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International Scientific & Professional Conference
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INNOVATION AS AN INITIATOR OF THE DEVELOPMENT
ИНОВАЦИЈЕ КАО ПОКРЕТАЧ РАЗВОЈА

INTERNATIONAL CONFERENCE PROCEEDINGS
ЗБОРНИК РАДОВА СА МЕЂУНАРОДНОГ СКУПА

INNOVATIONS

December 5th
Belgrade, 2024

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

MEFkon 2024 / МЕФкон 2024
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ПРЕДГОВОР

Поштовани аутори, читаоци, колеге, студенти и ентузијасти жељни знања,

Пред вама се налази зборник радова десете јубиларне Међународне научно-стручне конференције „Иновације као покретач развоја" коју организује Факултет за примењени менаџмент, економију и финансије, Београд. Већ десет година заредом заједно истражујемо границе и могућности реализације иновативних активности, а стечена сазнања презентујемо у виду чланака обједињених у зборнику радова. На том десетогодишњем путу учили смо, расли и развијали се заједно, а све са циљем креирања базе знања која ће допринети будућем економском развоју и просперитету. Значај конференције препознало је Министарство науке, технолошког развоја и иновација Републике Србије које је пружило финансијску подршку у њеној организацији. До сада смо се дотакли многих тема које прожимају различите научне области и сагледали их кроз призму иновативности. Неки научни одговори су понуђени, неки чак и усвојени, а за неким одговорима и решењима још увек трагамо. Захваљујемо вам што сте десет година уз нас и изражавамо наду да ћете и надаље учествовати у потрази за иновативним решењима и одговорима који ће овај свет учинити бољим него што је сада.

У Београду, децембра 2024.   Уредници,

Проф. др Дарјан Карабашевић

Проф. др Светлана Вукотић

Проф. др Габријела Поповић

FOREWORD

Dear authors, readers, colleagues, students, and enthusiasts seeking for knowledge,

In front of you are the proceedings of the tenth Jubilar International Scientific & Professional Conference, "Innovations as an initiator of the Development," which is organized by the Faculty of Applied Management, Economics and Finance, Belgrade. Ten years in a row, we explored the borders and possibilities for realizing innovative activities and gained knowledge presented in the form of articles united in the conference proceedings. In that ten-year road, we have learned, grown, and developed together, all with the goal of creating the knowledge base that will contribute to future economic development and prosperity. Conference significance is recognized by the Ministry of Science, Technological Progress and Innovation of the Republic of Serbia, which financially supports it. We have touched on many subjects that pervade different scientific fields and perceive them through the prism of innovativeness. Some scientific answers are offered, some are even accepted, and for some of them, we are still looking. Thank you for being these ten years by us, and we hope you will still be a part of the quest for innovative solutions and answers that will make this world better than it is now.

In Belgrade, December, 2024

Editors

Darjan Karabašević, PhD

Svetlana Vukotić, PhD

Gabrijela Popović, PhD

САДРЖАЈ / CONTENT

РАДОВИ ПО ПОЗИВУ

INVITED PAPERS

РАДОВИ СА КОНФЕРЕНЦИЈЕ

CONFERENCE PAPERS

Academic staff selection based on the MCDM approach

Избор наставног кадра заснован на ВКО приступу

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Abstract: *This article proposes an academic staff selection based on the Multiple-Criterion Decision-Making (MCDM) approach. Five candidates were evaluated against three factor groups: individual, work, and academic. Each of the factor groups was elaborated on a certain number of sub-factors. The evaluation procedure was performed using the Extended Pivot Pairwise Relative Criteria Importance Assessment (PIPRECIA-E). The final results revealed the applicability and potential of the PIPRECIA-E in facilitating the process of academic staff selection.*

Keywords: *PIPRECIA-E, Academic staff, Selection, Factors.*

Анстракт: *Овај чланак предлаже селекцију наставног кадра засновану на Вишекритеријумском одлучивању (ВКО). Пет кандидата оцењивано је у односу на три групе фактора које укључују: индивидуалне, радне и академске. Свака од поменутих група подељена је на одређени број подфактора. Процес евалуације реализован је применом Extended Pivot Pairwise Relative Criteria Importance Assessment (PIPRECIA-E). Финални резултати указали су на применљивост и потенцијал PIPRECIA-E за унапређење процеса селекције наставног кадра.*

