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An integrated multi-criteria group decision making process: selection of the chief accountant

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Abstract

Many individual attributes are considered in the selection of personnel accountants such as organization abilities, creativity, personality, and leadership demonstration. In the preceding decade the enormous economic and social costs due to financial fraud statements have shaken the market, devastated investment portfolios, and reduced confidence in financial reporting. Many of these frauds were carried out by employees who were privy to accounting information. The financial management is a special department; its needs to standards differ from any other department. In this paper, a fuzzy multi-criteria decision making (MCDM) algorithm, the additive ratio assessment method with fuzzy numbers (ARAS-F) and the analytic hierarchy process (AHP) are used in finding and promoting the most adequate chief accountant.

Keywords: chief accountant; ARAS-F; AHP; MCDM; multi-criteria.

1. Introduction

The first objective of this study is to develop a decision making approach to a multiple information sources problem, which enables to incorporate both crisp data and fuzzy data represented as linguistic variables or triangular fuzzy numbers into the analysis. ARAS is based on the intuitive principle that the sound alternative should have the biggest ratio to the optimal solution (Zavadskas & Turskis, 2010; Turskis & Zavadskas 2010; Tupenaite, Zavadskas, Kaklauskas, Turskis, & Seniut, 2010).

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The second objective of this paper is to construct a Chief Accountant Officer Selection Model, after studying how stakeholders select chief accountant officers. The significance of the model is that it reduces the time taken by stakeholders and managers to accumulate experience in chief accountant selection, further increasing the efficiency of the enterprises activities.

Human resources are one of the core competences for an organization to enhance its competitive advantage in the knowledge economy (Lin, 2010). Personnel selection is the process of choosing among candidates, who match the qualifications required to perform a defined job in the best way (Dursun & Karsak, 2010). It is one of the most important fields in human resources management, which directs company's present and future. The quality of human capital is crucial for high-tech companies to maintain competitive advantages in knowledge economy era (Chien & Chien, 2008).

Kelemenis, Ergazakis, & Askounis (2011) presented an overview of recent studies on the personnel selection problem (from 1992 till 2009 year). For instance, there are used fuzzy numbers, OWA operators, AHP, fuzzy analytic hierarchy process (AHP), analytic network process, fuzzy TOPSIS, fuzzy multiples objective programming, discriminant analysis, decision trees, analytic neural networks, total sum method, simple additive weighting, weighted product method, expert systems, group TOPSIS, nominal group technique, and etc.

The last two decades is era of changing client requirements. There has been lively academic and political debate about the continued gendering process of the accountancy profession (Heidhues & Patel, 2011). There are two fields of accounting: financial accounting and managerial accounting. In running business, outside business accountants are the core of companies' intellectual capital. Seifert, Sweeney, Joireman, & Thornton (2010) applied the theory of organizational justice to the design of whistle blowing policies and procedures. The numbers used in financial accounting are generally highly conservative in nature. Management accounting provides customised, appropriate and timely financial information to those internal managers entrusted with the day to day operations of the organisation. Lambert & Pezet (2011) analysed the practices through which the management accountant is constructed.

Tillmann & Goddard (2008) developed a substantive grounded theory of strategic management accounting and sense-making. It is not enough to 'simply' know accounting or management accounting techniques, but there is a need for a much broader know-how. The use of personality measures to predict job performance has a long and storied history (Penney, David, & Witt, 2010). However, methodological advances in meta-analytic techniques and the advent of the now widely-accepted Big Five model of personality – Conscientiousness, Extraversion, Agreeableness, Emotional Stability, and Openness to Experience renewed interest in personality as a selection device among academics.

2. The Chief accountant officer selection algorithm

The financial management is a special department, its needs to standards different from any other department. Evaluation criteria financial management are listed in Table 1.

