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Navigating the Complexity of HRM Practice: A Multiple-Criteria Decision-Making Framework

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Abstract: A myriad of diverse factors affect the contemporary business environment and all business areas, causing organisations to innovate new business models, or to use innovations to navigate the complexity of contemporary HRM practice successfully. Despite the plenitude of notable studies, a particular theoretical gap exists regarding the innovation's impact on particular HRM practices and on understanding how multiple-criteria decision-making (MCDM) methods can be effectively applied in the context of human resource management (HRM) to address important aspects of successful practices and prioritise the considered alternative solutions. Recognising the potential of the MCDM field highlighted the possibility of involving the MCDM methods in detecting the most influential and innovative HRM practices and defining the rank of companies that are most successful in applying them. The innovative MCDM approach proposed here utilises the CRITIC (CRiteria Importance Through Intercriteria Correlation) method and PIPRECIA-S (Simple PIvot Pairwise RElative Criteria Importance Assessment) method for prioritising innovative HRM practices, and the COBRA (COmprehensive Distance Based RAnking) method for assessing the companies under evaluation. The research, which involved 21 respondent experts from the HRM field and 12 companies from the Republic of Serbia, revealed that employee participation is the most significant innovative HRM practice that yields the best results in the contemporary business environment. Consequently, the first-ranked company most successfully met the requirements of the innovative HRM practices presented.

Keywords: human resource management; innovations; MCDM; CRITIC; PIPRECIA-S; COBRA; HRM; ranking; contemporary business environment

MSC: 90B50

Citation: Mirčetić, V.; Popović, G.; Vukotić, S.; Mihić, M.; Kovačević, I.; Đoković, A.; Slavković, M. Navigating the Complexity of HRM Practice: A Multiple-Criteria Decision-Making Framework. *Mathematics* **2024**, *12*, 3769. https://doi.org/10.3390/math12233769

Academic Editors: Marcio Basilio, Valdecy Pereira and Marcos Dos Santos

Received: 3 November 2024
Revised: 25 November 2024
Accepted: 26 November 2024
Published: 29 November 2024

1. Introduction

The contemporary business environment is affected by a plenitude of challenges, changes, and factors. The turbulence of the current business environment means that changes are more numerous and occur rapidly. These modern trends, and an increasingly enunciated uncertainty, impact all business areas, making them more challenging and ambivalent to deal with, and causing organisations to innovate new business models or use innovations. Organisations face intricate challenges and are required to make important decisions and explore diverse methods to make their processes more sustainable (Turskis and Šniokienė, 2024 [1]). Organisations that stagnate in product and business process development are denied the opportunity to prosper. Innovative organisations have

additional possibilities to endure in the hypercompetitive business environment (Elshaer, Azazz and Fayyad, 2023 [2]).

Innovation is one of the most important factors contributing to a competitive advantage (Penjišević and Sančanin, 2024 [3]). Today, in many business spheres, companies increasingly focus on innovation and different approaches to previous operating methods. If innovations are observed in the context of human resource management (HRM), it is important to emphasise their varied importance. Shen et al. (2022) [4] underscored that human resource management significantly influences organisations' development and competitiveness. Many scholars have examined the relationship between human resource management and organisational performance. Haque (2023) [5] also points out the disadvantages related to the application of innovations in human resource management, and states that online recruitment has challenges, given that there is no direct interaction involved. Innovations in human resources management involve using information and communication technologies and numerous innovative approaches to human resources management. Certain respectable studies (Corral de Zubielqui, Fryges and Jones, 2019; Hong, Zhao and Stanley Snell, 2019; Papa et al., 2020 [6–8]) aimed to integrate human resource management and open innovation. Engelsberger et al. (2021) [9] define open innovation using mindset, and point out that it represents values, attitudes, and beliefs in the context of an individual's openness to sharing knowledge.

It is impossible to know with certainty which innovations will be created and incorporated into human resource management in the following years, but certain innovations will undoubtedly be present. Given that the contemporary business environment is undoubtedly challenging and uncertain, there is a need for an effective approach to decision-making processes.

An effective tool in various areas with practical and theoretical applications regarding the decision-making process is the employment of multi-criteria decision-making (MCDM) methods (Turskis and Keršulienė, 2024, Zavadskas et al., 2022 [10,11]). Many scholars have demonstrated that MCDM methods can address complex challenges and empower decision-makers to select the best solution for many challenges in an uncertain environment. Multi-criteria decision-making methods strive to assist decision-makers in examining possible decisions and select the most adequate one of the available alternatives (Karamaşa, 2021; Özdağoğlu et al., 2021 [12,13]).

MCDM has many different applications, such as choosing the most suitable alternative, ranking alternatives (partially or completely), sorting a set of alternatives into the categories created earlier, assembling a set of criteria, specifying the performance of alternatives, and elaborating on alternatives (Roy, 1981 [14]). Pinto-DelaCadena, Liern, and Vinueza-Cabezas (2024) [15] point out that mathematical methods are increasingly being utilised to underpin decision-making in human resource management. In the context of human resource management, MCDM methods are used mainly in segments of HRM practices, such as selection, training, and maintaining skills that are necessary for the safe work of personnel; (Gendler, Tumanov and Levin, 2021 [16]); the selection of personnel (Karabašević et al., 2015; Ulutaş et al., 2020; López et al., 2022; Tuğrul, 2022 [17–20]); and the evaluation of human resources (Jakovljević et al., 2021 [21]).

So far, a myriad of respectable studies have been published regarding the employment of different MCDM methods in diverse human resource management contexts. However, despite the surplus of notable studies in this regard, a particular theoretical gap exists, specifically in understanding how MCDM methods can be effectively applied in the context of HRM practices and innovations to successfully navigate the complexity of contemporary HRM practice.

Building on the work of Heidary Dahooie et al. (2022) [22], this paper strives to narrow an existing gap by providing a fine-grained systematic literature review regarding MCDM methods, mainly elaborating on the CRITIC (CRiteria Importance Through Intercriteria Correlation) method, PIPRECIA-S (Simple PIvot Pairwise RElative Criteria Importance Assessment) method, and COBRA (COmprehensive Distance Based RAnking) method,

proposing a new and innovative MCDM approach to tackle the aforementioned decision-making challenges. The essential incentive for employing the MCDM approach was its ability to respect all the criteria involved in the decision process. Furthermore, research that utilises MCDM methods does not require the involvement of many respondents, which facilitates the data gathering procedure. Unlike usual statistical methods, incorporating meticulously selected expert groups leads to adequate scientific results. Nevertheless, it is worth mentioning that the issue of innovative HRM practices and their influence on the company's position was not very often perceived through the MCDM prism.

This article is meticulously structured to provide a comprehensive, in-depth analysis of the aforementioned problems. Therefore, the article is organised as follows. The introduction is followed by the first chapter, which explains the materials and methods that were used. The first subchapter of this chapter analyses the empirical research methods, while the next three subchapters explain the three employed MCDM methods, analysing groundbreaking and reputable study papers from the last five years to provide a fine-grained perspective on the significance of these MCDM methods in a myriad of areas and disciplines. The next chapter discusses the results and the numerical illustration of these. It critically evaluates the results and their implications, providing a holistic perspective of the research contributions to human resource management theory. The final chapter consists of conclusions, limitations, and suggestions for future research.

2. Materials and Methods

This chapter is divided into five subchapters. The first segment sets up the research hypotheses, while the second subchapter elaborates on the empirical research methods used in this study. The following three subchapters introduce the selected MCDM method, present its computational procedure, and describe the different fields of application in which it is used, providing the reasoning for the selection of that method in this paper. The CRITIC method is first analysed, followed by the subchapters examining PIPRECIA-S and the COBRA method. The final section of this chapter introduces the Borda rule.

