



Assessment of Human Resources Performance in Urban Maintenance Tasks: An MCDM Approach



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Received: 01-13-2024

Revised: 02-28-2024

Accepted: 03-15-2024

Citation: Stević, Ž., Novarlić, B., & Kchaou, M. (2023). Assessment of human resources performance in urban maintenance tasks: An MCDM approach. *J. Organ. Technol. Entrep.*, 2(1), 39-51. <https://doi.org/10.56578/jote020104>.



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Abstract: The escalating migration from rural to urban locales necessitates an augmented demand for the workforce, local utility services, and mechanization to sustain a balance conducive to public health. This investigation delineates the pivotal role of human resources in executing daily operations required for the upkeep of public green and asphalted areas within Dobož, Bosnia and Herzegovina. It is posited that teamwork and the requisite competencies of the workforce are integral to the utility company's efficacy and the establishment of conditions requisite for addressing business tasks delineated on weekly and monthly schedules. A cohort of 20 personnel, tasked with the aforementioned responsibilities, was segmented into three categories, predicated upon their skills and capability to fulfil the designated tasks within specified temporal bounds. A novel hybrid Multi-Criteria Decision-Making (MCDM) model, integrating Improved fuzzy Stepwise Weight Assessment Ratio Analysis (IMF SWARA) with Measurement Alternatives and Ranking according to Compromise Solution (MARCOS), was employed to appraise employees across the designated categories. Decision-makers articulated five criteria, which were quantified via the IMF SWARA methodology. Subsequently, the appraisal of worker categories through three discrete models was undertaken employing the MARCOS technique. Outcomes for each category were individually derived and subjected to verification tests, revealing that criterion significance markedly influences human resource ranking. This study underscores the crucial intersection between environmental stewardship and human resource management, advocating for a systematic approach to urban maintenance that leverages MCDM techniques to optimize workforce performance.

Keywords: Teamwork; Human resources; Green economy; Environmental protection; Improved fuzzy Stepwise Weight Assessment Ratio Analysis (IMF SWARA); Measurement Alternatives and Ranking according to Compromise Solution (MARCOS)

1. Introduction

A rhetorical question arises: why is one worker more valuable than another or others, that is, why is one job more important and makes a greater, broader contribution compared to another? On the other hand, it is often pointed out not only the problem, but also the significance of an individual working in a low-accumulative branch of the economy compared to one working in a sector of industry or information and communication technology. The economy represents a circular domain, where each individual contributes uniquely to its prosperity and without whom its existence is inconceivable. Therefore, each individual represents a key link in the prosperity and development of local as well as regional markets, which is included in contemporary global trends.

In this paper, we analyze a work unit of a local utility company, which consists of a total of 20 workers divided into three categories based on the complexity of tasks and compensation in terms of personal income, and who perform tasks related to maintaining public asphalt and green surfaces in the city of Dobož (Bosnia and

Herzegovina), in the downtown area. Supervision of the tasks is conducted by the head of the work unit, who periodically evaluates the performance of these workers, and upon whom advancement to a higher category (better financial reward) or even to a lower one (disincentive) depends.

The aim of this paper is to investigate the interdependence of work performance and skills among employees assigned to three categories and the criteria upon which they depend. The following sections will elaborate on the five criteria we have defined, which form the basis for evaluating work performance and achieving the company's set revenue. Additionally, the objective of the paper is to conduct a comprehensive analysis using a hybrid MCDM model for three categories of workers in order to achieve additional motivation for workers to fulfill their duties. The goal is for the worker with the best performance in the previous period to advance in terms of group (from the third to the second and from the second to the first), as well as to enable additional financial incentives for workers in the first group.

By reviewing the literature of relevant studies, we will present the role and significance of human resources in executing specific tasks, particularly those at lower levels of the hierarchical scale. It would be impossible to perform everyday tasks without their skills and knowledge, which directly contribute to the city of Dobož's green economy, the health of its population, and the wider region.