Table 1. List of professional standards on the basis of which is the evaluation process of financial management

Professional standards	Measurement process
Accuracy	The measured by the final output.
Efficiency and self-development	The measured on the basis of the manner in which the person works. Is it a routine way, or that there is constant innovation and development? Is there an impact on the work because of this development and innovation, or that things are randomly?
Integrity and honesty	One of the most important qualities that must be characterized by Accountant The presence of the most important and the most critical secrets in his hands. Measured through a period of coexistence.
Completion of the work required	Measured by the commitment deadlines for the end of work while adhering to the standard of accuracy.
The quantity and the importance of working	The measured by the quantity and importance of the data provided by the employee.
Experience	Factors vital and important when evaluating employee But when the assessment on the basis of the experience we have to pay attention to the experience gained in the same area under evaluation.
Active participation and positive	No longer is a staff member required to complete its work, but we have to have positive contributions towards the development of the place in which it operates.
Training	Measured employee skills development after the completion of the training and benefit return to work.
Ethics	Good morality affects others.

Evaluation criteria mentioned are the criteria for evaluating staff are already working as for the evaluation of new employees is a different matter.

Selecting of appropriate decision method depends on the problem's aim, available information, costs of decision and persons which are making decisions qualification. Keršulienė & Turskis (2011) described the multiple criteria expert system for personnel selection.

2.1. Criteria weights determination

Research has revealed a lot of different multiple criteria decision making methods (Zimmermann, 1985; Saaty, 1977, 1980). AHP method is one of most applicable in recent researches.

There are various approaches for assessing weights (Zavadskas, Turskis, Ustinovichius, & Shevchenko, 2010; Zavadskas, Turskis, & Vilutiene, 2010), e.g., the eigenvector method, SWARA (Keršulienė, Zavadskas, & Turskis, 2010), Entropy method, etc.

AHP method is one of most applicable in recent researches: Sivilevičius & Maskeliūnaite (2010) solved problem of improving the quality for passenger transportation; Steuten, Hummel, & Yzerman (2010) used AHP weights to fill missing gaps in Markov decision models; Yan, Pong, & Lo (2011) presented new developments and maintenances of the existing infrastructures under limited government budget and time.

The decision is made by using the derived weights *w* of the evaluative criteria (Saaty, 1980). Saaty (1980) established 9 objects as the upper limit of his integer scale for multiple pair wise comparisons (Table 2).

Table 2. The nine-point scale of pair wise comparison (according to Saaty (1980))

Intensity of importance	1	3	5	7	9	2, 4, 6, 8	Reciprocals nonzero
Definition	Criteria *i* and *j* have equal importance	Criterion *i* is weakly more important than criterion *j*	Criterion *i* is essentially (strongly) more important than criterion *j*	Criterion *i* is very strongly (demonstrably) more important than criterion *j*	Criterion *i* is absolutely more important than criterion *j*	Intermediate values between the two adjacent judgements	If activity *i* has one of the nonzero numbers assigned to it when compared with activity *j* then, then *j* has reciprocal value when compared with *i*.

In AHP the decision matrix is always a square matrix:

$$A = \left(a_{ij}\right) = \begin{bmatrix} 1 & \frac{w_1}{w_2} & \cdots & \frac{w_1}{w_m} \\ \frac{w_2}{w_1} & 1 & \cdots & \frac{w_2}{w_m} \\ \vdots & \vdots & \ddots & \vdots \\ \frac{w_m}{w_1} & \frac{w_m}{w_2} & \cdots & 1 \end{bmatrix}, \; a_{ii} = 1, a_{ij} = \frac{1}{a_{ji}}, a_{ij} \neq 0. \tag{1}$$

Fuzzy group weight is determined as follows:

- After obtaining the criteria weights from AHP the synthesising of ratio judgements is done.
- Suppose $\tilde{W} = \left[\overline{\tilde{w}_1, \tilde{w}_n}\right] = \left[\tilde{w}_j\right]$ is fuzzy group weight for *n* criteria and $\tilde{w}_j$ is fuzzy triangular number

$$\tilde{w}_j = \left(w_{j\alpha}, w_{j\gamma}, w_{j\beta}\right), \tag{2}$$

where $w_{j\alpha} = \min\limits_{k} y_{jk},\ j = \overline{1,n},\ k = \overline{1,p}$ is minimum possible value, $w_{j\gamma} = \left(\prod\limits_{k=1}^{p} y_{jk} \right)^{\frac{1}{p}},\ j = \overline{1,n},\ k = \overline{1,p}$ is the most possible value and $w_{j\beta} = \max\limits_{k} y_{jk},\ j = \overline{1,n},\ k = \overline{1,p}$ is the maximal possible value of *j*-th criterion.