2.1. Empirical Research Methods

A methodological procedure is carefully crafted as a roadmap for this research. To ensure the effective monitoring of the implementation of the relevant activities and paper segments, a detailed research implementation scheme is illustrated in Figure 1.

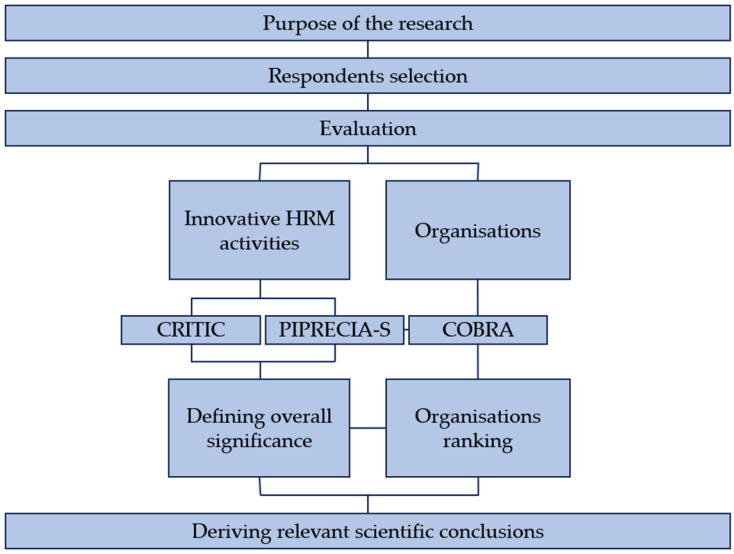

Figure 1. The innovative MCDM approach to HRM practices.

As introduced at the beginning of the article, and as can be observed in the previous Figure, this paper employed three MCDM methods: CRITIC and PIPRECIA-S to determine

the significance of the selected innovative HRM practices, and the COBRA method for the evaluation of the selected alternatives. Many MCDM methods could be used to facilitate the decision process in the HRM field. However, besides the well-known CRITIC method, we decided to employ two relatively new methods (PIPRECIA-S and COBRA), because researchers continually create and improve MCDM methods and models, so we believed that these new methods would bring new insights and contribute to the decision-making process, making it more reliable.

Defining the criteria weights represents an essential step in the MCDM analysis. Different weighting methods impact the decision process differently and could result in mutually differing weighting coefficients. Ponhan and Sureeyatanapas (2022) [23] analysed the discrepancy between weighting results that is gained by applying objective and subjective methods. Fourteen experts were assessed using eighteen criteria, with linguistic variables representing the base data, to employ subjective (direct rating, rank sum, and rank-order centroid) and objective (entropy and standard deviation) weighting methods. The final results outlined the volatility in the weighting coefficients depending on the method used.

Furthermore, Paramanik et al. (2022) [24] proposed the objective-subjective weighted method for minimising inconsistency (OSWMI) that involves an improved CRITIC method, BWM, and LINMAP II using a multi-objective non-linear programming (MONLP) model. The leading idea was to propose a model to reduce the possibility of manipulating weighting coefficients. In the present case, we proposed combining the CRITIC method and PIPRECIA-S to craft such an approach, which is sufficiently simple but also reliable. We aimed to define such an approach, that will enable the significance of the HRM practice to be defined while avoiding the extreme or biased weighting coefficients.

In this article, we propose a combination of the CRITIC and PIPRECIA-S methods to define the significance of the HRM practice. The possibilities of such an integrated MCDM approach have yet to be observed, and an explanation of why we chose to use it is given below. The CRITIC method belongs to the group of objective weighting methods that define the significance of the criteria based on the input data regarding the performance ratings of the evaluated alternatives. It is comprehensive and facilitates the process of determining the criteria weights. However, in some cases, the criterion with a high standard deviation and a low correlation with the other criteria may have a high weighting coefficient. As a result, such a dominant criterion relegates other criteria to the background and determines the final result. Therefore, to resolve this issue, we employed the PIPRECIA-S method, which is a subjective method for determining criteria weightings and is very applicable and easy to use. Even the respondents who were unfamiliar with MCDM methods understood the procedure of the PIPRECIA-S more easily, and learned to use it relatively quickly. Besides, the PIPRECIA-S method is very convenient for application in the group decision environment. However, as is the case with every subjective weighting method, the subjective judgements of decision-makers could lead to inadequate weighting coefficients (Paramanik et al., 2022; Mufazzal et al., 2021 [24,25]). Decision-makers could be dishonest or biased, which compromises the evaluation process (Liu et al., 2021 [26]). Because of the abovementioned reasons, we combined the CRITIC and PIPRECIA-S methods to (1) reduce the possibility of dominant weighting values, and (2) manipulate the results of decision-makers. The obtained weighting coefficients represent the input for further assessment using the COBRA method.

The COBRA method is a relatively new method that incorporates three types of distances from possible solutions. By calculating the distance from the positive ideal, negative ideal, and average solution, the reliability of the performed procedure increases, while the possibility of making the wrong decision or choice decreases. Although the procedure is somewhat complex, the reliability of the obtained results is expected to be higher because the distance measurements from different solutions are calculated.

2.2. CRITIC Method: Revolutionising Distance-Based Ranking in Scientific Studies

The CRITIC method (Diakoulaki, Mavrotas and Papayannakis, 1995 [27]) is a correlation method that aims to define the objective weights of relative importance in multi-criteria decision-making problems. Many scholars underlined the efficiency of this method in various multi-criteria issues, particularly when the decision-maker is absent. It facilitates the decision-maker's vocalisation of his argument or belief about the relative importance of the criteria, thereby decreasing the subjective character of the decision-making process. The method also assists in discarding the non-salient attributes in a primary weighting of the evaluation criteria, ensuring a fair and objective process.

The computational procedure of the CRITIC method comprises three steps, which are demonstrated below.

Step 1. Forming the decision-making matrix D as follows:

$$D = \left[x_{ij}\right]_{mxn} \tag{1}$$

where x_{ij} represents the ratings of the alternative i according to criterion j, m indicates the number of alternatives, and j denotes the number of criteria.

Step 2. Constructing the normalised decision-making matrix R as follows:

$$R = \left[r_{ij}\right] \tag{2}$$

where r_{ij} denotes the normalised ratings of the alternative i according to criterion j, and is calculated as follows:

$$r_{ij} = \frac{x_{ij-min_i\ x_{ij}}}{max_i\ x_{ij} - min_i\ x_{ij}} \tag{3}$$

Step 3. Determining the weights of criteria w_j using the following formula:

$$R = \frac{C_j}{\sum_{j=1}^{n} C_j} \tag{4}$$

where C_{ij} represents a quantity of information contained in criterion j, and is calculated in the following way:

$$C_j = \sigma_j \sum_{j=1}^{n} \left(1 - cr_{jj}\right) \tag{5}$$

and σ_j indicates the standard deviation of criterion j, cr_{jj} denotes the correlation coefficient between the two criteria.

The CRITIC method is multidisciplinary and applied across various domains, as presented in Table 1, which summarises the reputable and innovative studies that employ this method.

Table 1. Research goal or the field of application of the CRITIC method.

