ASSESSMENT OF CORPORATE SOCIAL RESPONSIBILITY USING FUZZY ANALYTIC HIERARCHY PROCESS

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Abstract: *Together with the managerial decision to run a business in accordance with Corporate Social Responsibility (CSR) principles, important steps dealing with the necessity of systematic CSR evaluation and measurement should be discussed. Organizations could choose from varied evaluation tools and procedures such as a special CSR audit, a certification, a quality mark, a non-financial report, a standard, or sustainability indices that differ in methodologies, complexity and scopes of their appropriate usage in various business sectors and organization structures. The main goal of this paper is focused on the application of the linear goal programming priority method together with fuzzy analytic hierarchy process (in short LGPPM-FAHP) in a complex CSR assessment of three major telecommunication organizations operating in the Czech Republic (T-Mobile Czech Republic, a.s., Vodafone Czech Republic, a.s. and O2 Czech Republic, a.s.). This paper proposes a systematic approach to evaluate CSR using linguistic scales that enable a decision maker to express his/her uncertainty in decision-making processes. It is described how the LGPPM-FAHP could be used as a helpful managerial tool providing reliable sources for a CSR assessment.*

Keywords: *Business ethics, Corporate Social Responsibility, Fuzzy analytic hierarchy process, Group decision making, Linear goal programming priority method.*

JEL Classification: *L14, M21.*

Introduction

In 1953 the American economist Howard R. Bowen [8] introduced his book named Social Responsibilities of Businessman that served as a source of inspiration for the title of the special field called Corporate Social Responsibility (in short CSR). Specialized research centres focusing on the exploration of this dynamically developing field have gradually emerged. Moreover, organizations supporting and promoting the sustainable and responsible entrepreneurship have been established worldwide. For example, *European Business Ethics Network*, *International Business Leaders Forum* and *CSR Europe* belong to the most popular ones at global level. This domain has grown significantly and nowadays is consisted of a large number of theories, approaches, and terminologies that causes difficulties connected with different interpretations of CSR results and performance [8]. The main goal of this paper is focused on the evaluation of CSR activities of the three major organizations operating in the Czech telecommunication sector by applying the LGPPM -FAHP method together with group decision making. A theoretic part of this paper is focused on more detailed characteristic of the CSR concept and contemporary possibilities of CSR measurement (see Chapter 1). The hybrid method called LGPPM-FAHP is described in Chapter 2, followed by result and conclusion sections.

1 Statement of a problem

In connection with the development of various definitions and characteristics of the CSR concept it is important to mention two most elaborated and quoted theories that, in fact,

polarize opinions on these issues. *The stockholder theory* states that there is the only one social responsibility: to use resources to support profit maximizing business activities but without breaking the law, deceptions or frauds. On the other hand, every business organization should respect ethical conventions and encourage beneficial social results. This theory was introduced by Milton Friedman in 1970 [8] and represents a narrow conception of CSR that is focused on the owners as investors who carry a risk of a lack of success. Owners are the ones who make key decisions but they also have to entrust their managers with the power to support profit maximization [10]. In 1984 Richard Edward Freeman presented *the stakeholder theory* as his critical reaction to Friedman´s work. It claims that diverse interests of all stakeholders: employees, customers, suppliers, trade unions, local communities etc. should be taken into consideration, as well [5].

What CSR means nowadays has been examined and presented in literature reviews such as [1], [8], [14], and [16]. Based on a content analysis of 37 CSR definitions according to [6], stakeholders, voluntariness, economic, environmental and social dimensions are considered to be characteristic features of the CSR concept. Contemporary authors such as [5], [10], and [13] are familiar with a triple-bottom-line concept presented also by the European Union that includes three basic areas of interest: Profit, Planet and People. A responsible organization conducts business transparently, respects Corporate Governance rules, ethical marketing policies and ethical codes, pays attention to quality, innovations or safety and is universally beneficial to its community (**Profit**). An environmentally sustainable organization uses environment-friendly technologies, supports their development and reduces its environmental impacts (**Planet**). A responsible organization also fully respects human rights, occupational health standards and is fair in relation to its stakeholders (**People**).

The level of a systematic assessment of CSR activities in organizations is dependent on individual understanding of the CSR principles by owners, managers and employees, together with their internal explanations of the necessity of a permanent implementation, monitoring and a regular evaluation of this above-standard commitment. Publicly presented CSR results could be considered as an opportunity to gain a competitive advantage, however, especially small organizations operating regionally take a responsible conduct of business for granted. Practical examples of current CSR evaluation possibilities and tools are given in Tab. 1.