2.2. Chief accountant officer selection using fuzzy MCDM approach

For Chief accountant officer assessment set of essential criteria consists of: education, academic level, long life learning, working knowledge, working skills, work experience, culture, competence, team player, leadership excellence, ability to work in different business units, determination of goal, problem solving ability, decision making skills, strategic thinking, ability to sell self and ideas, interpersonal skills, management experience, emotional steadiness, communication skill, ability of good discussion, personality assessment, computer skills, self-confidence, fluency in foreign languages, responsibility, patience, effective time using, and age.

Birkett (2002) developed a framework for competencies required of management accountants during their careers. There is used a simplified version of the Birkett (2002) framework in this research, which means that the research focuses on 8 of 375 competencies.

The problem's set of criteria was determined by three decision makers (owners) of the company as follows:

x_1 – Education, academic level, long life learning;
x_2 – Working knowledge, working skills, work experience, knowledge of legislation system;
x_3 – Responsibility;
x_4 – Strategic thinking;
x_5 – Leadership; ability to work in team;
x_6 – Motivation to work in particular position;
x_7 – Computer skills;
x_8 – Ability to work with clients, consultants and community.

At the first stage of problem's solution three decision makers determined criteria ranks by applying AHP method.

According to the calculations by applying AHP method fuzzy group criteria weights were established (Table 3).

Suppose $\tilde{W} = \left[\overline{\tilde{w}_1, \tilde{w}_n} \right] = \left[\tilde{w}_j \right]$ is fuzzy group weight for *n* criteria and $\tilde{w}_j$ is fuzzy triangular number

$$\tilde{w}_j = \left(w_{j\alpha}, w_{j\gamma}, w_{j\beta} \right), \tag{3}$$

where $w_{j\alpha} = \min\limits_{k} y_{jk},\ j = \overline{1,n},\ k = \overline{1,p}$ is minimum possible value, $w_{j\gamma} = \left(\prod\limits_{k=1}^{p} y_{jk} \right)^{\frac{1}{p}},\ j = \overline{1,n},\ k = \overline{1,p}$ is the most possible value and $w_{j\beta} = \max\limits_{k} y_{jk},\ j = \overline{1,n},\ k = \overline{1,p}$ is the maximal possible value of *j*-th criterion.

Table 3. Fuzzy group criteria weights

Criteria	Criteria weights					Fuzzy group criteria weights		
	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	$w_{j\alpha}$	$w_{j\gamma}$	$w_{j\beta}$
x_1	0.33	0.16	0.16	0.23	0.23	0.16	0.21	0.33
x_2	0.23	0.33	0.11	0.33	0.16	0.11	0.21	0.33
x_3	0.16	0.23	0.07	0.16	0.07	0.07	0.13	0.23
x_4	0.11	0.07	0.02	0.07	0.02	0.02	0.05	0.11
x_5	0.07	0.11	0.33	0.11	0.33	0.07	0.17	0.33
x_6	0.05	0.03	0.23	0.03	0.11	0.03	0.08	0.23
x_7	0.03	0.05	0.05	0.02	0.03	0.02	0.03	0.05
x_8	0.02	0.02	0.03	0.05	0.05	0.02	0.03	0.05

In this study, the six linguistic term set with associated semantic is considered (Table 4).

Table 4. Label set

Label set	Linguistic term	Fuzzy number		
		α	γ	β
s_1	Nothing answered, task was not completed	0	0	0.2
s_2	Bad	0	0.2	0.4
s_3	Weak	0.2	0.4	0.6
s_4	Satisfactory	0.4	0.6	0.8
s_5	Good	0.6	0.8	1.0
s_6	Excellent	0.8	1.0	1.0

The candidates were rated. Data related to accountant-general selection problem are given in Table 5.