Кључне речи: *PIPRECIA-E, наставни кадар, селекција, фактори.*

Introduction

A significant part of the Human Resources Management (HRM) is the adequate staff selection process. This process incorporates two perspectives: objective (personality, stress management, interviews and interviewer rating) and subjective (work experience, biography, skills). It can be stated that *"personnel selection is a way for selecting persons who meet the criterion requirements for a certain job to the fullest possible scope"* (Raj Mishra et al., 2020, p. 55). According to Raj Mishra et al. (2020), the personnel selection encompasses the following tasks:

- evaluation criteria assessment and determining their significance;
- defining the adequate scale for candidate evaluation;
- defining final ranking order using an adequate approach.

As can be concluded, the staff selection has the elements that characterize Multiple-Criteria Decision-Making (MCDM) problems.

MCDM represents a field of management science that offers a spectrum of methods designed to facilitate the decision process in the conditions of several alternatives and a set of conflicting criteria. The authors have proposed different methods as an aid in making adequate decisions and choices in

different fields (Taherdoost & Madanchian, 2023; Sahoo & Goswami, 2023; Singh & Pant, 2021; Akhtar et al., 2021; Tan et al., 2021; Chowdhury & Paul, 2020; Asadabadi et al., 2019).

Nevertheless, the MCDM methods have been used for resolving issues in the HRM and staff selection (Pinto-DelaCadena et al., 2024; Gottwald et al., 2024; Leyva-López et al., 2022; Kwok et al., 2022; Mahad et al., 2022; Nong & Ha, 2021; Ozgormus et al., 2021; Yildirim et al., 2019; Cetin & Icigen, 2017; Salehi, 2016).

This article proposes the selection of the academic staff based on the Multiple-Criteria Decision-Making (MCDM) approach. A well-chosen academic staff is essential because its quality influence on the quality of the organization in which they work. In this case, the assessment and selection procedure were performed using the Extended Pivot Pairwise Relative Criteria Importance Assessment (PIPRECIA-E). The possibility of the given method observed in the hypothetical example points to evaluating the five candidates relative to three factors and an adequate number of sub-factors. The remainder of the article is organized as follows: Section 2 explains the PIPRECIA-E computational procedure; Section 3 contains the numerical example; and the conclusion is at the end.

1. The PIPRECIA-E method

The PIPRECIA-E method has been proposed by Stanujkic et al. (2017). The advantages of this method are as follows:

- it does not require the presorting of the criteria according to the expected significance;
- it involves the consistency checking using the Pearson's or Spearman's correlation;
- it is bidirectional, contributing to the increased reliability of the performed evaluation.

Until now, this method has been used for defining the criteria weights and ranking of the considered alternatives in various business fields (Rasheed et al., 2024; Özdağoğlu et al., 2022; Popovic et al., 2021; Popović & Mihajlović, 2018).

For the need of this article, the computation procedure of the PIPRECIA-e method could be illustrated in the following way:

Step 1. Choose the evaluation criteria which presorting could be omitted.

Step 2. Define the relative importance s_j starting from the second criterion as it is presented:

$$s_j = \begin{cases} > 1 & when & C_j \succ C_{j-1} \\ 1 & when & C_j = C_{j-1} \\ < 1 & when & C_j \prec C_{j-1} \end{cases}. \tag{1}$$

Step 3. Compute the coefficient k_j as follows:

$$k_j = \begin{cases} 1 & j = 1 \\ 2 - s_j & j > 1 \end{cases}. \tag{2}$$

Step 4. Determine the recalculated value q_j in the following way:

$$q_j = \begin{cases} 1 & j = 1 \\ \frac{q_{j-1}}{k_j} & j > 1 \end{cases}. \tag{3}$$

Step 5. Calculate the relative weights of the considered criteria using the Eq. (4):

$$w_j = \frac{q_j}{\sum_{k=1}^{n} q_k}, \tag{4}$$

where w_j is the relative weight of the criterion j.