Year	Authors	Research Goal or Field of Application
2024	Chang [28]	Evaluation method for the classroom
2024	Krishnan [29]	Research trends in the CRITIC method
2024	Saensuk, Witchakool and Choompol [30]	Detection of fake news
2024	Shrinivas Balraj et al. [31]	Optimisation of machining parameters
2023	Hassan, Alhamrouni and Azhan [32]	Selection of a solar power plant location
2023	Hosseinzadeh Lotfi et al. [33]	Prioritisation and evaluation of projects based on different criteria
2023	Mishra, Chen and Rani [34]	Proposition of a model established on Fermatian fuzzy numbers
2023	Silva et al. [35]	Selection of investment portfolio
2023	Zhang et al. [36]	Evaluation of the rock burst intensity evaluation
2022	Bhadra, Dhar and Salam [37]	Natural fibres selection
2022	Haktanır and Kahraman [38]	Wearable health applications selection
2022	Kumari and Acherjee [39]	Unconventional processing method selection

Table 1. *Cont.*

Year	Authors	Research Goal or Field of Application
2022	Pamučar, Žižović and Đuričić [40]	CRITIC method modification using fuzzy rough numbers
2021	Mukhametzyanov [41]	Examination and comparison of different methods
2021	Zafar, Alamgir and Rehman [42]	Blockchain system evaluation
2020	Peng and Huang [43]	Financial risks analysis
2020	Peng, Zhang and Luo [44]	5G industry analysis
2019	Tuş and Aytaç Adalı [45]	Software selection

2.3. PIPRECIA-S Method: A New and Simplified Frontier for Assessment in Scientific Research

The PIPRECIA method (Stanujkić et al., 2017 [46]) is a subjective MCDM method for determining the criteria weights that were introduced and established based on the SWARA (Stepwise Weight Assessment Ratio Analysis) method (Keršuliene, Zavadskas and Turskis, 2010 [47]). Unlike in the SWARA method, the criteria are not required to be sorted according to their expected significance before starting the evaluation procedure.

This method was further developed, and one of the originated methods employed in this article is the PIPRECIA-S method (Stanujkić et al., 2021 [48]), which is easier to use for the respondents because they only perform the comparison regarding the first criterion.

The computational procedure of the PIPRECIA-S method includes five steps, as shown below.

Step 1. Determining the set of evaluation criteria.

Step 2. Setting the relative significance s_j of each criterion, except the first, as follows:

$$s_j = \begin{cases} 1 \ if \ \ c_j > c_1 \\ 1 \ if \ \ c_j = 1 \\ 1 \ if \ \ c_j < 1 \end{cases} \tag{6}$$

where $j \neq 1$.

The value of s_1 is set to 1, while the values of s_j belong to the interval (1, 1.9] when $C_j \succ C_1$, that is to the interval [0.1, 1) when $C_j \prec C_1$.

Step 3. Calculating the value of the coefficient k_j in the following way:

$$k_j = \begin{cases} 1 & if \ j = 1 \\ 2 - s_j & if \ j > 1 \end{cases} \tag{7}$$

Step 4. Calculating the recalculated weight q_j as follows:

$$q_j = \begin{cases} 1 & if \ j = 1 \\ \frac{1}{k_j} & if \ j > 1 \end{cases} \tag{8}$$

Step 5. Determining the relative weights of the evaluation criteria in the following way:

$$w_j = \frac{q_j}{\sum_{k=1}^{n} q_k} \tag{9}$$

The PIPRECIA-S method is used in many different domains. Table 2 provides a summary of the reputable studies that employed this method and the methods from the PIPRECIA family across various areas.

Table 2. Research goal or field of application of the methods from PIPRECIA family.

Year	Authors	Research Goal or Field of Application
2024	Mirčetić, Popović and Vukotić [49]	Determining characteristics of the charismatic leaders in the EU
2024	Rizwan, Fizza and Mumtaz [50]	Evaluating strategies for the growth of fibreglass composites industry
2024	Sarbat [51]	Job satisfaction analysis
2024	Setiawansyah et al. [52]	Personnel selection
2024	Stanujkić et al. [53]	Personnel selection in a group decision-making environment
2023	Hadad et al. [54]	Student ranking based on learning assessment
2023	Mladenović, Đukić and Popović [55]	Financial platforms reporting analysis
2023	Setiawansyah and Saputra [56]	Head of the school organisation selection
2023	Stanujkić et al. [57]	Improvement of the decision-making process in the IT industry
2023	Sulistiani et al. [58]	Employees in an educational institution evaluation
2022	Aytekin [59]	Vehicle tracking system
2022	Đukić, Karabašević and Popović [60]	Evaluation of different aspects of cognitive skills
2022	Ulutaş and Topal [61]	Renewable energy sources selection and criteria evaluation
2021	Popović et al. [62]	Identification of key determinants of tourism development
2021	Ulutaş et al. [63]	Transportation company selection
2020	Jauković Jocic, Karabašević and Jocić [64]	Quality of e-learning materials assessment

2.4. COBRA Method: A New Paradigm for Comprehensive Scientific Analysis

The COBRA method (Krstić et al., 2022 [65]) is one of the newer multi-criteria decision-making methods. This method belongs to the multi-criteria decision-making methods based on distance determination. A key advantage of the COBRA method is its comprehensive nature. Alternatives are ranked based on their comprehensive distance from three types of possible solutions: positive ideal, negative ideal, and average. This method implies Euclidean and taxicab distance measures when calculating the distances for all solutions, which contributes to increasing the reliability of the defined solutions.

The computational procedure of the COBRA method incorporates six steps, which are exhibited as follows.

Step 1. Forming an initial decision-making matrix.

Step 2. Normalising the initial decision-making matrix, using the following formula:

$$\alpha_{ij} = \frac{\xi_{ij}}{\max\limits_{i} \xi_{ij}} \tag{10}$$

Step 3. Forming the weight-normalised decision matrix Δ_w:

$$\Delta_w = \left[w_j \times \xi_j \right]_{m \times n} \tag{11}$$

where w_j is the relative weight of criterion j.

Step 4. Defining the positive ideal (PIS_j), negative ideal (NIS_j), and average solution (AS_j) for each criterion function, as presented in the following formulae:

$$PIS_j = \max_i \left(w_j \times \xi_{ij} \right), \quad \forall j = 1, \ldots, m \; for \; j \in B \tag{12a}$$

$$PIS_j = \min_i \left(w_j \times \xi_{ij} \right), \quad \forall j = 1, \ldots, m \; for \; j \in C \tag{12b}$$

$$NIS_j = \min_i \left(w_j \times \xi_{ij} \right), \quad \forall j = 1, \ldots, m \; for \; j \in B \tag{13a}$$

$$NIS_j = \max_i \left(w_j \times \xi_{ij} \right), \quad \forall j = 1, \ldots, m \; for \; j \in C \tag{13b}$$

$$AS_j = \frac{\sum_{i=1}^{n} \left(w_j \times \xi_{ij} \right)}{n}, \quad \forall j = 1, \ldots, m \; for \; j \in B, C \tag{14}$$

where B represents the set of benefits, and C denotes the set of cost criteria.