Table 5. Rating of the candidates with respect to subjective criteria

Criteria	Candidates	Decision makers			
		D$_1$	**D$_2$**	**D$_3$**	**D$_4$**
x_1	A_1	s_6	s_4	s_4	s_5
	A_2	s_5	s_6	s_4	s_6
	A_3	s_4	s_6	s_4	s_5
x_2	A_1	s_4	s_4	s_4	s_6
	A_2	s_5	s_5	s_5	s_5
	A_3	s_4	s_5	s_5	s_4
x_3	A_1	s_5	s_4	s_5	s_5
	A_2	s_6	s_6	s_4	s_4
	A_3	s_5	s_5	s_5	s_4
x_4	A_1	s_5	s_6	s_4	s_6
	A_2	s_5	s_5	s_5	s_6
	A_3	s_4	s_4	s_5	s_5
x_5	A_1	s_4	s_5	s_4	s_6
	A_2	s_5	s_4	s_4	s_5
	A_3	s_4	s_6	s_5	s_5
x_6	A_1	s_5	s_6	s_5	s_4
	A_2	s_6	s_5	s_4	s_6
	A_3	s_5	s_6	s_5	s_5
x_7	A_1	s_5	s_6	s_5	s_6
	A_2	s_4	s_5	s_4	s_6
	A_3	s_4	s_4	s_4	s_4
x_8	A_1	s_5	s_5	s_4	s_5
	A_2	s_4	s_4	s_5	s_4
	A_3	s_5	s_4	s_4	s_4

There are prepared matrix with fuzzy group criteria values (Table 5) and fuzzy decision making matrix with fuzzy group weights (Table 7).

Suppose $\tilde{W} = \left[\overline{\tilde{w}_1, \tilde{w}_n}\right] = \left[\tilde{w}_j\right]$ is fuzzy group weight for n criteria and $\tilde{w}_j$ is fuzzy triangular number

$$\tilde{w}_j = \left(w_{j\alpha}, w_{j\gamma}, w_{j\beta}\right), \tag{4}$$

where $w_{j\alpha} = \min_k y_{jk},\ j = \overline{1,n},\ k = \overline{1,p}$ is minimum possible value, $w_{j\gamma} = \frac{1}{p}\sum_{i=1}^{p} y_{jk},\ j = \overline{1,n},\ k = \overline{1,p}$ is the most possible value and $w_{j\beta} = \max_k y_{jk},\ j = \overline{1,n},\ k = \overline{1,p}$ is the maximal possible value of j-th criterion.