Step 6. Determine the inverse relative importance s_j' starting from the penultimate criterion as follows:

$$s_j' = \begin{cases} > 1 & when & c_j > c_{j+1} \\ 1 & when & c_j = c_{j+1}. \\ < 1 & when & c_j < c_{j+1} \end{cases} \qquad (5)$$

Step **7.** Compute the inverse coefficient k_j' as it is presented:

$$k_j' = \begin{cases} 1 & j = n \\ 2 - s_j' & j < 1 \end{cases} . \qquad (6)$$

Step **8.** Define the inverse recalculated weight q_j' in the following way:

$$q_j' = \begin{cases} 1 & j = n \\ \dfrac{q_{j+1}'}{k_j'} & j < n \end{cases} . \qquad (7)$$

Step **9.** Calculate the inverse relative weights of the considered criteria as follows:

$$w_j' = \frac{q_j'}{\sum_{k=1}^{n} q_k'}, \qquad (8)$$

where w_j' represents the inverse weight of the criterion j.

Step **10.** Verify the reliability of the defined results using Spearman's rank correlation coefficient:

$$\rho = 1 - \frac{6 \sum_{i=1}^{n} d_i^2}{n(n^2 - 1)}, \qquad (9)$$

where ρ designates the correlation coefficient, d_i represents a distance between the ranks for every x_i, n is the number of elements in each data series, and $\rho \in [-1, 1]$.

Step **11.** Compute the overall weight w_j'' of the criteria as follows:

$$w_j'' = \frac{1}{2}(w_j + w_j'), \qquad (10)$$

where w_j'' denotes the final weight of the criterion j.

2. Numerical example

In this section, we will outline the possibility of the PIPRECIA-E in the case of academic staff selection using a hypothetical example. The list of factors and sub-factors was created based on an article by Rouyendegh and Erkart (2012), and they are presented in Table 1.

Table 1. Initial data

Factors		Sub-factors		Alternatives	
IF	Individual factors	IF_1	Self-confidence	CD_1	Candidate 1
		IF_2	Compatibility		
		IF_3	Age	CD_2	Candidate 2
WF	Work factors	WF_1	Foreign language		
		WF_2	Obtained degree	CD_3	Candidate 3
		WF_3	Presentation skills		
AF	Academic factors	AF_1	Academic experience	CD_4	Candidate 4
		AF_2	Research papers		
		AF_3	Technical skills	CD_5	Candidate 5
		AF_4	Team working		

Source: Rouyendegh and Erkart, 2012

Table 2 shows the local weights of the factors and sub-factors for academic staff selection defined using the Eqs. (1)-(10), as well as the global weights.

Table 2. The local and global factor and sub-factor weights

Factors	Local weight	Sub-factors	Local weight	Global weight
IF	0.2941	IF_1	0.3101	0.0912
		IF_2	0.3797	0.1117
		IF_3	0.3101	0.0912
WF	0.3530	WF_1	0.3167	0.1118
		WF_2	0.3502	0.1236
		WF_3	0.3331	0.1176
AF	0.3530	AF_1	0.2346	0.0828
		AF_2	0.2594	0.0915
		AF_3	0.2594	0.0915
		AF_4	0.2467	0.0871

Source: Author's calculations

As can be seen from Table 2, factors WF – *Work factors* and AF – *Academic factors* have the same importance (0.3530), while the factor IF – *Individual factors* are slightly less critical (0.2941). Regarding the sub-factors, the highest weight has sub-factor WF_2 – *Obtained degree* with a significance of 0.1236. This sub-factor is followed by WF_3 – *Presentation skills*, the significance of which amounts to 0.1176. In the respectable third position is the sub-factor IF_2 – *Compatibility* (0.1117). According to the results, the least important is the sub-factor AF_1 – *Academic experience* (0.0828).

The five candidates were assessed against each previously presented sub-factor. The overall candidate significance was defined for every sub-factor group. The obtained results are presented in Tables 3, 4, and 5, respectively.