Teamwork, when it comes to task execution involving a large number of people with a common goal, such as simple business tasks of general interest to a local community, primarily related to a healthy environment and people's health, is a primary criterion in the hierarchy of needs. If only one link in the previous chain "disrupts" the business balance, it questions not only the timeframe for achieving the set goal but also the quality of the service provided. On the other hand, performing entrusted tasks on a daily or weekly basis, with the care of a good "host", while saving fuel and lubricants when using machinery at work, contributes to the business success of the company Progres JSC Dobož in the long term, along with appropriate financial compensation for all workers who have contributed to this (incentives, or employee of the month, or advancement to a higher category, with a higher personal income).

However, in order to complete the business process and execute all tasks on time with the engagement of necessary human resources and machinery, communication is crucial both horizontally (among workers belonging to the same category) and vertically within the decision-making hierarchy (towards the head of the work unit). This especially applies to identifying problems encountered during daily work, which can be resolved if they are suggested and reported to the head of the unit on time, thus reducing not only idle time but also potentially more significant issues that occur over a longer period (for example, problematic terrain on which grass is mowed - rocky terrain causing damage to motor trimmers or deliberately parked vehicles that are "set up" during grass mowing, demanding compensation for damage not caused by utility company workers, etc.).

2. Literature Review

The importance of human resources in modern business represents both a challenge and a necessity for organizations (Gilmore, 2023). Globalization and global changes have led to "extreme" and rapid changes in people's habits, their preferences, and business decision-making. Despite the information and communication revolution and the importance of information technologies, humans still remain at the center, i.e., the "brain" of operations. Daily business tasks require the maximum involvement of employees, either as executors of tasks or as decision-makers. Companies rely on their skills for prosperity and efficient operation, particularly when individual skills are lacking and teamwork is necessary to supplement them (Williams, 2023).

A dataset forms information, and verified, timely, and accurate information, conveyed within the collective and resulting from teamwork, constitutes the key to the success of the observed company (Gajdoš, 2021). The development of information technologies has accelerated communication in business processes, where workers are "closer," even if they are located remotely for a certain period, but this does not prevent them from successfully completing the tasks assigned to them (Đorđević, 2012). Many authors believe that human resources are one of the most important resources of an organization, upon which the comparative advantage of the observed organization over competing organizations (enterprises) depends. The greater the knowledge and skills of the employees, the greater the competitiveness of the organization (Lončarić et al., 2016; Stojadinović et al., 2021; Živković, 2019).

The importance of human resources in an organization, especially in executive positions-the lowest horizontal line of the pyramid-represents the ambition between the needs of employees and the economic effects for the company, which is directly related to the quality of services provided by the company (Stanković et al., 2018). Every reasonable and educated manager will respect the lower levels of the decision-making pyramid, especially when considering workers who perform simpler tasks within the company but without whom the existence of the organization would be impossible (Palamar, 2022). Therefore, all companies involved in the maintenance of public green and asphalt surfaces, as well as horticulture activities, which collectively constitute the green economy, place significant emphasis on the skills of workers necessary for these tasks, and on their responsible behavior towards the company's assets and their colleagues, a concept known as teamwork (Slavković & Mitić, 2023).

The motivation of human resources, especially those at the lowest level of the decision-making pyramid, is a particular challenge for the management of contemporary society for the simple reason that it is difficult to retain this category of workers in their jobs as well as in the system in general, and they represent a particularly vulnerable group when it comes to employment strategy, i.e., decision-making. Therefore, it is necessary to pay special attention to these categories in the business system, as they represent a guiding star for all other levels of the decision-making pyramid (Nakić & Lindov, 2020). Respecting the knowledge and competencies of employees at lower decision-making levels and entrusting them with decision-making opportunities will contribute to the systematic development of the organization, as well as boost morale and significance for these target groups, which will also reflect on the strategic growth and development of the organization (Radosavac, 2016). A satisfied worker, happy and motivated at work, but also a worker who provides suggestions to the organization through their behavior and considers it their own, is the key to success in today's business system. From the perspective of human resources, the organization's business success stems from the interdependence of theoretical and practical knowledge (Bodin, 2018).