Step 5. Defining the distances from the positive ideal $\left(\mathrm{d}\left(\mathrm{PIS_j}\right)\right)$ and negative ideal $\left(\mathrm{d}\left(\mathrm{NIS_j}\right)\right)$ solutions for each alternative, as well as the positive $\left(\mathrm{d}\left(\mathrm{AS_j^+}\right)\right)$ and negative distances $\left(\mathrm{d}\left(\mathrm{AS_j^-}\right)\right)$ from the average solution, as follows:

$$d(S_j) = dE(S_j) + \beta \times dE(S_j) \times dT(S_j), \ \ \forall_j = 1, \ldots, m \tag{15}$$

where S_j is any solution $(PIS_j,\ NIS_j$ or $AS_j)$, and β is the correction coefficient acquired in the following way:

$$\beta = \max_i dE(S_j)_i - \min_i dE(S_j)_i \tag{16}$$

where $dE(S_j)_i$ and $dT(S_j)_i$ represent Euclidian and Taxicab distances, which are, for the positive ideal solution, acquired as follows:

$$dE(PIS_j)_i = \sqrt{\sum_{j=1}^{m} (PIS_j - w_j \times \xi_{ij})^2}, \ \ \forall_i = 1, \ldots, n, \ \ \forall_j = 1, \ldots, m \tag{17}$$

$$dT(PIS_j)_i = \sum_{j=1}^{m} |PIS_j - w_j \times \xi_{ij}|, \ \ \forall i = 1, \ldots, n, \ \ \forall j = 1, \ldots, m \tag{18}$$

For the negative ideal solution, Euclidian and Taxicab distances are determined in the following way:

$$dE(NIS_j)_i = \sqrt{\sum_{j=1}^{m} (NIS_j - w_j \times \xi_{ij})^2}, \ \ \forall_i = 1, \ldots, n, \ \ \forall_j = 1, \ldots, m \tag{19}$$

$$dT(NIS_j)_i = \sum_{j=1}^{m} |NIS_j - w_j \times \xi_{ij}|, \ \ \forall i = 1, \ldots, n, \ \ \forall_j = 1, \ldots, m \tag{20}$$

For the positive distance from the average solution, acquired as follows:

$$dE(AS_j)_i^+ = \sqrt{\sum_{j=1}^{m} \tau^+ (AS_j - w_j \times \xi_{ij})^2}, \ \ \forall_i = 1, \ldots, n, \ \ \forall_j = 1, \ldots, m \tag{21}$$

$$dT(AS_j)_i^+ = \sum_{j=1}^{m} \tau^+ |AS_j - w_j \times \xi_{ij}|, \ \ \forall i = 1, \ldots, n, \ \ \forall_j = 1, \ldots, m \tag{22}$$

$$\tau^+ = \begin{cases} 1 \ if \ AS_j < w_j \times \xi_{ij} \\ 0 \ if \ AS_j > w_j \times \xi_{ij} \end{cases} \tag{23}$$

For the negative distance from the average solution, acquired as follows:

$$dE(AS_j)_i^- = \sqrt{\sum_{j=1}^{m} \tau^- (AS_j - w_j \times \xi_{ij})^2}, \ \ \forall_i = 1, \ldots, n, \ \ \forall_j = 1, \ldots, m \tag{24}$$

$$dT(AS_j)_i^- = \sum_{j=1}^{m} \tau^- |AS_j - w_j \times \xi_{ij}|, \ \ \forall i = 1, \ldots, n, \ \ \forall_j = 1, \ldots, m \tag{25}$$

$$\tau^- = \begin{cases} 1 \ if \ AS_j > w_j \times \xi_{ij} \\ 0 \ if \ AS_j < w_j \times \xi_{ij} \end{cases} \tag{26}$$

Step 6. Ranking the alternatives by increasing the values of the comprehensive distances (dC_i) obtained using the following formula:

$$dC_i = \frac{d(PIS_j)_i - d(NIS_j)_i - d(AS_j)_i^+ + d(AS_j)_i^-}{4}, \ \forall i = 1, \ldots, n \tag{27}$$

Despite being a new method, the scholars found many different areas where the COBRA method can be employed. The respectable studies that used this method are shown in Table 3.

Table 3. Research goal or the field of application of the COBRA method.

Year	Authors	Research Goal or Field of Application
2024	Asker [66]	Financial performance assessment
2024	Krstić et al. [67]	Risk analysis of the agricultural products supply
2024	Oğuz and Satır [68]	Retail trade enterprises' financial performance assessment
2024	Sahak and Karsli [69]	Environmental degradation in urban conditions analysis
2024	Tadić, Krstić and Radovanović [70]	Strategies for using drones in logistics analysis
2024	Ulutaş et al. [71]	Supplier selection
2024	Verma, Koul and Ajaygopal [72]	Cyber security platforms assessment and selection
2024	Zorlu, Tuncer and Yılmaz [73]	Evaluation of the potential for geo-tourism development
2023	Krstić, Tadić and Agnusdei [74]	Intermodal terminals analysis
2023	Tadić et al. [75]	Decision-making in logistics
2023	Ulutaş, Balo and Topal [76]	Natural stone selection in the construction industry
2022	Krstić et al. [65]	Evaluation of the scenarios for smart reverse logistics development
2022	Popović, Pucar and Smarandache [77]	E-commerce development strategy selection
2022	Verma, Ajaygopal and Koul [78]	Circular supplier selection

2.5. Borda Rule

The Borda rule is usually employed to aggregate the opinions of different decision-makers (Emerson, 2013; Marchant, 2000 [79,80]). For example, if more different attitudes exist because several decision-makers are choosing between numerous alternatives, each of the decision-makers ranks the given alternatives from best to worst. The Borda rule can be used with or without ponders, depending on the decision problem. If the decision-making process is based on a different number of indicators, pondering is applied to include them when forming the final results. The aforementioned rule was proposed to unify the results obtained by employing diverse models. The aforementioned rule implies that, when ranking the m alternative, the best alternative is assigned a score of $m - 1$, the following $m - 2$, the subsequent $m - 3$, and so on until the last. Based on the overall defined score that considers all the positions that the observed alternative took, the final ranking of the evaluated alternatives is determined (Fedajev, Panić and Živković, 2024 [81]). A plenitude of respectable articles study the generalisation of the Borda method to make it more suitable for application in conditions of uncertainty, competition and fuzzy relations. However, there are particular objections to the Borda rule regarding an alternative being considered better than the alternative only if the difference between the Borda scores of the alternatives is greater than zero, while the amplitude of this difference is not considered (Marchant, 2000 [80]).

3. Case Study

Gathering data about the companies considered was necessary to conduct a planned analysis of the importance and impact of innovative HRM practices on the companies' performance. Twelve Serbian companies were chosen for data collection from the following sectors:

- Agriculture, forestry and fishing—three companies;
- Industry and construction—three companies;
- Services—three companies;
- ICT—three companies.

The company selection was based on the quartile report regarding companies' business operations, which is a part of regular "*Quarterly structural research on business operations of companies*" (SORS, 2024 [82]). According to this document, there are four sectors, as mentioned above. The sectors were selected because they face the most challenges for human resource management in the current conditions. One of the key issues is associated with the talent and general workforce deficits in these sectors. The names of the companies are not revealed because of privacy protection, and they are designated as K_1 to K_{12}. The companies' performances regarding innovative HRM practices were estimated by

21 respondents (R_1–R_{21}), who involved 11 experienced HR managers and 10 members of academia. Respondents used the Likert scale (1—the worst to 5—the best) (Likert, 1932 [83]) to assess the companies relative to the chosen innovative activities.

Innovative HRM activities which are involved in the research procedure were determined based on the paper by Heidary Dahooie et al. (2022) [22]. They represent the criteria against which the selected company's performance was evaluated, and all of them are beneficial. The list of the selected HRM practices and their abbreviations are presented in Table 4.

Table 4. Innovative HRM activities.

Selected HRM Practices	Abbreviation
Employee participation	Ep
Hiring process	Hp
Internal promotion	Ip
Job security	Js
Pay and reward	Pr
Performance management	Pm
Sharing information	Si
Teamwork	Tw
Training and development	Td

Source: Heidary Dahooie et al. (2022) [22].

Due to the thoroughness of our data collection process, which involved extensive data, we have chosen not to present all the data in this article.

The CRITIC approach was applied using the initial data about the respondents' estimation of the companies regarding the selected innovative HRM practices. The results obtained, defined based on the initial data from each respondent, are presented in Table 5.

Table 5. Assessment of the innovative HRM practices—CRITIC method.