Tab. 1: Overview of selected CSR evaluation tools and methods

Certification/ Guidance	Specialization	Organization
AA 1000	Evaluation of CSR principles application	*AccountAbility*
ISO 14001, ISO 14004	Environmental management system	*International Organization for Standardization*
ISO 26000	Guidance on reliable CSR strategy	*International Organization for Standardization*
Quality Label	Appraisal of CSR strategy complexity from stakeholders´ point of view	*Forum Ethibel*
CSR Evaluation Methodology	**Specialization**	**Organization**
International Standard for Measuring Corporate Community Investment	Corporate community investment	*London Benchmarking Group*

Sustainability Indices	Specialization	Organization
Ethibel Sustainability Index	CSR performance evaluation of the world´s largest companies whose stocks are marketable in global stock markets	*Forum Ethibel*
Dow Jones Sustainability Indices		*S&P Dow Jones Indices*
FTSE4Good		*London Stock Exchange Group*
Non-financial Reporting	**Specialization**	**Organization**
G4 Guidelines	CSR reporting methodology and forms	*Global Reporting Initiative*

Source: own adaptation according to [7], [9], [11], [18]

2 Fuzzy Analytical Hierarchy Process

The regular (deterministic) AHP method has been presented by [19] and it is the usual method of multi-criteria decision-making when the criteria can be structured into the linear hierarchy. Unfortunately, the original version of this method requires deterministic inputs, which is, very often, impossible or at least too simplifying for various reasons. The most used concept that involves uncertainty into models (when no probabilities are available) is a fuzzification (i.e. extension of real "crisp" numbers by fuzzy sets). Many different procedures and approaches dealing with implementation of fuzziness into the AHP method have been already presented. They can be divided into three main groups. The first one is based on defuzzification using fuzzy mean values, see e.g. [3]. This approach is very easy to use, but, similarly to mean values of stochastic random variables, it neglects a substantial piece of information involved in a fuzzy set. The second group uses so called synthetic extensions in procedure, see e.g. [20] or [25]. However, this method uses a possibility measure to assign the weights for compared elements which often results in undesirable zero values of weights. That disadvantage has been partially solved by e.g. [21] who used a modification of synthetic extensions in which the spreads of fuzzy numbers are changed in order to obtain non-zero values of weights. But, [22] have pointed out the problems of that modification – the weights obtained by that method is not in accordance with inputs (preference ratios are/can be deformed). The last group of FAHP methods are approaches based on mathematical programming. For example, a logarithmic fuzzy preference programming methodology or LGPPM-FAHP have been presented by [22] and [23], respectively. In this paper, a goal programming approach is used. Transparency of this method together with correct and consistent results are the main reasons for this choice.

In order to keep a reasonable length of this contribution, a theory of the deterministic AHP method is skipped – it is available in many books and papers published during more than 35 years of its existence, see e.g. [18]. Also there is not enough space to present extensively the basics of the fuzzy theory. Because of a clarity of further notations, a triangular fuzzy number (*t*-number) and operations of multiplication and division of two *t*-numbers are given, see equations (1), (2) and (3), respectively.

$$\mu_{\tilde{a}} = \begin{cases} \dfrac{x - a_l}{a_m - a_l}, & a_l \le x < a_m \\ \dfrac{a_u - x}{a_u - a_m}, & a_m \le x < a_u \\ 0, & \text{otherwise.} \end{cases} \qquad (1)$$

The t-number $\tilde{a}$ is defined by the membership function $\mu_{\tilde{a}}$ (1) that can be denoted symbolically using the on-the-line notation $\tilde{a} = (a_l, a_m, a_u)$. Equations (2) and (3) show an approximation of multiplication/division of two t-numbers (actually, the result is not a t-number because it loses its linearity, on the other hand, such approximation is reasonable and satisfying in this case[1]).

$$\tilde{a} \odot \tilde{b} = (a_l b_l, a_m b_m, a_u b_u), \qquad (2)$$

$$\tilde{a} \oslash \tilde{b} = (a_l/b_u, a_m/b_m, a_u/b_l), \qquad (3)$$

where $\odot$ represents the fuzzy extension of multiplication and $\oslash$ stands for the fuzzy extension of division. In the case of division, none of b_l, b_m, b_u can be equal to 0.