The sustainability of an organization, especially today in increasingly challenging business conditions, is directly related to motivated and competent human resources and their behavior towards the external environment, as viewed through the company's approach to ecology, with a particular emphasis on a sustainable environment. Managing human resources through the so-called "green" practice contributes to the corporate image of the company as well as the competitive advantage of the organization (Saifulina et al., 2020). Studies have shown that teamwork contributes to better company performance and not only local but also regional visibility, for the reason that their innovation and creativity respond to global market challenges in this way (King, 2017). Organizations are increasingly recognizing the importance of human resources for their operations and, therefore, investing in intangible assets as responses to crises in both the private and public sectors. This entails various types of support in terms of the education of their employees and the like (Fang, 2004).

Research has shown that the motivation of employees through financial rewards has a positive impact on their intangible performance, reflected in the quality of service provided, greater dedication to work, and faster completion of tasks (Wonki & Hoyoung, 2013). Conversely, a company's green climate positively correlates with employees' green behavior, indicating that employees who prioritize environmental preservation positively promote the company as socially responsible, thereby enhancing its reputation and market positioning (Liang et al., 2022). Furthermore, the application of green practices in human resource management has shown that green training and green awards lead to progressive practices in the strategic performance of the organization as a whole, particularly evident through higher levels of employee motivation and greater attention to the problems they encounter in their daily work duties (Shah et al., 2021). Setting up a reward system in the company (either individual or group incentives) through regular evaluations of employees (in line with the plan) and worker rotations at lower levels of decision-making and task performance (for manual workers) has also been shown to improve the company's image, as seen through its ability to compete locally and globally (Bloom & Van Reenen, 2011). Respect for work discipline and tools contributes to better employee performance, as well as their productivity, but also to the overall contribution of the organization, especially at lower levels of the so-called decision-making pyramid, as satisfied employees contribute to the overall performance of the organization (Hong et al., 2012).

A healthy organization depends on healthy leaders and managers, and healthy leaders and their management of the organization depend on healthy employees and a healthy business environment, which all together contribute to the long-term business success of the organization (Quick et al., 2007). Direct and continuous communication at the lowest decision-making level among colleagues produces a healthy foundation for the business excellence of the organization, which, from the horizontal through the middle vertical level, reaches the top management as decision-makers and whom timely, reliable, and accurate information aids in making final, correct decisions (Gittel, 2000).

Research has shown that group members, i.e., colleagues, working within the same business task, complement each other to create general social benefit and promote positive company practices, but with the encouragement or ultimate positive intention of the supervisor or manager (Aslih, 2021). On the other hand, the motivation of employees is a key factor for the success of a business system, whether it is a company or an organization, where workers feel healthy, happy, and satisfied and are long-term ready for new business challenges, through which their material well-being will grow, thus increasing the revenue of the observed organization or enterprise (Liang et al., 2018). Human resource management, through the implementation of green strategies, can be a very sensitive and delicate issue, requiring significant adaptation to vulnerable categories of workers who are sensitive, particularly due to social status and stratification, especially in underdeveloped countries and countries in transition (Ndlovu & Ndlovu, 2023). However, on the other hand, many multinational companies seek to integrate a unified global market, and when it comes to human resources, there are uniform rules for performing similar tasks. Nevertheless, national regulations, legal provisions, tradition, and culture reduce the global strategy to local thinking and action (Taylor, 2006).

The green economy, green reward system, and green motivation, according to many authors, are fundamentally

important links for the economy of a country, where each individual is equally important and their attitude is significant in the decision-making system for strategic management and also through individual practice (Adekoya et al., 2023; Mittal & Kaur, 2023; Tirno et al., 2022). Economic success relies on non-material resources (human knowledge) as well as on skills and competencies, enabling observed stakeholders to contribute to personal and thus societal well-being (Micić & Arsić, 2017). The goal of human resource management encompasses a set of several factors, from managerial knowledge to understanding the needs of employees. The level of stress and its causing factors are the greatest and most crucial factor that requires continuous control (Ivkov, 2021).