	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8	R_9	R_{10}	R_{11}	R_{12}	R_{13}	R_{14}	R_{15}	R_{16}	R_{17}	R_{18}	R_{19}	R_{20}	R_{21}
Ep	0.13	0.15	0.13	0.08	0.11	0.11	0.13	0.08	0.13	0.15	0.09	0.09	0.16	0.16	0.14	0.23	0.19	0.20	0.21	0.11	0.14
Hp	0.15	0.16	0.11	0.11	0.11	0.11	0.12	0.11	0.08	0.13	0.12	0.06	0.10	0.08	0.11	0.08	0.07	0.12	0.04	0.14	0.10
Ip	0.09	0.10	0.08	0.18	0.15	0.13	0.10	0.10	0.14	0.09	0.09	0.13	0.09	0.17	0.11	0.11	0.12	0.11	0.10	0.12	0.09
Js	0.08	0.09	0.08	0.09	0.09	0.09	0.12	0.18	0.08	0.09	0.08	0.12	0.13	0.09	0.10	0.13	0.10	0.08	0.06	0.10	0.11
Pr	0.12	0.10	0.11	0.07	0.16	0.12	0.10	0.11	0.11	0.12	0.11	0.08	0.08	0.09	0.11	0.06	0.16	0.10	0.08	0.13	0.11
Pm	0.09	0.09	0.10	0.10	0.08	0.17	0.08	0.11	0.14	0.11	0.10	0.10	0.08	0.14	0.12	0.11	0.10	0.07	0.08	0.08	0.08
Si	0.10	0.13	0.10	0.09	0.10	0.08	0.09	0.10	0.10	0.08	0.12	0.22	0.19	0.07	0.07	0.12	0.10	0.12	0.18	0.09	0.16
Tw	0.10	0.10	0.19	0.18	0.10	0.12	0.17	0.14	0.12	0.12	0.10	0.08	0.07	0.09	0.10	0.09	0.09	0.08	0.16	0.15	0.11
Td	0.14	0.08	0.10	0.10	0.09	0.07	0.10	0.07	0.09	0.11	0.19	0.11	0.11	0.11	0.13	0.07	0.07	0.10	0.09	0.09	0.10

Source: authors' calculations.

The results highlight the volatility of the innovative HR practice importance elicited from each respondent separately. Although the CRITIC method belongs to the group of objective methods and involves the initial data in the assessment procedure, when this data is collected from the respondents, it is nevertheless biased and reflects the personal opinion of the particular person. This subjectiveness is expressed indirectly, because the respondents were unaware that their estimation of the companies according to the selected practices led to the estimation of the practices themselves. To gain the results about the importance of the practice where subjectivity is present and intentionally expressed, we used the PIPRECIA-S method.

The PIPRECIA-S method involves the use of special questionnaires, which were distributed via email to the same group of respondents. The responses obtained were then utilised in the computational procedure to determine the importance of the considered practices. Once again, due to the comprehensive nature of the data, only the final results are presented in Table 6.

Table 6. Assessment of the innovative HRM practices—PIPRECIA-S method.

	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8	R_9	R_{10}	R_{11}	R_{12}	R_{13}	R_{14}	R_{15}	R_{16}	R_{17}	R_{18}	R_{19}	R_{20}	R_{21}
Ep	0.11	0.11	0.10	0.10	0.10	0.11	0.11	0.11	0.10	0.11	0.11	0.10	0.11	0.10	0.10	0.10	0.11	0.12	0.11	0.11	0.09
Hp	0.10	0.13	0.10	0.09	0.14	0.11	0.12	0.12	0.13	0.11	0.11	0.11	0.13	0.10	0.11	0.10	0.13	0.10	0.12	0.10	0.08
Ip	0.11	0.10	0.13	0.12	0.09	0.11	0.09	0.11	0.10	0.12	0.11	0.09	0.11	0.09	0.11	0.10	0.11	0.10	0.12	0.12	0.11
Js	0.11	0.10	0.13	0.10	0.10	0.10	0.09	0.11	0.13	0.09	0.11	0.12	0.10	0.12	0.10	0.09	0.11	0.10	0.09	0.12	0.13
Pr	0.13	0.11	0.11	0.14	0.12	0.11	0.14	0.11	0.13	0.12	0.15	0.16	0.14	0.15	0.16	0.14	0.11	0.14	0.12	0.12	0.11
Pm	0.11	0.13	0.13	0.13	0.16	0.12	0.12	0.12	0.10	0.10	0.12	0.12	0.11	0.10	0.14	0.14	0.11	0.11	0.12	0.12	0.13
Si	0.12	0.11	0.11	0.12	0.10	0.11	0.12	0.11	0.10	0.14	0.11	0.11	0.10	0.13	0.14	0.10	0.12	0.12	0.14	0.12	0.15
Tw	0.10	0.09	0.09	0.10	0.09	0.11	0.10	0.11	0.09	0.10	0.11	0.11	0.11	0.10	0.08	0.10	0.11	0.10	0.09	0.10	0.10
Td	0.12	0.11	0.10	0.11	0.11	0.12	0.11	0.12	0.11	0.10	0.10	0.08	0.09	0.10	0.09	0.12	0.12	0.10	0.10	0.10	0.09

Source: authors' calculations.

The importance of the considered practices relative to each respondent varies again. We applied the geometric mean to define the final results regarding the CRITIC and PIPRECIA-S methods and the overall results. Table 7 presents the defined significances and their rank order.

Table 7. Overall innovative HRM practices significance.

	CRITIC	Rank	PIPRECIA-S	Rank	Overall Significance	Rank
Ep	0.1386	1	0.1053	7	0.1211	1
Js	0.1068	5	0.1293	1	0.1178	2
Si	0.1130	4	0.1180	3	0.1158	3
Pr	0.1026	7	0.1204	2	0.1114	4
Ip	0.1151	3	0.1066	5	0.1111	5
Hp	0.1167	2	0.0993	9	0.1080	6
Pm	0.1050	6	0.1097	4	0.1076	7
Tw	0.1009	9	0.1065	6	0.1040	8
Td	0.1012	8	0.1049	8	0.1033	9

Source: authors' calculations.

The overall significance obtained using the CRITIC method emphasised the innovative practice Ep—Employee participation, which is extremely important in modern business conditions. This HRM practice strongly dominates the results that amount to 0.1386. The situation was relatively different when the respondents were asked to intentionally evaluate modern HRM practices. Namely, the PIPRECIA-S results placed the practice Js—Job security as the most significant, followed by the practice Pr—Pay and reward (0.1204). The final ranking prioritised Ep—Employee participation as the practice leading to better operations and positioning in the particular company's market. It is not unexpected that respondents consciously give higher priority to performances such as job security and payment. However, the initial estimation of the chosen companies regarding the considered practices revealed that the involvement of the employees is at the core of a successful company.

The obtained results proved that awareness of the criteria evaluation impacts the results regarding the weighting coefficients (Paramanik et al., 2022 [24]). Additionally, the different MCDM methods are grounded on different approaches that also lead to variations in the results (Ponhan and Sureeyatanapas, 2022 [23]). As Table 7 presents, the CRITIC method highlighted employee participation as the priority, while pay and reward are the most important according to the PIPRECIA-S results. The final ranking order, incorporating both approaches, gives a more realistic perspective on the significance of HRM practice in the contemporary business environment.

After defining the objective and subjective significance of the involved HRM practices, we applied the COBRA method to rank the selected companies. The procedure is performed on the data obtained by each respondent separately. We utilise the CRITIC-COBRA and PIPRECIA-S-COBRA approaches to obtain the relevant results. Table 8 presents the results obtained, and Table 9 contains the defined rankings of the alternative companies.

Table 8. The COBRA results.