Fuzzy comparison matrix $\tilde{S}$ comparing n elements is shown in (4). The set of feasible elements comes from the definition of linguistic imprecise variables. In this paper, the values written in Tab. 2 are used. They are based on the traditional Saaty's scale but, generally speaking, the scale can be modified according to the decision-maker. In order to keep the reciprocity of the matrix, the same power of preference (but of opposite direction) is used when comparing pairs of elements.

$$\begin{pmatrix} (1,1,1) & (s_l^{12}, s_m^{12}, s_u^{12}) & \cdots & (s_l^{1n}, s_m^{1n}, s_u^{1n}) \\ (s_l^{21}, s_m^{21}, s_u^{21}) & (1,1,1) & \cdots & (s_l^{2n}, s_m^{2n}, s_u^{2n}) \\ \vdots & \vdots & \ddots & \vdots \\ (s_l^{n1}, s_m^{n1}, s_u^{n1}) & (s_l^{n2}, s_m^{n2}, s_u^{n2}) & \cdots & (1,1,1) \end{pmatrix} \qquad (4)$$

Tab. 2: Linguistic and numerical characteristics of triangular fuzzy numbers

Linguistic variable	t-number of preference	t-number of non-preference	Linguistic variable	t-number of preference	t-number of non-preference
Just equal	(1,1,1)	(1,1,1)	Strong	(5,7,9)	(1/9,1/7,1/5)
Equally important	(1,1,3)	(1/3,1,1)	Very strong	(7,7,9)	(1/9,1/7,1/7)
Weak	(1,3,5)	(1/5,1/3,1)	Extremely strong	(9,9,9)	(1/9,1/9,1/9)
Moderate	(3,5,7)	(1/7,1/5,1/3)			

Source: [12]

According to [18], Saaty's matrix is consistent if equation (5) holds.

$$s_{ij} = \frac{w_i}{w_j}, \text{ for } \forall \, i, j, \qquad (5)$$

where s_{ij} is an element of Saaty's matrix and w_i stands for the weight assigned to the i-th compared element. In the fuzzy environment, computations of matrix consistency are similar and they come from (3), see (6).

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[1] see [2] for more details.

$$s_{ij} = \frac{(w_l^i, w_m^i, w_{\ddot{u}}^i)}{(w_l^j, w_m^j, w_{\ddot{u}}^j)}, \text{for } \forall i, j. \tag{6}$$

Using multiplication procedures (3), the formula (6) can be used to split the whole Saaty's matrix into three submatrices, see (7).

$$\mathbf{S}_L = \begin{pmatrix} 1 & \cdots & \frac{w_l^1}{w_u^n} \\ \vdots & \ddots & \vdots \\ \frac{w_l^n}{w_u^1} & \cdots & 1 \end{pmatrix}, \mathbf{S}_M = \begin{pmatrix} 1 & \cdots & \frac{w_m^1}{w_m^n} \\ \vdots & \ddots & \vdots \\ \frac{w_m^n}{w_m^1} & \cdots & 1 \end{pmatrix}, \mathbf{S}_U = \begin{pmatrix} 1 & \cdots & \frac{w_u^1}{w_l^n} \\ \vdots & \ddots & \vdots \\ \frac{w_u^n}{w_l^1} & \cdots & 1 \end{pmatrix} \tag{7}$$

The equation (7) can be rewritten as (8), (9), and (10), see [22].

$$\mathbf{S}_L \boldsymbol{w}_U = \boldsymbol{w}_U + (n-1)\boldsymbol{w}_L, \tag{8}$$

$$\mathbf{S}_U \boldsymbol{w}_L = \boldsymbol{w}_L + (n-1)\boldsymbol{w}_U, \tag{9}$$

$$\mathbf{S}_M \boldsymbol{w}_M = n\boldsymbol{w}_M, \tag{10}$$

where $\boldsymbol{w}_L = (w_l^1, w_l^2, \dots, w_l^n)^{\mathrm{T}}, \boldsymbol{w}_M = (w_m^1, w_m^2, \dots, w_m^n)^{\mathrm{T}}$ and $\boldsymbol{w}_U = (w_u^1, w_u^2, \dots, w_u^n)^{\mathrm{T}}$.

