Универзитет Привредна академија у Новом Саду
University Business Academy in Novi Sad

Факултет за примењени менаџмент, економију и финансије Београд
Faculty of Applied Management, Economics and Finance Belgrade

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INNOVATION AS AN INITIATOR OF THE DEVELOPMENT

ИНОВАЦИЈЕ КАО ПОКРЕТАЧ РАЗВОЈА

INTERNATIONAL CONFERENCE PROCEEDINGS

ЗБОРНИК РАДОВА СА МЕЂУНАРОДНОГ СКУПА

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Gabrijela Popović, PhD, Faculty of Applied Management, Economy and Finance Belgrade, University Business Academy in Novi Sad, Serbia
(President of the Organizing Committee)

Sanja Anastasija Marković, MSc, Faculty of Applied Management, Economy and Finance Belgrade, University Business Academy in Novi Sad, Serbia
(Vice-president of the Organizing Committee)

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Vuk Mirčetić, MSc, Faculty of Applied Management, Economy and Finance Belgrade, University Business Academy in Novi Sad, Serbia

Goran Jocić, MSc, Faculty of Applied Management, Economy and Finance Belgrade, University Business Academy in Novi Sad, Serbia

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Cipriana Sava, PhD, Faculty of Computers and Applied Informatics, "TIBISCUS", University of Timişoara, Timişoara, Romania

ПРЕДГОВОР

Иновације и даље прожимају наш свакодневни живот, а ове године, баш као и претходних осам, Факултет за примењени менаџмент, економију и финансије, Универзитет Привредна академија у Новом Саду, приредио је зборник радова с обзиром на пристигле чланке и њихов свеобухватан тематски аспект. Под насловом 'Иновације као покретач развоја', радови у овом зборнику истражују значај иновација у обликовању будућности, почевши од садашњости која захтева пажљиво истраживање, анализу и разматрање. Овај зборник обухвата преко 60 радова послатих од стране угледних универзитетских професора, истакнутих истраживача, експерата и научних радника како из Србије, тако и из иностранства.

Желимо и да истакнемо да је међународна научно-стручна конференција "Иновације као покретач развоја" финансијски подржана од стране Министарства науке, технолошког развоја и иновација Републике Србије. Зборник радова међународног значаја, стандардно је категорисан у домаћој науци као М33, је у форми дигиталне и штампане едиције и биће доступан широј научној и стручној јавности.

Београд,

Децембар, 2023.

Уредници

Др Дарјан Карабашевић

Др Светлана Вукотић

Др Габријела Поповић

FOREWORD

Innovations continue to permeate our daily lives, and this year, just like the previous eight, the Faculty of Applied Management, Economics and Finance, University Business Academy in Novi Sad, prepared a collection of papers considering the articles received and their comprehensive thematic aspect. Entitled "Innovation as the initiator of development", the papers in this collection explore the importance of innovation in shaping the future, starting with the present, which requires careful research, analysis and consideration. This collection includes over 60 papers sent by distinguished university professors, prominent researchers, experts and scientific workers both from Serbia and abroad.

We would also like to point out that the International Scientific & Professional Conference "Innovation as the initiator of development" is financially supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia. The book of proceedings of international importance, categorized in domestic science as M33, is in the form of a digital and print edition and will be available to the wider scientific and professional public.

Belgrade,

December, 2023

Editors

Darjan Karabašević, PhD

Svetlana Vukotić, PhD

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Approach to the personnel selection process in a group decision-making environment based on the PSI method

Pristup procesu selekcije kadrova u grupnom odlučivanju zasnovan na PSI metodi

Maja Stanujkic[1], Gabrijela Popovic[2], Dragisa Stanujkic[3], Florentin Smarandache[4]

[1]*ReMade DOO, Industrijska 3b, Novi Sad, Serbia, maja.stanujkic@gmail.com*
[2] *University Business Academy in Novi Sad, Faculty of Applied Management, Economics and Finance, Jevrejska 24, Belgrade, Serbia, gabrijela.popovic@mef.edu.rs*
[3]*Technical Faculty, Vojske Jugoslavije 12, Bor, Serbia, dstanujkic@tfbor.bg.ac.rs*
[4] *Department of Mathematics, University of New Mexico, Gallup, NM 87301, USA, smarand@unm.edu*