3. Methods

3.1 IMF SWARA Method

The IMF SWARA method has been created in study (Vrtađić et al., 2021) and represents a method for determining criteria weights. The algorithm of this method is as follows (Badi & Bouraima, 2021):

Step 1: Sorting criteria in descending order based on their expected significance.

Step 2: Relatively smaller significance of the criterion (criterion C_j) was determined in relation to the previous one (C_{j-1}), and that was repeated for each subsequent criterion. The comparative significance of the average value is denoted with $\bar{\varphi}_j$. Linguistics and the TFN scale for assessment of criteria is shown in Table 1.

Table 1. Linguistics and the TFN scale

Linguistic Variable	Abbreviation	TFN Scale
Absolutely less significant	ALS	1 1 1
Dominantly less significant	DLS	1/2 2/3 1
Much less significant	MLS	2/5 1/2 2/3
Really less significant	RLS	1/3 2/5 1/2
Less significant	LS	2/7 1/3 2/5
Moderately less significant	MDLS	1/4 2/7 1/3
Weakly less significant	WLS	2/9 1/4 2/7
Equally significant	ES	0 0 0

Step 3: Determining the fuzzy coefficient $\bar{\mathfrak{S}}_j$ Eq. (1):

$$\bar{\mathfrak{S}}_j = \begin{cases} \bar{1} & j=1 \\ \bar{\varphi}_j \oplus \bar{1} & j > 1 \end{cases} \quad (1)$$

Step 4: Determining the calculated weights $\bar{\mathfrak{N}}_j$ Eq. (2):

$$\bar{\mathfrak{N}}_j = \begin{cases} \bar{1} & j=1 \\ \frac{\bar{\mathfrak{N}}_{j-1}}{\bar{\mathfrak{S}}_j} & j > 1 \end{cases} \quad (2)$$

$\bar{\mathfrak{S}}_j$ is the fuzzy coefficient from the previous step.

Step 5: Calculation of the fuzzy weight coefficients, Eq. (3):

$$w_j = \frac{\bar{\mathfrak{N}}_j}{\sum_{j=1}^n \bar{\mathfrak{N}}_j} \quad (3)$$

where, $\overline{w_j}$ represents the fuzzy relative weight of the criteria j , and n represents the number of criteria.

3.2 MARCOS Method

The Measurement Alternatives and Ranking according to Compromise Solution (MARCOS) method is based on defining the relationship between alternatives and reference values (ideal and anti-ideal alternatives). The MARCOS method is performed through the following steps (Stević et al., 2020).

Step 1: Formation of an initial decision-making matrix.

Step 2: Formation of an extended initial matrix with the ideal (AI) and anti-ideal (AAI) solution.

$$X = \begin{matrix} & C_1 & C_2 & & C_n \\ \begin{matrix} AAI \\ A_1 \\ A_2 \\ \dots \\ A_m \\ AI \end{matrix} & \begin{bmatrix} x_{aa1} & x_{aa2} & \dots & x_{aan} \\ x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \dots & \dots & \dots & \dots \\ x_{m1} & x_{m2} & \dots & x_{mn} \\ x_{ai1} & x_{ai2} & \dots & x_{ain} \end{bmatrix} \end{matrix} \quad (4)$$

Step 3: Normalization of the extended initial matrix (X).

$$n_{ij} = \frac{x_{ai}}{x_{ij}}; j \in C \quad (5)$$

$$n_{ij} = \frac{x_{ij}}{x_{ai}}; j \in B \quad (6)$$

where, elements x_{ij} and x_{ai} represent the elements of the matrix X.