It is nearly impossible to get an absolutely consistent matrix in practice. A decision-maker's opinion is influenced by uncertainty and subjectivity. That's why some deviation from the absolute consistency is expected. The aim of the LGPPM-FAHP method is to find the vectors of weights with minimum deviations from consistency (i.e. from (8), (9) and (10)). The resulting linear goal programming model is given by (11)-(19), see [22].

$$\min_{W_L, E^+, E^-, \Gamma^+, \Gamma^-, \Delta \geq 0} J = \boldsymbol{e}^{\mathrm{T}}(\boldsymbol{E}^+ + \boldsymbol{E}^- + \boldsymbol{\Gamma}^+ + \boldsymbol{\Gamma}^- + \boldsymbol{\Delta}) \tag{11}$$

$$\text{Subject to} \quad (\mathbf{S}_L - \mathbf{I})\boldsymbol{w}_U - (n-1)\boldsymbol{w}_L - \boldsymbol{E}^+ + \boldsymbol{E}^- = 0, \tag{12}$$

$$(\mathbf{S}_U - \mathbf{I})\boldsymbol{w}_L - (n-1)\boldsymbol{w}_U - \boldsymbol{\Gamma}^+ + \boldsymbol{\Gamma}^- = 0, \tag{13}$$

$$(\mathbf{S}_M - n\mathbf{I})\boldsymbol{w}_M - \boldsymbol{\Delta} = 0, \tag{14}$$

$$w_l^i + \sum_{j=1, j \neq i}^{n} w_u^j \geq 1, \quad i = 1, \dots, n, \tag{15}$$

$$w_u^i + \sum_{j=1, j \neq i}^{n} w_l^j \leq 1, \quad i = 1, \dots, n, \tag{16}$$

$$\sum_{i=1}^{n} w_m^i = 1 \tag{17}$$

$$\boldsymbol{w}_U - \boldsymbol{w}_M \geq 0, \tag{18}$$

$$\boldsymbol{w}_M - \boldsymbol{w}_L \geq 0, \tag{19}$$

where $\boldsymbol{e} \in \mathbb{R}^{1 \times n}$ is a vector of ones, $\mathbf{I} \in \mathbb{R}^{n \times n}$ is an identity matrix, $\boldsymbol{E}^+, \boldsymbol{E}^- \in \mathbb{R}^{1 \times n}$ are the vectors of (positive and negative) deviations from the equality (8) caused by matrix inconsistency, $\boldsymbol{\Gamma}^+, \boldsymbol{\Gamma}^- \in \mathbb{R}^{1 \times n}$ are the vectors of (positive and negative) deviations from the equality (9) caused by matrix inconsistency, $\boldsymbol{\Delta} \in \mathbb{R}^{1 \times n}$ is a vector of deviations from the equality (10) caused by matrix inconsistency, $n \in \mathbb{R}^{1 \times 1}$ is a number of elements in a matrix, $\boldsymbol{w}_L, \boldsymbol{w}_M, \boldsymbol{w}_U \in \mathbb{R}^{1 \times n}, (\boldsymbol{w}_L = w_l^1, w_l^2, \dots, w_l^n), \boldsymbol{w}_M = (w_m^1, w_m^2, \dots, w_m^n), \boldsymbol{w}_U =$

$(w_u^1, w_u^2, ..., w_u^n)$ are the vectors describing the fuzzy weights of compared elements ($\boldsymbol{w}_L$ represents left bounds of the fuzzy weights' support, $\boldsymbol{w}_M$ is a core of the fuzzy weights and $\boldsymbol{w}_U$ stands for right bounds of the fuzzy weights' support.

The constraints (12), (13) and (14) correspond with the equations (8), (9), (10), only deviations from those equalities are accepted. The constraints (15), (16) and (17) guarantee the normalization of the fuzzy weight vector. According to [23], the fuzzy weight vector is normalized if and only if those three constraints hold. The last two constraints (i.e. (18) and (19)) ensure that "$w_l \leq w_m \leq w_u$" condition is met. The objective function (11) aims the minimum deviation from matrix consistency.

If a pairwise comparison matrix is absolutely consistent (i.e. when $J = 0$), there are not any deviations from (8), (9) and (10). But, it is reasonable to accept some level of inconsistency. In order to measure the inconsistency, a consistency ratio using the maximum eigenvalue is utilized. This approach is well known in deterministic AHP, see [19]. For example, [22] do not deal with inconsistency at all. On the one hand, that can be reasonable because the model of (11) - (19) finds always the best vectors of weights (guaranteeing the smallest deviation from perfect consistency as possible). On the other hand, in this contribution, we use the input data set based on opinions of knowledgeable persons that is why significant deviations from the perfect consistency would decrease the explanatory power and credibility of the results.

The maximum acceptable value for consistency ratio is set at 0.1, see [19]. A consistency check will be computed using the cores of fuzzy weights (i.e. $\boldsymbol{w}_M$). Due to the limited length of the paper and also because of the fact that the procedure is generally well known, the algorithm and formulas of consistency ratio are skipped and they can be found e.g. in [19].

