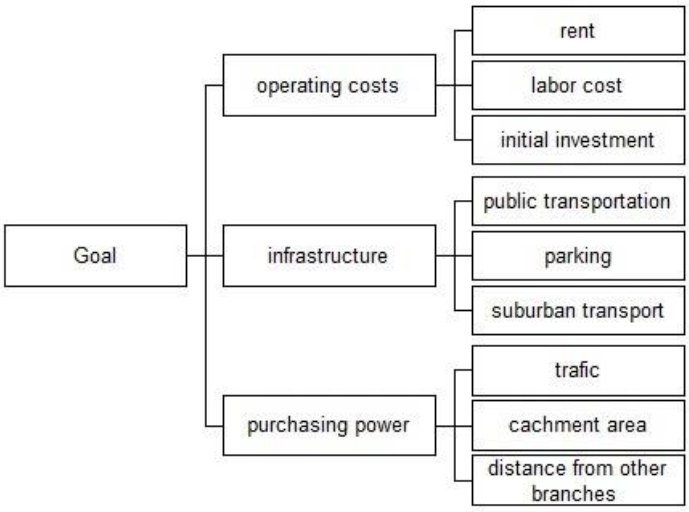
The decision making process itself consists of a several consecutive steps. First of all the decision making situation must be described and the problem must be defined. In our case it is the strategic factor mapping of a company which business is in the services. The example on which the MADM method (Multiple Attribute Decision Making) will be applied, simulates a realistic situation in which a company in the service business mapps significant factors, the result will be the selection of the most appropriate location.

The subject of this work is a selection and comparison of chosen localities of the city Olomouc. At the same time analysis of how appropriate possible types of utilizing the areas in these locations are and that is by appropriate multiple criteria methods. Firstly it was necessary to find an appropriate location and concrete business center in which the new branch will be open. Among the selected localities, i.e. variants of the research are:

- location 1 - OC Olympia,
- location 2 - Galerie Šantovka,
- location 3 - OC Haná.

These variants will be further described and their advantages and specifications will be defined. Input critera and sub-criteria will be selected on discussion base, that is brainstorming of three experts from the companies (owner of the franchise, store manager and regional manager).

Fig. 2: Hierarchy structure of criteria groups and criteria



Source: Own elaboration

Criteria were evaluated by ranking method, see Tab. 1. This method assumes that the user is able to quantitatively evaluate the importance of individual criteria; in this case the importance was assessed by five experts from a company X. The higher the ranking is the more important the criteria are. This method was selected because it has more differentiated representation of individual expert's preferences. For the selection of most appropriate localization, VIKOR and WSA methods were used the weights were determined by Saaty's method.

Tab. 1: Input criteria data

Criteria / variants	OC Olympia	Galerie Šantovka	OC Haná
rent	5	3	7
labor cost	5	1	5
initial investment	5	3	7
public transportation	1	9	5
parking	3	9	3
suburban transport	9	9	3
traffic	5	7	3
catchment area	3	7	5
distance from other branches	7	3	5

Source: Own elaboration

In this part the weights are calculated using input data and Saaty's method of pairwise comparison, see chap. 1.2. The value of criteria was determined by the functions in MS Excel.

Tab. 2: Values of criteria groups and individual criteria's scale

Criteria group	Weights of criteria's groups	Criteria	Local weights	Global weights
operating costs	0,7147	rent	0,5695	0,4071
		labor cost	0,3331	0,2380
		initial investment	0,0974	0,0696
infrastructure	0,0668	public transportation	0,5861	0,0391
		parking	0,3531	0,0236
		suburban transport	0,0608	0,0041
purchasing power	0,2185	traffic	0,7854	0,1716
		catchment area	0,0658	0,0144
		distance from other branches	0,1488	0,0325

Source: Own elaboration

Tab. 3: Applicant's ranking based on VIKOR method

Variants	1	2	**3**
S	0,1507	0,5000	0,1215
R	0,0678	0,5000	0,0000
Qj	0,2185	1,0000	0,1215

Source: Own elaboration

VIKOR methods allows its users to compare different variables of varied measures, next it enables the freedom when selecting based on distance from ideal or basal variant because both of the solutions are combined into one criteria Q. For this decision problem the authors considered weight 0.5. From table 3 it is evident that applicant's ranking based on VIKOR method is significantly different from the WSA method. In this case the applicant number 3 took the first place.

Tab. 4: Input criteria data WSA

Criteria	Rent	LC	II	PT	P	ST	T	CA	DfOB
H_j	7	5	7	9	9	9	7	7	7
D_j	3	1	3	1	3	3	3	3	3
$H_j - D_j$	4	4	4	8	6	6	4	4	4

Source: Own elaboration

The variant which will have the highest value of weighted sum is chosen as a compromise variant. From the results it is evident that individual variants are very near each other. The task for multicriteria evaluation of variants is to find a variant, which is based on all decision criteria. In this case variant 2 Galerie Šantovka achieves the maximum utility value and is selected as the best alternative. In the following table can be seen all applicant's score and their ranking.