Step 4: Determination of the weighted matrix.

$$v_{ij} = n_{ij} \times w_j \quad (7)$$

Step 5: Calculation of the utility degree of alternatives K_i .

$$K_i^- = \frac{S_i}{S_{aa1}} \quad (8)$$

$$K_i^+ = \frac{S_i}{S_{ai}} \quad (9)$$

where, $S_i (i=1, 2, \dots, m)$ represents the sum of the elements of the weighted matrix V, Eq. (10).

$$S_i = \sum_{j=1}^n v_{ij} \quad (10)$$

Step 6: Determination of the utility function of alternatives $f(K_i)$.

$$f(K_i) = \frac{K_i^+ + K_i^-}{1 + \frac{1 - f(K_i^+)}{f(K_i^+)} + \frac{1 - f(K_i^-)}{f(K_i^-)}} \quad (11)$$

where, $f(K_i^-)$ represents the utility function in relation to the anti-ideal solution, while $f(K_i^+)$ represents the utility function in relation to the ideal solution.

Utility functions in relation to the ideal and anti-ideal solution are determined.

$$f(K_i^-) = \frac{K_i^+}{K_i^+ + K_i^-} \quad (12)$$

$$f(K_i^+) = \frac{K_i^-}{K_i^+ + K_i^-} \quad (13)$$

Step 7: Ranking the alternatives is based on the final values of utility functions. It is desirable that an alternative has the highest possible value of the utility function.

4. Case Study

In this paper, we analyzed 20 workers from the local Utility Company Progres JSC Doboj in Bosnia and Herzegovina, who are divided into three categories based on their skills and knowledge related to their work, which is the maintenance of the city's public green and asphalt surfaces. Therefore, the division into the aforementioned categories was based on the required knowledge and skills, but primarily on familiarity with tools and handling the tools. They are responsible for maintaining cleanliness in the Doboj city zone from January 1st to December 31st of the current year. The tasks are performed daily and according to the instructions of the city's supervisory authority and accompanying paperwork, both manually and by machines.

The first category consists of a total of six workers, who are also the best financially rewarded for their contribution to work and are skilled in handling work equipment such as riding and manual lawnmowers, trimmers and chainsaws, electric telescopic tree pruners, working on a tree-pruning basket at heights up to 32 meters, and possessing a category B driver's license for operating small motor vehicles owned by the company. The group received the best individual ratings from the supervisor, who monitors and evaluates their work on a daily basis.

The second most important category out of the three observed consists of a total of five workers, who were placed in the same category by the supervisor based on the following skills: all five workers were trained to operate manual lawnmowers and gasoline-powered trimmers for maintaining public green areas, as well as blowers for maintaining asphalt surfaces, and manual telescopic pruners for tree branch pruning and tree-lined maintenance. In addition, they also possess handheld grabbers used for collecting small waste in green and public areas in the city of Doboj.

The last, but very important, category comprises a total of nine workers who perform simple tasks. These workers possess handheld brooms for maintaining hygiene on asphalt surfaces as well as for cleaning the area around waste receptacles where containers for non-hazardous municipal waste are located. Additionally, they use handheld grabbers for collecting scattered small waste on both green and asphalt surfaces. Considering that this group of workers, constituting the third category, has fewer tasks on a weekly basis (but crucial tasks without which work cannot proceed, and they are team players and integral parts of the collective), the success of the work performed often depends on them (weekly or monthly), i.e., whether they are willing to assist colleagues with more complex tasks in the second category as auxiliary workers and often in performing main tasks (handling work equipment such as blowers and handheld trimmers).

The division into the three categories described above was based on the following five criteria:

1. Dedication to performing work tasks;
2. Willingness to engage in teamwork (assisting colleagues, regardless of category, if necessary) if daily tasks are completed earlier;
3. Proper handling of tools and equipment for work and preservation of company assets;
4. Reporting issues from the field to the supervisor in order to perform work tasks more efficiently;
5. Fuel and lubricant savings when using work machinery (reducing idle time).

Considering it is a low-accumulative branch of the economy, workers in these three categories have completed primary education, except for the supervisor who leads the workers and tasks. However, their skills and contributions to work were the initial criteria for evaluating and determining the category to which they belong.

Regarding the selected criterion, dedication to performing work tasks, we have been guided by the idea of how employees in all three categories are primarily willing to engage in teamwork, and then what their contribution to the achieved results is at the end of the week or on a monthly basis, viewed through the total revenue generated by the Utility Company Progres JSC Doboj. An important criterion to consider in this case is also the motivation of workers to fulfill work duties (material compensation - monthly salary incentives, paid leave if justified, etc.).