	CRITIC-COBRA																				
	R_1	**R_2**	**R_3**	**R_4**	**R_5**	**R_6**	**R_7**	**R_8**	**R_9**	**R_{10}**	**R_{11}**	**R_{12}**	**R_{13}**	**R_{14}**	**R_{15}**	**R_{16}**	**R_{17}**	**R_{18}**	**R_{19}**	**R_{20}**	**R_{21}**
K_1	0.036	−0.003	−0.043	−0.031	−0.034	−0.045	−0.050	−0.055	−0.033	−0.044	−0.042	−0.060	−0.042	−0.062	−0.065	−0.064	−0.049	−0.040	−0.076	−0.034	−0.026
K_2	0.041	0.029	0.000	0.003	−0.021	−0.057	−0.044	−0.032	−0.040	−0.012	−0.028	−0.009	0.023	0.019	−0.032	−0.051	−0.009	−0.029	−0.007	−0.047	−0.028
K_3	0.029	−0.013	0.005	−0.008	−0.020	−0.019	−0.043	−0.037	−0.035	−0.047	−0.033	−0.043	−0.047	−0.012	−0.012	−0.020	−0.021	−0.032	−0.019	−0.088	−0.032
K_4	−0.030	−0.006	0.016	0.012	−0.011	−0.030	−0.023	−0.036	−0.003	−0.015	−0.006	−0.023	−0.024	0.026	−0.004	−0.034	−0.009	−0.016	0.005	−0.016	−0.015
K_5	−0.037	0.007	−0.006	0.003	0.019	0.003	0.005	−0.020	−0.021	−0.012	−0.002	−0.008	0.004	0.002	0.031	0.014	−0.012	0.043	0.042	0.021	−0.001
K_6	−0.014	−0.021	−0.009	0.005	−0.001	−0.002	0.005	0.014	−0.009	−0.012	0.002	−0.016	0.018	0.015	−0.005	−0.004	0.008	−0.025	0.009	0.027	0.018
K_7	−0.025	−0.018	−0.016	0.007	0.001	0.017	0.058	−0.016	0.000	−0.008	0.017	0.004	−0.010	−0.008	0.008	0.001	−0.006	0.004	−0.013	0.050	0.020
K_8	−0.026	0.021	−0.007	−0.006	0.001	0.032	0.035	0.010	0.022	0.011	−0.002	0.024	0.009	0.018	0.012	0.051	0.030	0.013	0.034	0.047	0.026
K_9	−0.025	−0.028	0.001	−0.007	−0.009	0.017	0.015	0.020	0.007	0.001	−0.004	0.019	−0.009	0.015	−0.010	0.021	0.016	0.025	0.014	0.047	0.006
K_{10}	0.024	0.011	0.009	0.023	0.022	0.004	−0.011	−0.017	0.009	0.018	0.028	0.039	0.025	−0.019	0.011	0.019	−0.018	0.024	0.039	0.015	0.019
K_{11}	0.022	0.020	0.032	0.015	0.025	0.036	0.024	0.012	0.025	0.039	0.029	0.047	0.010	0.004	0.020	0.006	0.007	0.033	0.035	0.043	0.017
K_{12}	0.002	0.011	0.013	0.038	0.047	0.067	0.070	0.033	0.059	0.032	0.027	0.039	0.035	0.028	0.042	0.023	0.016	0.007	0.026	0.026	0.035
	PIPRECIA-S-COBRA																				
K_1	0.031	−0.002	−0.045	−0.028	−0.036	−0.046	−0.058	−0.055	−0.042	−0.043	−0.042	−0.070	−0.042	−0.070	−0.065	−0.066	−0.059	−0.039	−0.066	−0.025	−0.026
K_2	0.040	0.021	−0.006	−0.005	−0.040	−0.063	−0.050	−0.022	−0.052	−0.011	−0.025	−0.010	0.005	0.008	−0.037	−0.057	−0.023	−0.025	−0.021	−0.057	−0.028
K_3	0.031	0.000	0.003	0.007	−0.002	−0.020	−0.043	−0.047	−0.032	−0.050	−0.037	−0.047	−0.053	0.005	−0.006	−0.030	−0.023	−0.028	−0.013	−0.088	−0.032
K_4	−0.033	−0.003	0.009	0.004	−0.025	−0.029	−0.017	−0.034	−0.003	−0.016	−0.015	−0.008	−0.021	0.050	0.005	−0.047	−0.027	−0.031	0.002	−0.006	−0.015
K_5	−0.038	0.001	0.005	0.017	0.014	−0.001	−0.009	−0.026	−0.027	−0.011	0.002	−0.002	0.008	−0.003	0.042	0.002	0.000	0.056	0.037	0.035	−0.001
K_6	−0.007	−0.026	−0.015	0.004	−0.007	0.007	0.006	−0.001	−0.010	−0.016	−0.008	−0.026	0.010	0.014	−0.010	0.004	−0.001	−0.026	0.021	0.043	0.018
K_7	−0.021	−0.024	−0.024	0.011	−0.002	0.020	0.057	−0.015	0.006	−0.004	0.011	0.007	0.004	−0.006	0.007	0.012	−0.010	−0.009	−0.008	0.042	0.020
K_8	−0.023	0.019	−0.005	−0.014	−0.008	0.035	0.029	0.003	0.020	0.008	0.004	0.020	0.015	0.025	−0.013	0.052	0.028	−0.002	0.031	0.060	0.026
K_9	−0.026	−0.025	−0.004	−0.009	−0.008	0.016	0.013	0.014	0.007	−0.001	0.002	0.031	0.003	0.027	0.006	0.032	0.039	0.020	0.032	0.038	0.006
K_{10}	0.028	0.022	0.028	0.035	0.020	0.000	−0.010	−0.008	0.009	0.022	0.036	0.042	0.024	−0.020	0.005	−0.004	−0.013	0.033	0.028	0.031	0.019
K_{11}	0.032	0.018	0.029	0.017	0.041	0.043	0.046	0.036	0.041	0.039	0.028	0.050	0.026	0.022	0.022	0.020	0.014	0.044	0.037	0.038	0.017
K_{12}	−0.001	0.016	0.029	0.043	0.049	0.067	0.063	0.024	0.066	0.032	0.028	0.050	0.036	0.039	0.057	0.029	0.018	0.014	0.032	0.020	0.035

Source: authors' calculations

Table 9. Final rankings.