Abstract: *The selection of adequate personnel is significant for the successful operation of companies. Therefore, this article observed the application of the Preference Selection Index (PSI) method for evaluating personnel in the conditions of group decision-making. The PSI method was chosen because it does not require determining the weights of the criteria, which is why it can be suitable for application by HR managers unfamiliar with the application of multiple criteria decision-making methods.*
Keywords: *human resources management, personnel selection, recruitment, PSI method, MCDM*

Apstrakt: *Izbor adekvatnih kadrova je veoma značajan za uspešno poslovanje kompanija. Zbog toga je u ovom radu pazmatrana primena Preference Selection Index (PSI) metoda za evaluaciju kadrova u uslovima grupnog odlučivanja. PSI metoda je izabrana jer ne zahteva određivanje težina kriterijuma zbog čega može biti pogodna za primenu od strane menadžera ljudskih resursa kojima nije bliska primena metoda višekriterijumskog odlučivanja.*
Ključne reči: *upavljanje ljudskim resursima, izbor kadrova, PSI metoda, MCDM*

Introduction

Recruitment and selection of adequate personnel are essential for the efficient functioning and advancement of the company in a competitive environment. That is why almost every contemporary company has a specialized part, the Human Resources (HR) management department, which deals with recruitment and the selection of personnel needed for the efficient functioning of the company.

In addition to numerous other approaches, using multiple criteria decision-making (MCDM) methods in the recruitment and selection process can be identified as one of the actual approaches. As a result, numerous articles were published in the scientific and professional literature, such as Liang and Wang (1994), Dursun and Karsak (2010), Karabašević et al. (2015), Ulutaş et al. (2020), Popović (2021), Uslu et al. (2021), and so on.

Numerous MCDM methods were applied in these researches, such as TOPSIS (Kelemenis & Askounis, 2010; Matin et al., 2011; Samanlioglu et al., 2018; Nabeehet al. 2019), VIKOR (Liu et al., 2015; Krishankumar et al., 2020), PROMETHEE (Luo & Xing, 2019), EDAS (Karabasevic et al., 2018), COPRAS (Zolfani et al., 2012; Ighravwe & Oke, 2019), and MULTIMOORA (Baležentis et al., 2012a; Baležentis et al., 2012b; Uslu et al., 2021).

Inspired by the previously mentioned research, this article presents the application of one rarely used MCDM method for personnel evaluation in a group decision-making environment.

Methodology

The Preference Selection Index method

The PSI method was proposed by Maniya and Bhatt (2010). This method is interesting because it does not require criteria weights, considering that calculating criteria weights is an integral part of this method. In addition, this method has a relatively simple and easy-to-understand calculation procedure that can be presented as follows:

Step 1. Evaluate the alternatives and construct initial decision-making matrix D, as follows:

$$D = [x_{ij}]_{m \times n}, \tag{1}$$

where x_{ij} denotes ratings of the alternative i concerning criterion j.

Step 2. Construct the normalized decision matrix in which the elements of the matrix are calculated as follows:

$$r_{ij} = \begin{cases} \frac{x_{ij}}{max_i x_{ij}}; & for\ beneficial\ criteria \\ \frac{max_i x_{ij}}{x_{ij}}; & for\ nonbeneficial\ criteria \end{cases}, \tag{2}$$

where r_{ij} denotes normalized ratings of the alternative i concerning criterion j.

Step 3. Calculate preference variation χ_j value to each criterion as follows:

$$\chi_j = \sum_{i=1}^{m} (r_{ij} - \bar{r}_j)^2, \tag{3}$$

where $\bar{r}_j$ denotes the mean value of normalized ratings of criterion j, and it is determined as follows:

$$\bar{r}_j = \frac{1}{m} \sum_{i=1}^{m} r_{ij}. \tag{4}$$

Step 4. Calculate deviation in the preference variation value Ω_j as follows:

$$\Omega_j = 1 - \frac{\chi_j}{m-1}. \tag{5}$$

Step 5. Determine the criteria weights w_j as follows:

$$w_j = \frac{\Omega_j}{\sum_{j=1}^{n} \Omega_j}. \tag{6}$$

Step 6. Calculate the preference selection index of alternatives S_i as follows:

$$S_i = \sum_{j=1}^{n} r_j w_j. \tag{7}$$

Step 7. Based on the alternatives' preference selection index values, determine the alternatives' complete ranking order. The alternative with the most extensive preference selection index represents the best-ranked alternative.