Table 6. The fuzzy group criteria values

Criteria	Candidates	Ratings														
		D_1			D_2			D_3			D_4			Group fuzzy		
		α	γ	β	α	γ	β	α	γ	β	α	γ	β	α	γ	β
x_1	A_1	0.8	1.0	1.0	0.4	0.6	0.8	0.4	0.6	0.8	0.6	0.8	1.0	0.4	0.66	1
	A_2	0.6	0.8	1.0	0.8	1.0	1.0	0.4	0.6	0.8	0.8	1.0	1.0	0.4	0.73	1
	A_3	0.4	0.6	0.8	0.8	1.0	1.0	0.4	0.6	0.8	0.6	0.8	1.0	0.4	0.66	1
x_2	A_1	0.4	0.6	0.8	0.4	0.6	0.8	0.4	0.6	0.8	0.8	1.0	1.0	0.4	0.62	1
	A_2	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.71	1
	A_3	0.4	0.6	0.8	0.6	0.8	1.0	0.6	0.8	1.0	0.4	0.6	0.8	0.4	0.63	1
x_3	A_1	0.6	0.8	1.0	0.4	0.6	0.8	0.6	0.8	1.0	0.6	0.8	1.0	0.4	0.67	1
	A_2	0.8	1.0	1.0	0.6	0.8	1.0	0.4	0.6	0.8	0.4	0.6	0.8	0.4	0.66	1
	A_3	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0	0.4	0.6	0.8	0.4	0.67	1
x_4	A_1	0.6	0.8	1.0	0.8	1.0	1.0	0.4	0.6	0.8	0.8	1.0	1.0	0.4	0.73	1
	A_2	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0	0.8	1.0	1.0	0.6	0.73	1
	A_3	0.4	0.6	0.8	0.4	0.6	0.8	0.6	0.8	1.0	0.6	0.8	1.0	0.4	0.63	1
x_5	A_1	0.4	0.6	0.8	0.6	0.8	1.0	0.4	0.6	0.8	0.8	1.0	1.0	0.4	0.66	1
	A_2	0.6	0.8	1.0	0.4	0.6	0.8	0.4	0.6	0.8	0.6	0.8	1.0	0.4	0.63	1
	A_3	0.4	0.6	0.8	0.8	1.0	1.0	0.6	0.8	1.0	0.6	0.8	1.0	0.4	0.70	1
x_6	A_1	0.6	0.8	1.0	0.8	1.0	1.0	0.6	0.8	1.0	0.4	0.6	0.8	0.4	0.70	1
	A_2	0.8	1.0	1.0	0.6	0.8	1.0	0.4	0.6	0.8	0.8	1.0	1.0	0.4	0.73	1
	A_3	0.6	0.8	1.0	0.8	1.0	1.0	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.73	1
x_7	A_1	0.6	0.8	1.0	0.8	1.0	1.0	0.6	0.8	1.0	0.8	1.0	1.0	0.6	0.76	1
	A_2	0.4	0.6	0.8	0.6	0.8	1.0	0.4	0.6	0.8	0.8	1.0	1.0	0.4	0.66	1
	A_3	0.4	0.6	0.8	0.4	0.6	0.8	0.4	0.6	0.8	0.4	0.6	0.8	0.4	0.54	0.8
x_8	A_1	0.6	0.8	1.0	0.6	0.8	1.0	0.4	0.6	0.8	0.6	0.8	1.0	0.4	0.67	1
	A_2	0.4	0.6	0.8	0.4	0.6	0.8	0.6	0.8	1.0	0.4	0.6	0.8	0.4	0.59	1
	A_3	0.6	0.8	1.0	0.4	0.6	0.8	0.4	0.6	0.8	0.4	0.6	0.8	0.4	0.59	1

There are a lot of methods for multi-criteria decision making problems (Zavadskas & Turskis, 2011). ARAS-F (Turskis & Zavadskas, 2010; Tupenaite *et al.*, 2010) method was selected among them, and the problem was solved.

Table 7. The fuzzy decision making matrix with fuzzy group weights (all criteria should to be maximized and optimal value equals to 1)

Criterion	Alternatives										Total			Fuzzy group weight		
	A_0	A_1			A_2			A_3								
	Ratings													$\tilde{w}_j$		
	α; γ; β	α	γ	β	α	γ	β	α	γ	β	α	γ	β	$w_{j\alpha}$	$w_{j\gamma}$	$w_{j\beta}$
x_1	1.0	0.4	0.66	1	0.4	0.73	1	0.4	0.66	1	2.2	3.05	4	0.16	0.21	0.33
x_2	1.0	0.4	0.62	1	0.6	0.71	1	0.4	0.63	1	2.4	2.96	4	0.11	0.21	0.33
x_3	1.0	0.4	0.67	1	0.4	0.66	1	0.4	0.67	1	2.2	3	4	0.07	0.13	0.23
x_4	1.0	0.4	0.73	1	0.6	0.73	1	0.4	0.63	1	2.4	3.09	4	0.02	0.05	0.11
x_5	1.0	0.4	0.66	1	0.4	0.63	1	0.4	0.70	1	2.2	2.99	4	0.07	0.17	0.33
x_6	1.0	0.4	0.70	1	0.4	0.73	1	0.6	0.73	1	2.4	3.16	4	0.03	0.08	0.23
x_7	1.0	0.6	0.76	1	0.4	0.66	1	0.4	0.54	0.8	2.4	2.96	3.8	0.02	0.03	0.05
x_8	1.0	0.4	0.67	1	0.4	0.59	1	0.4	0.59	1	2.2	2.85	4	0.02	0.03	0.05

Solution results are presented in Table 8.