	CRITIC-COBRA																				
	R_1	**R_2**	**R_3**	**R_4**	**R_5**	**R_6**	**R_7**	**R_8**	**R_9**	**R_{10}**	**R_{11}**	**R_{12}**	**R_{13}**	**R_{14}**	**R_{15}**	**R_{16}**	**R_{17}**	**R_{18}**	**R_{19}**	**R_{20}**	**R_{21}**	**Final Ranking**
K_1	11	6	1	1	1	2	1	1	3	2	1	1	2	1	1	1	1	1	1	3	3	**1**
K_2	12	12	6	6	2	1	2	4	1	5	3	5	10	10	2	2	6	3	4	2	2	**3**
K_3	10	4	8	2	3	4	3	2	2	1	2	2	1	3	3	4	2	2	2	1	1	**2**
K_4	2	5	11	9	4	3	4	3	6	3	4	3	3	11	6	3	5	5	5	4	4	**4**
K_5	1	7	5	5	9	6	6	5	4	5	6	6	6	5	11	8	4	12	12	6	5	**6**
K_6	6	2	3	7	6	5	7	10	5	4	8	4	9	7	5	5	9	4	6	8	8	**5**
K_7	5	3	2	8	7	9	11	7	7	7	9	7	4	4	7	6	7	6	3	12	10	**7**
K_8	3	11	4	4	8	10	10	8	10	9	7	9	7	9	9	12	12	8	9	10	11	**10**
K_9	4	1	7	3	5	8	8	11	8	8	5	8	5	8	4	10	11	10	7	11	6	**8**
K_{10}	9	9	9	11	10	7	5	6	9	10	11	11	11	2	8	9	3	9	11	5	9	**9**
K_{11}	8	10	12	10	11	11	9	9	11	12	12	12	8	6	10	7	8	11	10	9	7	**11**
K_{12}	7	8	10	12	12	12	12	12	12	11	10	10	12	12	12	11	10	7	8	7	12	**12**
	PIPRECIA-S-COBRA																				
K_1	10	5	1	1	2	2	1	1	2	2	1	1	2	1	1	1	1	1	1	3	3	**1**
K_2	12	11	4	4	1	1	2	5	1	5	3	4	6	6	2	2	3	5	2	2	2	**3**
K_3	9	6	7	7	8	4	3	2	3	1	2	2	1	5	5	4	4	3	3	1	1	**2**
K_4	2	4	9	5	3	3	4	3	6	3	4	5	3	12	7	3	2	2	5	4	4	**4**
K_5	1	7	8	10	9	5	6	4	4	5	7	6	7	4	11	6	8	12	11	7	5	**7**
K_6	6	1	3	6	6	7	7	8	5	4	5	3	8	7	4	7	7	4	6	11	8	**5**
K_7	5	3	2	8	7	9	11	6	7	7	9	7	5	3	9	8	6	6	4	10	10	**6**
K_8	4	10	5	2	5	10	9	9	10	9	8	8	9	9	3	12	11	7	8	12	11	**10**
K_9	3	2	6	3	4	8	8	10	8	8	6	9	4	10	8	11	12	9	9	8	6	**8**
K_{10}	8	12	10	11	10	6	5	7	9	10	12	10	10	2	6	5	5	10	7	6	9	**9**
K_{11}	11	9	12	9	11	11	10	12	11	12	11	11	11	8	10	9	9	11	12	9	7	**11**
K_{12}	7	8	11	12	12	12	12	11	12	11	10	12	12	11	12	10	10	8	10	5	12	**12**

Source: authors' calculations.

Table 9 shows that the obtained rankings are relatively uniform, which leads to the conclusion that the respondents were familiar with the business performance of the evaluated companies. The Borda rule enabled defining the final ranking results regarding both approaches, CRITIC-COBRA and PIPRECIA-S-COBRA, and the ranking involving both approaches (Table 10 and Figure 2).

Table 10. Overall ranking results.

	CRITIC-COBRA Rank	PIPRECIA-S-COBRA Rank	Overall Rank
K_1	1	1	1
K_2	3	3	3
K_3	2	2	2
K_4	4	4	4
K_5	6	7	6
K_6	5	5	5
K_7	7	6	6
K_8	10	10	10
K_9	8	8	8
K_{10}	9	9	9
K_{11}	11	11	11

Source: authors' calculations.

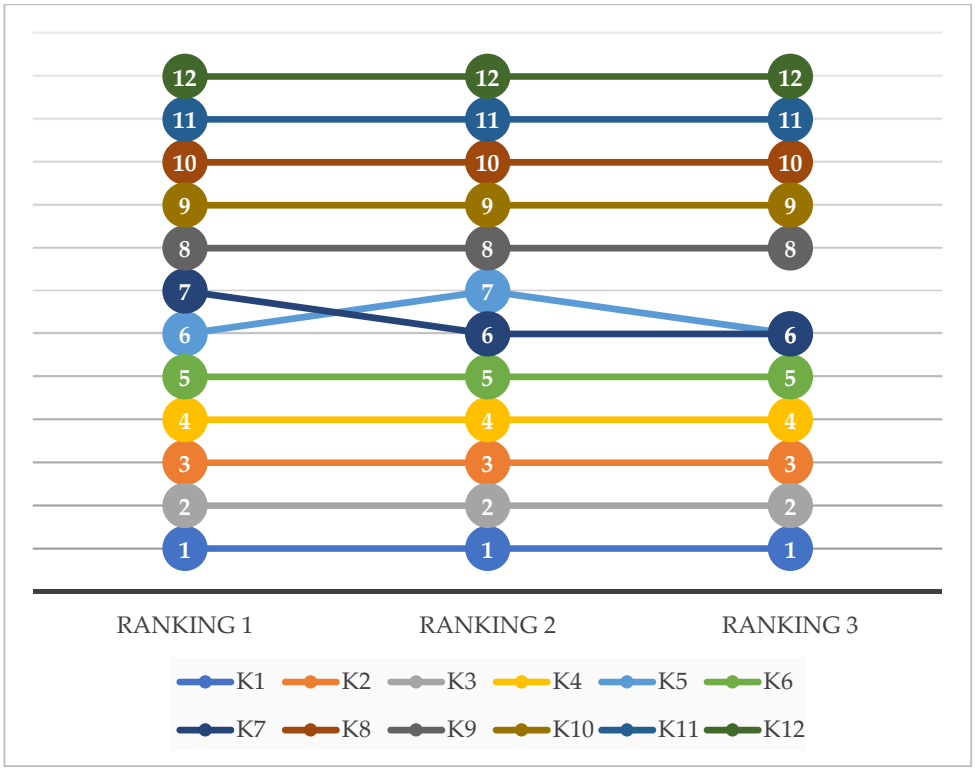

Figure 2. Overall ranking results. Source: authors' calculations.

The final results emphasised company K_1 as the one with the best results and the most successful in applying modern HRM practices.

Heidary Dahooie et al. (2022) [22] based their research on fuzzy DEA and ARAS methods, and highlighted the criteria related to financial results as the most critical HRM practice. Saeidi et al. (2022) [84] assessed sustainable HRM practices using the Pythagorean fuzzy SWARA-TOPSIS method. Because the chosen practices differed, the final results outlined the green work-life balance as the most important practice. In contrast, we applied the crisp model in our case, which outlined employee participation as the most critical practice, followed by pay and reward. These discrepancies are not surprising, because

research studies were employed in different landscapes. Furthermore, the crisp MCDM model enables respondents to express their opinions more easily. The resulting estimation of the HRM practices influences the final ranking of the organisations involved.

4. Discussion

The application of the mathematically grounded objective-subjective approach yields adequate scientific results. The CRITIC method defined the objective significance of nine selected innovative HRM practices, while the PIPRECIA-S method helped to find the subjective significance. The geometric mean was used to determine the final significance of the innovative practices. Using the COBRA method, twelve companies from different sectors were evaluated against the mentioned innovative practices. Twenty-one respondents, experts from the HRM field, were involved in gathering data regarding the mentioned companies and fulfilling the special PIPRECIA-S questioners. As is the case with any research study, the methodological approach applied in this article has advantages and disadvantages.

The CRITIC method, which is the objective method intended for calculating the criteria weights, enabled defining innovative HRM practice's significance based on the initial data. However, the method in the current research study is somewhat subjectivised, because the initial data connected to the innovative practices and chosen companies were gathered from twenty-one respondents, reflecting their standpoints. The respondents used the Likert scale to perform previous estimations of the alternative companies regarding the considered innovative practices. However, the fact that the ratings are based on personal views slightly decreases their reliability, which would be higher if this evaluation was based on quantitative and exact data.

The PIPRECIA-S belongs to the category of subjective weighting methods, which are easily understandable and convenient for application when the respondents are unfamiliar with the MCDM techniques. This method has a straightforward computation procedure and is suitable for group decision environments because it enables more accessible group result aggregation. Besides, the estimation procedure in the PIPRECIA-S is much simpler because the respondent constantly compares the criteria with the first one. Nevertheless, this method has shortcomings, too. An essential disadvantage of the PIPRECIA-S is the absence of consistency checking of the gathered estimations from the respondents, which is contrary to the AHP (Analytic Hierarchy Process) (Saaty, 1987 [85]) and PIPRECIA-E (Extended PIPRECIA) (Stanujkić et al., 2017 [46]). This shortcoming of the PIPRECIA-S method makes it difficult to define if the respondents were consistent during the questionnaire filling.