A very important criterion was also the willingness to engage in teamwork, due to the fact that there was a "surplus" of free time during a certain period (daily/weekly), which resulted from early completion of tasks. This allowed workers to be assigned to other positions according to their abilities and skills, which corresponded to the aforementioned work tasks. Evaluating the criterion of teamwork will help us understand the strength of human resources in the utility company, which is also a reflection of all other utility companies in Bosnia and Herzegovina.

Regarding the selected criterion, the proper handling of tools and equipment for work and the preservation of

company assets, it is one of the most important criteria, as it actually reflects the awareness of the employees towards one of the three aforementioned categories, i.e., the care of a good host, which is the key to the success of every family and business person as a whole. Greater willingness to cooperate with the team and obedience to management or the supervisor contribute to higher productivity and ultimately to the business success of the observed organization/company. It is important to preserve the entrusted assets of the company, which can be seen through the tools for work, each assigned to individual workers (in a separate room, there is equipment that workers use daily, placed in enclosed wooden boxes, labeled with the worker's name, so they are expected to clean the specified tools after completing the work and return them to their designated place). Fuel savings during task execution (using lawnmowers, blowers, trimmers, and mowers) by avoiding idling, along with proper handling, also entail returning the assigned equipment to the condition it was in when received (for example, lubricating the chainsaw chain, cleaning the trimmer from grass residues, etc.). Therefore, this criterion is certainly one of the greatest challenges for both workers and managers, providing a good basis for evaluating the performance of each worker, respectively.

On the other hand, a particularly important criterion is the so-called awareness of workers in terms of reporting issues from the field to the supervisor in order to perform work tasks more efficiently. In practice, this criterion carries a significant number of points when evaluating each individual worker, for the reason that their financial motivation is higher (employee(s) of the month), and it is reflected in certain monetary bonuses. Namely, workers who report issues they encounter in the field (for example, rocky terrain where grass mowing takes place, or pointing out irresponsible citizens who often deliberately park their vehicles in the area where public green surfaces are being mowed, attempting to attribute the "newly emerged" damage to the vehicles through the negligence of workers involved in lawn mowing and to blame them for the damage, to constructive suggestions regarding the landscaping of green areas or maintenance of asphalt surfaces during the observed period, with the ultimate goal of cost optimization, which is directly related to the company's revenue growth and the like) have the opportunity and potential for advancement from lower categories (from the third to the second or even to gain an additional bonus in the first category).

And the last criterion, which is no less important than the ones described earlier, relates to fuel and lubricant savings when using work machinery. The head of the unit particularly values the work and dedication of the workers, which involves thoughtful grass mowing or engaging work machines by avoiding idling, where "lack of time" is turned into optimally utilized time, all through the ultimate goal - the company's revenue growth but also bonuses, i.e., incentives for all workers who contributed to it.

4.1 Determining Criteria Weights for Evaluation of Human Resources Using IMF SWARA

As explained in the previous section, this research includes 20 workers of the Utility Company Progres JSC Doboj, Bosnia and Herzegovina, from the Hygiene and Greenery unit, who throughout the year take care of a healthy living environment and people's health by ensuring hygiene on public green and asphalt surfaces. The workers are divided into three categories based on their skills and competencies in performing tasks, under the supervision of the head, who assigns daily, weekly, and monthly tasks according to the directives of the city authority. The city authority issues orders, monitors task implementation, and approves the payment of invoices for the work completed by Progres.

For the Utility Company Progres JSC Doboj, Bosnia and Herzegovina, which, as we emphasize once again, falls within a low-accumulative branch of the economy, performing simpler yet demanding tasks, without whose workers the environment and people's health would be damaged and the city would turn into a wild landfill and become a source of infection, revenue is important. From this revenue, the earned salaries of employees will be paid, the vehicle fleet will be renewed, and new machinery will be procured or existing machinery will be repaired. Due to the aforementioned, criteria contributing to this have been defined, ranging from the most important (C2) to the least important but indispensable in the entire observed process (C4).