Table 3. The overall importance of candidates according to the individual factors

	IF_1	IF_2	IF_3
CD_1	0.2122	0.1933	0.2000
CD_2	0.1919	0.1933	0.2000
CD_3	0.1919	0.1843	0.2000
CD_4	0.1919	0.2038	0.2000
CD_5	0.2122	0.2252	0.2000

Source: Author's calculations

Table 4. The overall importance of candidates according to the work factors

	WF_1	WF_2	WF_3
CD_1	0.1761	0.2003	0.1732
CD_2	0.1852	0.2100	0.1915
CD_3	0.1852	0.1899	0.2117
CD_4	0.2268	0.1899	0.2117
CD_5	0.2268	0.2099	0.2117

Source: Author's calculations

Table 5. The overall importance of candidates according to the academic factors

	AF_1	AF_2	AF_3	AF_4
CD_1	0.1892	0.1864	0.1998	0.1575
CD_2	0.2091	0.1686	0.1998	0.1928
CD_3	0.1987	0.1864	0.2208	0.1744
CD_4	0.1812	0.2061	0.1803	0.2136
CD_5	0.2218	0.2525	0.1994	0.2617

Source: Author's calculations

Table 6 presents the final results and ranking order of the candidates involved in the procedure, which is also illustrated in Figure 1.

Table 6. Ranking order of the candidates

Candidate	Importance	Rank
CD_5	0.1984	1
CD_4	0.1818	2
CD_2	0.1762	3
CD_3	0.1754	4
CD_1	0.1710	5

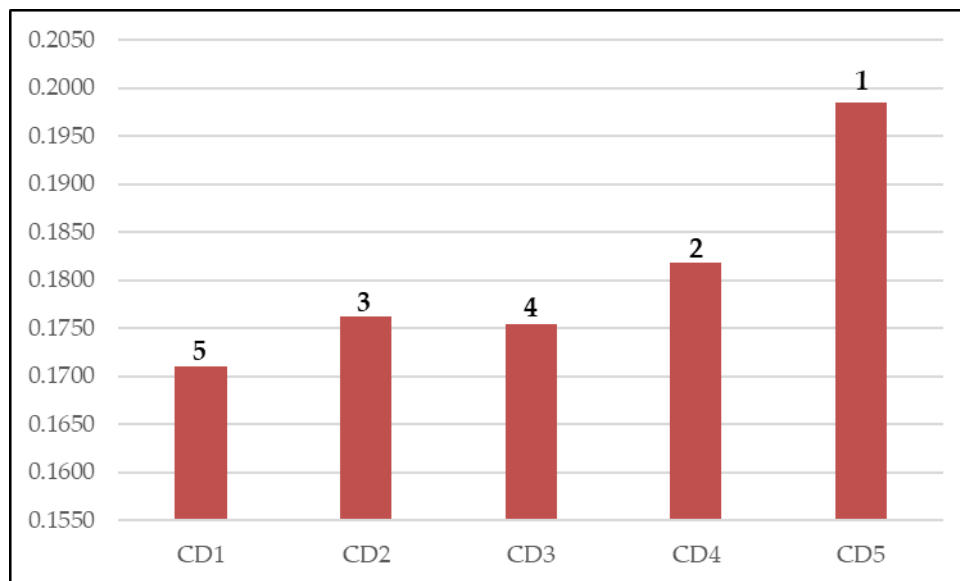Source: Author's calculations

Figure 1. Ranking order of the candidates
Source: Author's calculations

The results highlighted the fifth candidate (CD_5) as the most suitable for an academic position within an organization. The candidate designated as CD_1 is the least adequate.

Conclusion

This article proposes applying the PIPRECIA-E method for academic staff selection. The applicability of the proposed methodology is presented using the hypothetical example of the assessment of the

five candidates regarding the three main factors, which are elaborated in a certain number of sub-factors. The final results successfully emphasized the candidate best suited to the particular academic position.

This research has certain advantages and disadvantages that should be mentioned. The PIPRECIA-E key benefit, contrary to the PIPRECIA and PIPRECIA-S methods, is that it predicts the consistency checking. In that way, the obtained results are more reliable because the invalid responses are discarded. On the other hand, the essential disadvantage of the PIPRECIA-E method is its complex procedure, which could be unclear to the respondents unfamiliar with the MCDM. Additionally, the flaw of the performed research is reflected in the list of the factors and sub-factors that are very scarce. Furthermore, the proposed methodology is based on crisp numbers, which are not quite suitable for the qualitative type of problems. Each of these article shortcomings automatically represents the propositions for future research. Although the mentioned shortcoming, the methodology used proved its adequacy and usefulness because it enabled the obtaining of acceptable results. Nevertheless, it is not limited to the academic staff selection but could be used to resolve other business issues.

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