Table 8. The normalized-weighted fuzzy decision making matrix and solution results

Criterion	Alternatives											
	A_0			A_1			A_2			A_3		
	Ratings											
	α	β	γ	α	β	γ	α	β	γ	α	β	γ
x_1	0.0400	0.0689	0.1500	0.0160	0.0454	0.1500	0.0160	0.0503	0.1500	0.0160	0.0454	0.1500
x_2	0.0275	0.0709	0.1375	0.0110	0.0440	0.1375	0.0165	0.0504	0.1375	0.0110	0.0447	0.1375
x_3	0.0175	0.0433	0.1045	0.0070	0.0290	0.1045	0.0070	0.0286	0.1045	0.0070	0.0290	0.1045
x_4	0.0050	0.0162	0.0458	0.0020	0.0118	0.0458	0.0030	0.0118	0.0458	0.0020	0.0102	0.0458
x_5	0.0175	0.0569	0.1500	0.0070	0.0375	0.1500	0.0070	0.0358	0.1500	0.0070	0.0398	0.1500
x_6	0.0075	0.0253	0.0958	0.0030	0.0177	0.0958	0.0030	0.0185	0.0958	0.0045	0.0185	0.0958
x_7	0.0053	0.0101	0.0208	0.0032	0.0077	0.0208	0.0021	0.0067	0.0208	0.0021	0.0055	0.0167
x_8	0.0050	0.0105	0.0227	0.0020	0.0071	0.0227	0.0020	0.0062	0.0227	0.0020	0.0062	0.0227
$\tilde{S}_i$	0.1253	0.3021	0.7273	0.0512	0.2003	0.7273	0.0566	0.2082	0.7273	0.0516	0.1993	0.7231
S_i		0.770			0.652			0.661			0.649	
K_i		1.000			0.848			0.859			0.844	

The best candidate from available and feasible is the second candidate (see Fig. 1). He was selected by decision makers.

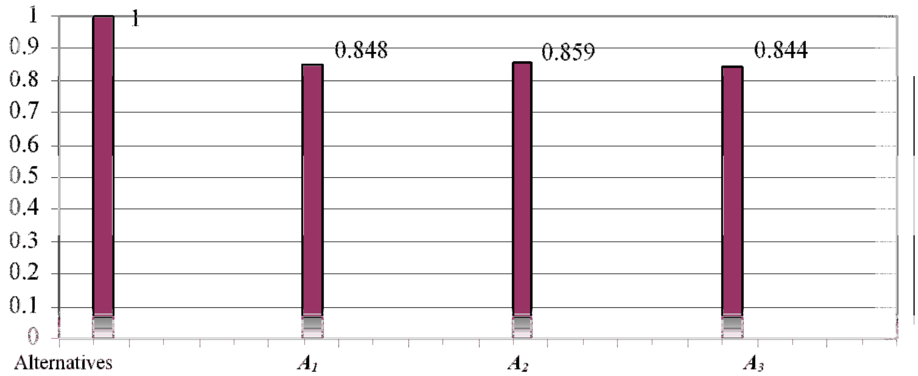

Fig. 1. Solution results

Conclusions

The chief accountant officer is one of the most important persons in each organization. The proposed model helps to overcome difficulties in chief accountant officer chief accountant officer selection process. The values of criteria set describing candidates in most cases are lexical values. The fuzzy set theory is proper way to deal with uncertainty. It can be stated that the ratio with an optimal alternative may be used in cases when it is sought to rank alternatives and find ways to improve them. Presented case study shows that this model successfully could help in cases when actors need to select among feasible candidates.

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