Tab. 5: Applicant's ranking based on WSA method

Variants	$u(a_i)$	Ranking
OC Olympia	1,2688	3
OG Šantovka	**1,8512**	**1**
OC Haná	1,4003	2

Source: Own elaboration

The table 6 shows comparison of VIKOR and WSA methods. Applicant's ranking for given work position are dramatically different in the methods which is caused by different methodology and different criteria of variant's localization, see chapter 1.2 and 1.3.

Tab. 6: Input criteria data

Ranking	VIKOR	WSA
1.	OC Haná	Galerie Šantovka
2.	OC Olympia	OC Haná
3.	Galerie Šantovka	OC Olympia

Source: Own elaboration

Conclusion

Multicriteria evaluation of variants methods belong among the mathematical modeling methods. This paper presented AHP (analytic hierarchy process) VIKOR method and last but not least WSA method, which is used for multiple criteria decision making and enables to take into account preferences of individual evaluators. Based on the results, see table 6 we would recommend to hire applicant location. From the various methods application results it was found that only one variant cannot be recommended; various methods bring different results.

The signal is that variant ranking changes were dramatic and this was caused especially by different methodology and by different criteria of variant localization. However, both of these methods can well support localization suitable places process, which should be cost-efficient, legal, technically sound and transparent.

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References

1. BROŽOVÁ, Helena, Milan HOUŠKA a Tomáš ŠUBRT. Modely pro vícekriteriální rozhodování. Vyd. 1. V Praze: Česká zemědělská univerzita, Provozně ekonomická fakulta, 2014. ISBN 978-80-213-1019-3.

2. DOČKALÍKOVÁ, Iveta a Kateřina KASHI. Selection of Employees: Multiple Attribute Decision Making Methods in Personnel Management. In: Proceedings of the 9th European Conference on Management Leadership and Governance. Maria Th. Semmelrock-Picej a Ales Novak. 1. vyd. Reading: Academic Conferences and Publishing International Limited, 2013. s. 367-375. ISBN 978-1-909507-86-9.
3. HSIAO, WH et al. (2011). Selection criteria of recruitment for information systems employees: Using the analytic hierarchy process (ahp) method. African Journal Of Business Management, 5(15), 6201-U209.
4. CHALÚPKOVÁ, Eva, FRANEK, Jiří. Application of Multiple Criteria Method of Analytic Hierarchy Process and Sensitivity Analysis in Financial Services in the Czech Republic. Journal of Applied Economic Sciences. 2014, roč. 9, č. 2, s. 221. ISSN 1843-6110.
5. ISHIZAKA, Allesio and Ashrab LABIB. Review of the main developments in the analytic hierarchy process. Expert systems with Applications. Vol. 38., 2011. No 11, pp. 14336-14345.
6. JABLONSKÝ, Josef, Miroslav MAŇAS a Petr FIALA. Vícekriteriální rozhodování. Praha: Vysoká škola ekonomická v Praze, 1994. ISBN 80-7079-748-7.
7. SAATY, Thomas and Luis G. VARGAS. Decision Making With The Analytic Network Process Economic, Political, Social And Technological Applications With Benefits, Opportunities, Costs And Risks. Springer, Pittsburgh, 2006.
8. SAATY, Thomas L. The analytic hierarchy process: planning, priority setting, resource allocation. 1. vyd. London: McGraw-Hill International Book Co., 1980, 287 s. ISBN 9780070543713.
9. SAATY, Thomas. L. Fundamentals of Decision Making and Priority Theory with the Analytic Hierarchy Process. Pittsburgh: RWS Publications, 1994. ISBN 09-620-3176-3.
10. SERAFIM Opricovic and Gwo-Hshiung TZENG. Extended vikor method in comparison with outranking methods. European Journal of Operational Research 178 (2007) pp 514–529.
11. ZMEŠKAL, Zdeněk (2012). Aplikace dekompozičních vícekriteriálních metod AHP a ANP ve finančním rozhodování. In: 6thInternational Scientific Conference Managing and Modelling of Financial Risks. Ostrava: VŠB-TU Ostrava, 10th – 11th September 2011.89 – 698.

Contact

Iveta Dočkalíková
College of Logistics o.p.s.
Palackého 1381/25, Přerov 750 02
iveta.dockalikova@vslg.cz

Jana Klozíková
VŠB-Technical University of Ostrava
Sokolská 33, 701 21 Ostrava
jana.klozikova@vsb.cz