As well as in the case of deterministic AHP, local weights are derived from each single pairwise comparison matrix. In order to evaluate criteria (and alternatives) with respect to all levels of the hierarchical structure, local weights must be recalculated to the global ones. In FAHP, this can be done very easily in the same manner as in the deterministic AHP, i.e. by multiplying the local weights by all superior local weights in the hierarchy. The only one difference comes from a fuzzy nature of weights. A fuzzy extension of multiplication (2) must be used instead of the usual crisp binary relation.

The last remaining task to describe is an interpretation of the results. Using the LGPPM-FAHP method, an evaluation of alternatives is given by t-numbers. Unlike the set of real numbers which is linearly ordered under "$<$" relation, comparing two fuzzy sets is not so clear. The first possibility how to face this problem is a deffuzification of t-numbers using the possibilistic mean value, see e.g. [3] or [22]. According to the authors' humble opinion, although this step is very easy to proceed, it leads to unnecessary loss of information. As a more suitable alternative to this step, we propose to use a credibility measure presented by [17] which extends the concept of the possibility and necessity measures for comparing the fuzzy sets [24]. The possibility measure expresses a level of probability that one fuzzy set/number is greater than another one, meanwhile the necessity measure describes a level of certainty that one fuzzy set/number is greater than another one, see (20) and (21). The credibility measure (22) aggregates the possibility and necessity and it gives the best possible information about the mutual position of a pair of fuzzy sets.

$$\text{Pos}(\tilde{a} \leq \tilde{b}) = \sup_{x \leq y}(\mu_{\tilde{a}}(x), \mu_{\tilde{b}}(y)) \qquad (20)$$

$$\text{Nec}(\tilde{a} \leq \tilde{b}) = 1 - \sup_{x > y}(\mu_{\tilde{a}}(x), \mu_{\tilde{b}}(y)) \qquad (21)$$

$$\text{Cr}(\tilde{a} \leq \tilde{b}) = \frac{1}{2}(\text{Pos}(\tilde{a} \leq \tilde{b}) + \text{Nec}(\tilde{a} \leq \tilde{b})) \qquad (22)$$

If any alternative $\tilde{a}$ defeats another alternative $\tilde{b}$ with the credibility of 1 (i.e. $\text{Cr}(\tilde{a} \geq \tilde{b})$ = 1) then it is certain that $\tilde{a}$ is a better choice for a decision-maker than $\tilde{b}$. Otherwise, some level of uncertainty in ranking exists and it should be taken into consideration by the decision-maker. Generally, regardless a level of uncertainty, $\tilde{a}$ is preferred to $\tilde{b}$ if and only if $\text{Cr}(\tilde{a} \geq \tilde{b}) \geq \text{Cr}(\tilde{a} \leq \tilde{b})$.

2.1 Utilization of LGPPM-FAHP in Corporate Social Responsibility

First of all, it was necessary to create a hierarchic structure with respect to a main goal that is connected with the evaluation of CSR activities of three selected organizations operating in the Czech telecommunication sector. Each criterion was chosen according to the triple-bottom-line definition of CSR (see Chapter 1) while it was specified by three sub-criteria. It is assumed that every responsible organization fully respects law regulations and that is why the sub-criteria mainly focus on above-standard commitments and activities. The graphic representation of the hierarchic structure together with the indication of criteria, sub-criteria and options (organizations) is shown in Fig. 1.

In second step, the importance (preference) appraisal of criteria and sub-criteria using a linguistic scale was accomplished by 6 knowledgeable persons interested in the CSR issues. They were supposed to work together and fill in a fuzzy judgement matrix. It was assumed that experts´ opinions were equal (i.e. decision-making outcomes of each expert were given a same weight).

Thirdly, a CSR evaluation of chosen organizations was accomplished. A CSR performance of the three organizations was appraised by authors´ opinions based on information got from a content analysis of current internet presentations, CSR reports and other available publications and surveys. *T-Mobile Czech Republic, a.s.* is marked with the expression "Organization A", *Vodafone Czech Republic, a.s.* is called "Organization B" and finally *O2 Czech Republic, a.s.* is labelled "Organization C". According to the results of the Czech Top 100 Most Admired Firms survey held in 2015, all of these organizations are considered to be an essential part of the Czech business sector.