After defining the importance of the criteria in evaluating the human resources of the company Progres, the steps of the IMF SWARA method were applied to calculate their values. It is important to note that a list of criteria with their weights, presented in Table 2, is the same for all three groups of workers.

Table 2. Criterion weights after applying the IMF SWARA

	$\bar{\rho}_j$	$\bar{\mathfrak{F}}_j$			$\bar{\mathfrak{N}}_j$			\bar{w}_j			Crisp
C2		1.000	1.000	1.000	1.000	1.000	1.000	0.294	0.319	0.364	0.322
C5	DLS	1.500	1.667	2.000	0.500	0.600	0.667	0.147	0.191	0.242	0.193
C3	ES	1.000	1.000	1.000	0.500	0.600	0.667	0.147	0.191	0.242	0.193
C1	MLS	1.250	1.286	1.333	0.375	0.467	0.533	0.110	0.149	0.194	0.150
C4	ES	1.000	1.000	1.000	0.375	0.467	0.533	0.110	0.149	0.194	0.150
				SUM	2.750	3.133	3.400				

From the table provided above, we can see that C2 is the most important for the observed company, followed by less important but indispensable criteria, namely C5, C3, C1, and finally C4, respectively. Based on the ratings obtained for each individual worker within their respective categories, we have concluded that teamwork is the key to success for a modern 21st-century company, both due to accelerated globalization and changing trends in technology and tools. Adaptation to the group, along with individual participation in tasks, makes the team particularly successful. If we set up a hierarchy of needs, at the top would be C2, serving as the foundation or base, the motivation, for all other observed criteria, which are interconnected with it and which are for a nuance less valuable but necessary and essentially inseparable, and without their participation we would not ensure safe and healthy work, nor the outcome mentioned several times - the company's revenue. Furthermore, it is very important for us that workers in all three categories are aware and maintain this awareness continuously, especially regarding thoughtfulness and taking care of fuel and lubricant consumption by the machines they use in their daily tasks (C5). Only in this way can we optimally manage the company's resources and provide additional incentives for workers in all three categories, regarding salary increases, bonuses, or even advancement into higher categories. The remaining three criteria, C3, C1, and C4, respectively, lack that nuance compared to C2, so they are rated as less important, but we emphasize that only because of that nuance, as they are essential and indispensable links in the chain. This means that without proper handling of tools along with dedication to task execution, there would be no benefit or efficiency from teamwork, i.e., it would be useless both as the mentioned criterion for evaluation and as a contribution to the company's revenue in the end. Finally, C4 is the least important, based on the evaluation by the supervisor who monitors the workers' performance, and we conclude that it is less significant because workers generally only do their assigned tasks, which they consider their obligation. They might think that anything beyond that is unnecessary because their salary will essentially remain the same (earned according to the employment contract). Also, one of their possible considerations might be that the company (top management) will achieve higher profits year after year, thanks to their contributions, but without affecting their personal incomes.

4.2 Evaluation of Human Resources Using the MARCOS Method

Table 3. Rankings of workers in category I

Ai	Si						
AAI	0.770	Ki ⁻	Ki ⁺	f(K ⁻)	f(K ⁺)	f(Ki)	Rank
W1	0.937	1.217	0.930	0.433	0.567	0.699	2
W2	0.905	1.175	0.898	0.433	0.567	0.675	3
W3	0.890	1.155	0.883	0.433	0.567	0.663	4
W4	1.008	1.308	1.000	0.433	0.567	0.751	1
W5	0.792	1.028	0.786	0.433	0.567	0.590	6
W6	0.798	1.036	0.792	0.433	0.567	0.595	5
AI	1.008						

Table 4. Rankings of workers in category II

Ai	Si						
AAI	0.754	Ki ⁻	Ki ⁺	f(K ⁻)	f(K ⁺)	f(Ki)	Rank
W1	0.856	1.135	0.850	0.428	0.572	0.643	3
W2	0.792	1.051	0.787	0.428	0.572	0.596	5
W3	0.818	1.086	0.812	0.428	0.572	0.615	4
W4	0.886	1.175	0.879	0.428	0.572	0.666	2
W5	1.008	1.336	1.000	0.428	0.572	0.757	1
AI	1.008						