The Preference Selection Index method in group decision-making

Many complex decision-making problems, such as the ranking and selection of candidates in the recruitment process, require the participation of several or more decision-makers (DM). Numerous procedures proposed for adapting MCDM methods in a group environment are discussed in the literature. In this article, two straightforward approaches for applying the PCI method in a group environment are presented and discussed.

The first approach is based on the complete calculations using the PCI method for each DM, determining the ranking orders of alternatives based on the attitudes of each DM and finally selecting the most appropriate alternative, i.e., candidate using the Dominance Theory (DT). It should be

emphasized here that the basis of the DT is that the best alternative is the alternative that most often appears in the first position.

The second approach is based on calculating a group decision matrix based on the ratings obtained from all DMs involved in the evaluation and calculation using the PSI method based on this matrix. In this approach, the elements of the group decision matrix can be determined as follows:

$$DG = \left[x_{ij}^{G}\right]_{m\times n}, \tag{8}$$

$$x_{ij}^{G} = \frac{1}{k}\sum_{l=1}^{k} x_{ij}^{l}, \tag{9}$$

where x_{ij}^{l} denotes ratings of the alternative i in relation to criterion j obtained from decision maker l, and k denotes the number of decision-makers involved in the evaluation.

Illustrative example

In order to show the usability of the PSI method for ranking and selecting candidates, a numerical example adopted from Karabasevic et al. (2018) is discussed in this section. In the mentioned example, an evaluation of a candidate for the position of human resource manager in a telecommunications company was carried out based on the following criteria: C_1 – Relevant work experience, C_2 – Education, C_3 – Communication and presentation skills, C_4 – People management skills, C_5 – Organizational and planning skills and C_6 – Foreign languages.

The decision matrices obtained from the three DMs involved in the evaluation are shown in Tables 1 to 3, while the group decision matrix is shown in Table 4.

Table 2. The decision matrix obtained from the first of three DMs

	C1	**C2**	**C3**	**C4**	**C5**	**C6**
A1	4	4	3	4	4	3
A2	4	3	4	4	3	3
A3	5	4	3	5	4	4

Table 2. The decision matrix obtained from the second of three DMs

	C1	**C2**	**C3**	**C4**	**C5**	**C6**
A1	3	4	3	4	4	3
A2	5	4	3	3	3	3
A3	3	3	3	3	4	2

Table 3. The decision matrix obtained from the third of three DMs

	C1	**C2**	**C3**	**C4**	**C5**	**C6**
A1	4	4	3	3	4	3
A2	3	4	3	4	3	3
A3	3	4	3	3	2	3

Table 4. Group decision matrix obtained from three DMs

	C1	**C2**	**C3**	**C4**	**C5**	**C6**
A1	3.67	4.00	3.00	3.67	4.00	3.00
A2	4.00	3.67	3.33	3.67	3.00	3.00
A3	3.67	3.67	3.00	3.67	3.33	3.00

The first approach

The normalized decision matrix formed based on the ratings obtained from the first DM, using Eq. (2), is shown in Table 5, while the values of χ_j, Ω_j, and criteria weights, calculated using Eqs. (3), (5), and (6) are shown in Table 6.