Fig. 1: Hierarchic decomposition of decision-making task
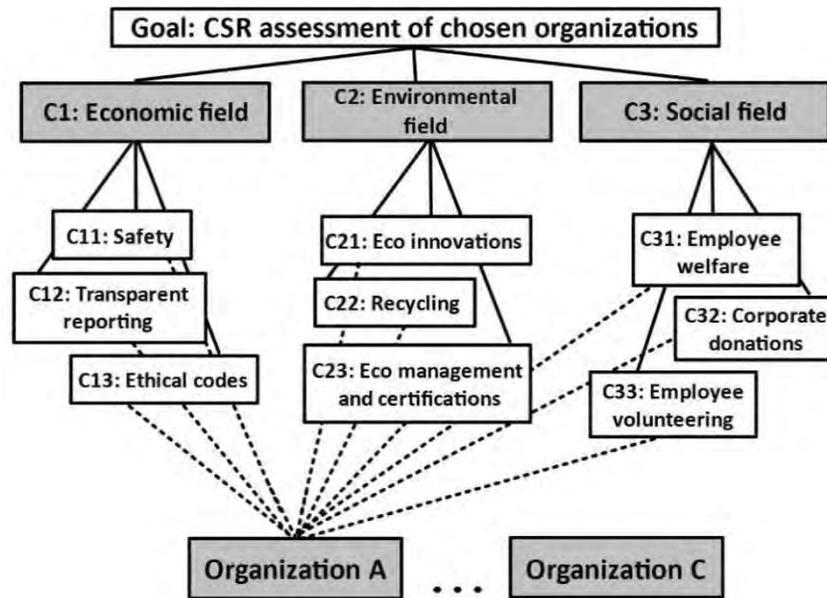
3 Problem solving

Input data represented by fuzzy judgement matrices together with weighted fuzzy numbers are presented in Tab. 3 – 13. According to computed consistency ratio values (CR) ranging between 0.01 to 0.07, the obtained results represent a reliable source of information for subsequent decision – making analysis. Tab. 14 shows computed fuzzy weight values and comparisons of alternatives (organizations) using the credibility measure ($\widetilde{w}_X$ stands for the fuzzy evaluation of the alternative *X*). It can be seen that the alternative A (*T-Mobile Czech Republic, a.s.*) is certainly defeated by the other organizations in the sample. The comparison between the alternative B (*Vodafone Czech Republic, a.s.*) and C (*O2 Czech Republic, a.s.*) is not so clear. The alternative C is better at the credibility level of 0.624. The results are also depicted in Fig. 2. If the possibilistic mean values were used for an interpretation of fuzzy evaluations instead of the credibility measure, the ranking $C \succcurlyeq B \succcurlyeq A$ would be the final but simplifying result. It means that the fact of uncertainty included in the comparison between B and C would be lost.

Tab. 3: Fuzzy judgement matrix and weighted fuzzy numbers for CSR fields

Goal	**C1**	**C2**	**C3**	*Local fuzzy weights*
C1	(1, 1, 1)	(1, 3, 5)	(3, 5, 7)	(0.505, 0.613, 0.613)
C2	(1/5, 1/3, 1)	(1, 1, 1)	(1, 1, 3)	(0.234, 0.234, 0.234)
C3	(1/7, 1/5, 1/3)	(1/3, 1, 1)	(1, 1, 1)	(0.149, 0.149, 0.257)

Tab. 4: Overview of global fuzzy weights for groups of sub-criteria

C1	*Global fuzzy weights*	C2	*Global fuzzy weights*	C3	*Global fuzzy weights*
C11	(0.281, 0.378, 0.378)	**C21**	(0.120, 0.146, 0.146)	**C31**	(0.107, 0.116, 0.200)
C12	(0.055, 0.066, 0.103)	**C22**	(0.057, 0.057, 0.057)	**C32**	(0.019, 0.019, 0.034)
C13	(0.139, 0.168, 0.168)	**C23**	(0.036, 0.036, 0.061)	**C33**	(0.014, 0.014, 0.039)

Tab. 5: Fuzzy judgement matrix and weighted fuzzy numbers for organization performance in safety (C11)

C11	A	B	C	Global fuzzy weights
A	(1, 1, 1)	(1/3, 1, 1)	(1/7, 1/5, 1/3)	(0.063, 0.084, 0.116)
B	(1, 1, 3)	(1, 1, 1)	(1/5, 1/3, 1)	(0.043, 0.058, 0.058)
C	(3, 5, 7)	(1, 3, 5)	(1, 1, 1)	(0.152, 0.236, 0.236)

Tab. 6: Fuzzy judgement matrix and weighted fuzzy numbers for organization performance in transparent reporting (C12)