The final analysis and ranking of the alternative companies were meticulously performed using the COBRA method. This method's thoroughness is reflected in its ranking, which is based on the distances from three types of solutions: positive ideal, negative ideal, and average. The distance measures are calculated using the Euclidian and Taxicab distance measures for all possible solutions, thereby increasing the relevance and reliability of the analysis. However, the COBRA method's advantage is also its disadvantage. The method is characterised by a complex and extensive computing procedure, which could be challenging for users who do not frequently use this type of decision support system.

The article expresses the intention of decreasing the research subjectivity level by involving a more significant number of respondents who are familiar with the effects of applying innovative HRM practices and business performances of the considered companies. In that way, the existence of biased estimations is minimised. However, crisp numbers were used to express the respondents' attitudes, which could not transfer the nuances of the respondent's opinions. Applying the fuzzy, grey, or neutrosophic numbers will more accurately reveal the immanent hesitancy and vagueness that characterise every decision-making process. Bearing in mind the previously argued points, it is desirable to use a particular model that involves extensions by applying some of the mentioned logic to observe if the obtained results would be the same. Nevertheless, despite the ex-

isting limitations, the applied methodological approach enabled the gaining of relevant scientific results.

The CRITIC method underscored the innovative HRM practice and designated Ep—Employee participation as the most significant and influential factor. This method, while objective, is subjectivised to some degree due to the data types used in the research. The results gained using the PIPRECIA-S method highlighted Jb—Job security as the most important HRM practice. The final results obtained using the geometric mean had employee participation and job security positioned as first and second, respectively. This suggests that employees want to be involved in the company's decision process, but in the current Serbian business environment, job security is nearly equally important to them. It can be concluded that the respondents consciously and unconsciously performed the estimation of the chosen selected innovative HRM practices with the CRITIC method, indirectly by evaluating the companies using the Likert scale, and directly using the questionnaire for the PIPRECIA-S method.

A comparison of the results obtained with those from other research studies revealed some differences. It should be emphasised that these differences originate from variations in the human practices lists and because of the conditions in the countries involved in the research. For example, Heidary Dahooie et al. (2022) [22] discovered that a trained and expert workforce is the most important for promoting innovativeness in Iranian nanotechnology small and medium enterprises (SMEs). The research conducted in Pakistan showed that innovative recruitment practices positively influenced the company's innovativeness (Aslam et al., 2023 [86]). Knowledge acquisition and adequate HRM practices are essential to enhance a company's innovativeness (Papa et al., 2020 [8]). Organisational memory, which represents knowledge acquired and preserved for future needs, is considered a critical HRM practice in India (Soumyaja and Sowmya, 2020 [87]). The fact that we observed the situation in Serbia holistically justifies the obtained results, because the involvement of the employees in the decision-making process still needs to be satisfactory. In addition to this, job security is paramount considering the fragile economic environment.

The question of why companies rank separately for each respondent is raised. The reason is that each respondent estimated the chosen companies himself/herself regarding the chosen innovative HRM performance, so the main idea was that the results obtained in that way would be more realistic and accurate. After defining the ranks of the chosen companies using the objective-subjective approach regarding all respondents, the final rank is defined using the Borda rule. This rule is a beneficial and straightforward approach that enables the calculation of the total score, which defines the final position of the estimated alternative, which in this case was the company. The final results showed that the company performed best in innovative HRM practices, being marked as K_1, while K_{12} had the worst results and was ranked last.

Applying the proposed MCDM model is more comprehensive than just facilitating decision-making in the HRM field; it could also be used to resolve different kinds of business issues. The accuracy of the proposed model could be improved by introducing adequate fuzzy, grey, or neutrosophic extensions. Until now, the authors have introduced the spherical fuzzy COBRA (Zorlu et al., 2024 [73]), fuzzy COBRA (Krstić et al., 2022 [65]), and grey COBRA (Ulutaş et al., 2024 [71]). There are different kinds of CRITIC method extensions (Puška et al., 2022; Wang et al., 2022; Sleem et al., 2023 [88–90]), while for the PIPRECIA-S, the extensions have yet to be introduced. These extensions will increase the model's reliability by incorporating the immanent vagueness into the decision environment. Furthermore, the complexity of the proposed model might be mitigated by developing suitable, more user-friendly tools, such as a software application based on the computational technique proposed by Mandal and Seikh (2023) [91]. This would reduce the time and effort required to perform the procedure, enabling a broader audience to benefit from the software support of the MCDM model during the decision-making process. Developing the specified software would promote the application of the suggested MCDM model, rendering it more accessible for use in various studies across various research fields, HRM

practices, or national contexts, hence yielding comparable results and extending its reach beyond the academic community.

5. Conclusions

The main aim of this article was to determine the most successful HRM practices and to rank the selected organisations in Serbia according to them. The evaluation procedure was performed using the hybrid MCDM approach, consisting of the CRITIC, PIPRECIA-S, and COBRA methods. Nine innovative HRM practices and eleven organisations were submitted for evaluation. The results shed light on employee participation as a practice that is a primary one in the current business environment. The organisation designated as K1 is the first-ranked and represents the most successful utilisation of innovative HRM practices. This study aimed to employ the HRM domain as an initial application of this method, and to advocate for adopting the suggested model within HRM and other fields. This model's limitations lie in its complexity, as it incorporates three MCDM approaches, with the COBRA method being particularly difficult and potentially intricate for users. The identified deficiency may be addressed by developing a computer program that enhances the efficacy of applying the suggested MCDM model in facilitating the decision-making process. The suggested perspective would improve accessibility across varied scientific fields, facilitating additional studies and obtaining comparable results. Having user-friendly software would make the proposed MCDM model accessible beyond the academic community and allow practitioners and a broader audience to employ it in real business conditions in the decision-making process. Scientifically, the proposed MCDM model employs relatively new MCDM methods (besides the CRITIC method), the potential of which have yet to be discovered. Nevertheless, the results proved its applicability and usefulness to practitioners. By applying the proposed approach, managers could easily prioritise HRM practices and compare their organisations with others within the selected business field. In that way, they could perform benchmarking to highlight their vital business aspects and the areas they should improve. This MCDM model could be applied to finding solutions or selecting appropriate options in the different business fields such as sustainable development (Hasankhani et al., 2024 [92]), artificial intelligence (Alshahrani et al., 2024 [93]), the economy (Baydaş et al., 2024 [94]), hospitality management (Ayvaz-Çavdaroğlu et al., 2024 [95]), e-learning (Al-Gerafi et al., 2024 [96]), supply chains (Dohale et al., 2024 [97]), etc. Additionally, further research can also use the single-valued (Smarandache, 2020 [98]) or interval-valued (Wang et al., 2005 [99]) neutrosophic sets to make an extension of the PIPRECIA-S method, or involve the extended PIPRECIA method (Stanujkić et al., 2017 [46]) in the procedure of criteria weightings determination.

Author Contributions: Conceptualisation, V.M. and G.P.; methodology, V.M. and G.P.; software, V.M., G.P. and A.Đ.; validation, S.V., I.K. and A.Đ.; formal analysis, V.M. and M.M.; investigation, V.M. and G.P.; resources, V.M. and S.V.; data curation, A.Đ.; writing—original draft preparation, V.M., G.P. and S.V.; writing—review and editing, M.M., I.K. and M.S.; visualisation, V.M.; supervision, S.V. and M.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: The data supporting this study's findings are available from the corresponding author upon reasonable request.

Conflicts of Interest: The authors declare no conflicts of interest.

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