Table 5. The normalized decision matrix formed based on the ratings obtained from the first DM

	C1	C2	C3	C4	C5	C6
A1	0.80	1.00	0.75	0.80	1.00	0.75
A2	0.80	0.75	1.00	0.80	0.75	0.75
A3	1.00	1.00	0.75	1.00	1.00	1.00

Table 6. Calculation details obtained using the PSI method

	C1	C2	C3	C4	C5	C6
χ_j	0.027	0.042	0.042	0.027	0.042	0.042
Ω_j	0.987	0.979	0.979	0.987	0.979	0.979
w_j	0.168	0.166	0.166	0.168	0.166	0.166

The weighted normalized decision matrix, calculated by multiplying the values from the normalized decision matrix, shown in Table 5, and the criteria weights, shown in Table 6, are presented in Table 7. Table 7 also shows the values of S_i, calculated using Eq. (7), as well as the ranking order of the alternatives.

Table 7. The weighted normalized decision matrix and ranking orders of alternatives

	C1	C2	C3	C4	C5	C6	S_i	Rank
A1	0.13	0.17	0.12	0.13	0.17	0.12	0.85	2
A2	0.13	0.12	0.17	0.13	0.12	0.12	0.81	3
A3	0.17	0.17	0.12	0.17	0.17	0.17	0.96	1

Using the previously presented procedure, the ranking orders of alternatives, the candidates, were determined for the second and third DMs, and the obtained results are summarized in Table 8.

Table 8. Summarized ranking orders based on the ratings obtained from three DMs

	DM I		DM II		DM III		Overall
	S_i	Rank	S_i	Rank	S_i	Rank	Rank
A1	0.85	2	0.94	1	0.96	1	1
A2	0.81	3	0.92	2	0.92	2	2
A3	0.96	1	0.80	3	0.84	3	2

As can be observed from Table 8, the alternative, that is, the candidate denoted as A1, is the best placed or the most suitable candidate selected based on the ratings obtained from three DMs involved in the evaluation using the PSI method.

The second approach

The second calculation form performed using the second proposed approach is briefly summarized in Tables 9 to 11.

Table 9. The normalized decision matrix formed based on three DMs

	C1	C2	C3	C4	C5	C6
A1	0.92	1.00	0.90	1.00	1.00	1.00
A2	1.00	0.92	1.00	1.00	0.75	1.00
A3	0.92	0.92	0.90	1.00	0.83	1.00

Table10. Calculation details were obtained using the PSI method based on the ratings obtained from three DMs

	C_1	C_2	C_3	C_4	C_5	C_6
χ_j	0.005	0.005	0.007	0.000	0.032	0.000
Ω_j	0.998	0.998	0.997	1.000	0.984	1.000
w_j	0.167	0.167	0.167	0.167	0.165	0.167

Table 11. The weighted normalized decision matrix and ranking orders of alternatives based on the ratings of three DMs

	C_1	C_2	C_3	C_4	C_5	C_6	S_i	Rank
A_1	0.15	0.17	0.15	0.17	0.16	0.17	0.97	1
A_2	0.17	0.15	0.17	0.17	0.12	0.17	0.94	2
A_3	0.15	0.15	0.15	0.17	0.14	0.17	0.93	3

As can be concluded from Table 11, the best alternative, the candidate selected by applying the second approach, is the candidate designated as A_1.

Conclusion

This article presents the application of the PSI method for evaluating candidates in the recruitment and selection process. The mentioned method does not require the determination of criteria weights because the calculation procedure of this method includes the determination of the significance of the criteria. For this reason, this method can be applicable in cases of evaluation when the criteria weights are not known. In addition, the calculation procedure of this method is still relatively simple and understandable, which is why its application can be interesting for use by DMs who need to become more familiar with the application of MCDM methods.

The article also discusses two possible approaches for using the PSI method in group decision-making. The first approach requires significant calculations but is more suitable for analysis and forming a compromise solution that satisfies the attitudes of all DMs involved in the evaluation. The second approach is more compact and involves fewer calculations because it is based on applying a group decision matrix, but it is also less informative. That is, it does not provide significant opportunities for conducting additional analyses. In addition, this approach can be suitable when several DMs are involved in the decision-making process. In addition, this approach can be easily adapted for decision-making in cases where different DMs have different weights, that is, when their attitudes can have a different impact on the final evaluation of the candidate. The main limitation of the paper is reflected through its inability to reflect the decision environment ambiguity. This shortcoming could be resolved by introducing the fuzzy or grey extensions in the evaluation process, which is also a direction for future research.

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