C12	A	B	C	Global fuzzy weights
A	(1, 1, 1)	(1/9, 1/7, 1/5)	(1/5, 1/3, 1)	(0.008, 0.009, 0.016)
B	(5, 7, 9)	(1, 1, 1)	(1, 1, 3)	(0.029, 0.036, 0.056)
C	(1, 3, 5)	(1/3, 1, 1)	(1, 1, 1)	(0.017, 0.021, 0.032)

Tab. 7: Fuzzy judgement matrix and weighted fuzzy numbers for organization performance in ethical codes (C13)

C13	A	B	C	Global fuzzy weights
A	(1, 1, 1)	(1/5, 1/3, 1)	(1, 1, 3)	(0.034, 0.041, 0.041)
B	(1, 3, 5)	(1, 1, 1)	(5, 7, 9)	(0.090, 0.105, 0.105)
C	(1/3, 1, 1)	(1/9, 1/7, 1/5)	(1, 1, 1)	(0.018, 0.022, 0.031)

Tab. 8: Fuzzy judgement matrix and weighted fuzzy numbers for organization performance in ecological innovations (C21)

C21	A	B	C	Global fuzzy weights
A	(1, 1, 1)	(1/5, 1/3, 1)	(1, 3, 5)	(0.033, 0.040, 0.040)
B	(1, 3, 5)	(1, 1, 1)	(5, 7, 9)	(0.067, 0.090, 0.090)
C	(1/5, 1/3, 1)	(1/9, 1/7, 1/5)	(1, 1, 1)	(0.013, 0.016, 0.025)

Tab. 9: Fuzzy judgement matrix and weighted fuzzy numbers for organization performance in recycling (C22)

C22	A	B	C	Global fuzzy weights
A	(1, 1, 1)	(1/5, 1/3, 1)	(1, 1, 3)	(0.013, 0.013, 0.013)
B	(1, 3, 5)	(1, 1, 1)	(3, 5, 7)	(0.029, 0.035, 0.035)
C	(1/3, 1, 1)	(1/7, 1/5, 1/3)	(1, 1, 1)	(0.008, 0.008, 0.015)

Table 10: Fuzzy judgement matrix and weighted fuzzy numbers for organization performance in environmental management and certifications (C23)

C23	A	B	C	Global fuzzy weights
A	(1, 1, 1)	(1/3, 1, 1)	(1, 3, 5)	(0.010, 0.012, 0.020)
B	(1, 1, 3)	(1, 1, 1)	(3, 5, 7)	(0.017, 0.018, 0.031)
C	(1/5, 1/3, 1)	(1/7, 1/5, 1/3)	(1, 1, 1)	(0.006, 0.006, 0.012)

Tab. 11: Fuzzy judgement matrix and weighted fuzzy numbers for organization performance in employee welfare (C31)

C31	A	B	C	Global fuzzy weights
A	(1, 1, 1)	(1, 1, 3)	(1/7, 1/5, 1/3)	(0.014, 0.015, 0.026)
B	(1/3, 1, 1)	(1, 1, 1)	(1/9, 1/9, 1/7)	(0.010, 0.011, 0.030)
C	(3, 5, 7)	(7, 9, 9)	(1, 1, 1)	(0.077, 0.090, 0.155)

Source: own elaboration

Tab. 12: Fuzzy judgement matrix and weighted fuzzy numbers for organization performance in corporate donations (C32)

C32	A	B	C	Global fuzzy weights
A	(1, 1, 1)	(1/3, 1, 1)	(1/9, 1/7, 1/5)	(0.002, 0.002, 0.006)
B	(1, 1, 3)	(1, 1, 1)	(1/5, 1/3, 1)	(0.005, 0.005, 0.009)
C	(5, 7, 9)	(1, 3, 5)	(1, 1, 1)	(0.011, 0.012, 0.021)

Source: own elaboration

Tab. 13: Fuzzy judgement matrix and weighted fuzzy numbers for organization performance in employee volunteering (C33)

| C33	A	B	C	Global fuzzy weights
A	(1, 1, 1)	(1/9, 1/7, 1/5)	(1/3, 1, 1)	(0.002, 0.002, 0.006)
B	(5, 7, 9)	(1, 1, 1)	(3, 5, 7)	(0.009, 0.009, 0.026)
C	(1, 1, 3)	(1/7, 1/5, 1/3)	(1, 1, 1)	(0.002, 0.002, 0.007)

Source: own elaboration

Tab. 14: Overview of organization CSR performance

	Final fuzzy weight value	Organization A	Organization B	Organization C
A	(0.179, 0.219, 0.285)	x	$Cr(\widetilde{w}_A \geq \widetilde{w}_B) = 0$	$Cr(\widetilde{w}_A \geq \widetilde{w}_C) = 0$
B	(0.289, 0.368, 0.440)	$Cr(\widetilde{w}_B \geq \widetilde{w}_A) = 1$	x	$Cr(\widetilde{w}_B \geq \widetilde{w}_C) \doteq 0.376$
C	(0.304, 0.413, 0.532)	$Cr(\widetilde{w}_C \geq \widetilde{w}_A) = 1$	$Cr(\widetilde{w}_C \geq \widetilde{w}_B) \doteq 0.624$	x

Source: own elaboration

Fig. 2: Graphic representation of final fuzzy weight values
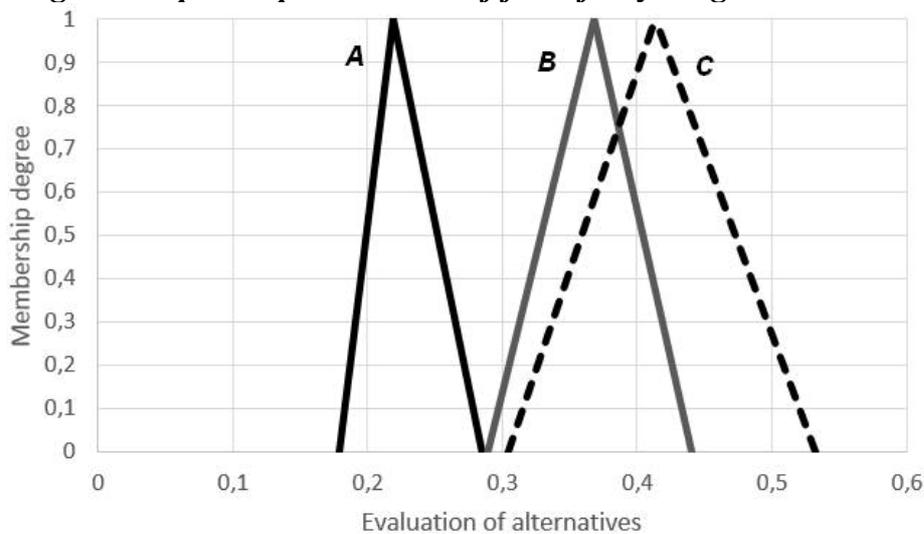
Source: Author

4 Discussion

According to [4] and [15], the deterministic AHP approach is ineffective in cases of ambiguous problems. Sometimes an exact numerical assessment of defined criteria could be very difficult for decision makers. To overcome this limitation of AHP method and to deal with vagueness, the FAHP method should be applied. In the FAHP approach exact values (so called crisp values) are replaced with interval values (fuzzy numbers) that depict assessment of criteria more realistically. This contribution proposes a procedure combining linear goal programming and FAHP. To prevent from a loss of information connected with a distribution of preferences the credibility measure is applied. Although this study has its limitations, e.g. it presents the opinions of a certain group of knowledgeable persons that may be different from other opinions of individuals, groups and organizations; it provides a basis for an advanced application of fuzzy logic principles in multiple-attribute decision making. It is possible to use different shapes of fuzzy numbers, scales or methods dealing with various ranking procedures of alternatives, see [12].

Conclusion

The main goal of this paper is connected with the complex assessment of CSR performance of the selected telecommunication organizations using the LGPPM-FAHP method. The application of this method in CSR evaluation topics is demonstrated on a sample consisted of the three organizations considered to be an essential part of the Czech telecommunication sector. Preferences of the criteria and the sub-criteria included in that multiple-criteria decision-making task were appraised by 6 knowledgeable persons, while the CSR performance of each selected organization was considered by the authors´ opinions based on information got from a content analysis of current internet presentations, CSR reports and other available publications and surveys. In comparison with the AHP method, the FAHP approach deals with a possible vagueness connected with decision makers´ inability to express their opinions exactly (numerically – using a crisp value). For that reason, various linguistic scales are usually used. According to the results, *O2 Czech Republic, a.s.* (Organization C) is better than *Vodafone Czech Republic, a.s.* (Organization B) at the credibility level of 0.624. *T-Mobile Czech Republic, a.s.* (Organization A) is certainly defeated by the other organizations within the sample. In this ranking uncertainty is included and maintained in comparison with the deterministic AHP that seems to be too simplifying, and e. g. fuzzy possibilistic mean computations where ascertained uncertainty is suppressed and lost.

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