Table 5. Rankings of workers in category III

Ai	Si						
AAI	0.541	Ki ⁻	Ki ⁺	f(K ⁻)	f(K ⁺)	f(Ki)	Rank
W1	0.922	1.703	0.915	0.349	0.651	0.770	4
W2	0.922	1.703	0.915	0.349	0.651	0.770	4
W3	0.834	1.541	0.828	0.349	0.651	0.697	6
W4	0.965	1.782	0.957	0.349	0.651	0.806	1
W5	0.937	1.731	0.930	0.349	0.651	0.783	3
W6	0.831	1.536	0.825	0.349	0.651	0.695	7
W7	0.940	1.737	0.933	0.349	0.651	0.786	2
W8	0.541	1.000	0.537	0.349	0.651	0.452	9
W9	0.758	1.400	0.752	0.349	0.651	0.633	8

In this section of the paper, human resources were evaluated across three previously described categories. The methodology of the MARCOS method was used, and the results for each category are presented below in Table 3, Table 4, and Table 5.

5. Discussion Through Sensitivity and Comparative Analysis

The change in values of dominant criteria often plays a crucial role in altering initial results. Therefore, in this section, the impact of the criteria on the final ranking of workers was tested by creating 50 scenarios in which the values of all criteria were modeled within the range of 5 - 95%. The weights across all scenarios are shown in Figure 1.

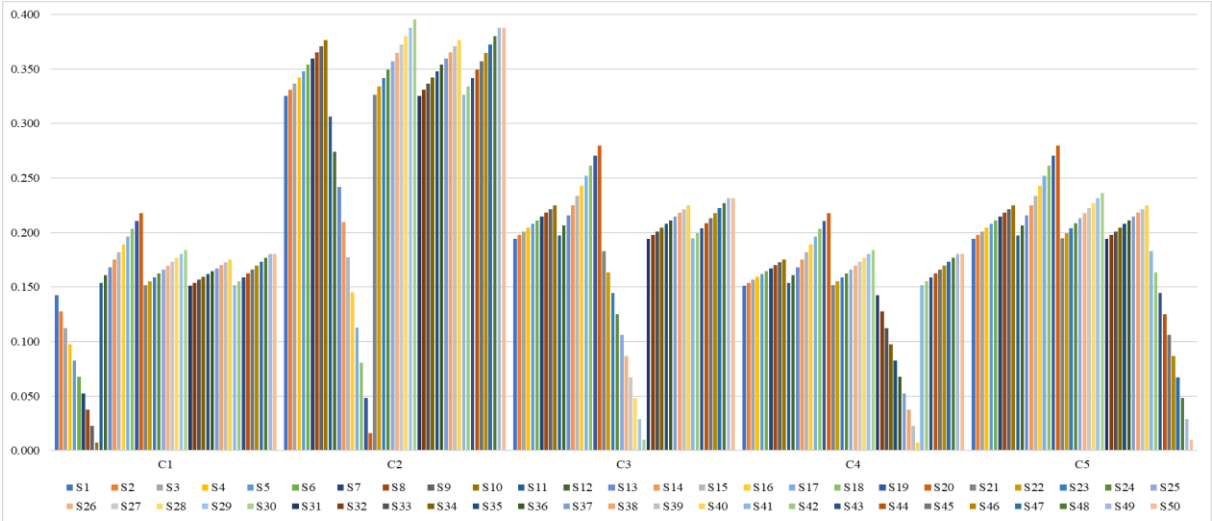


Figure 1. Criterion values in formed scenarios of sensitivity analysis

Since the criterion values are equal for all categories of workers, this means that the scenarios created apply to all groups in the sensitivity analysis. After calculating the new 50 models of the IMF SWARA-MARCOS model for the first category of workers, the rankings shown in Figure 2 are obtained.

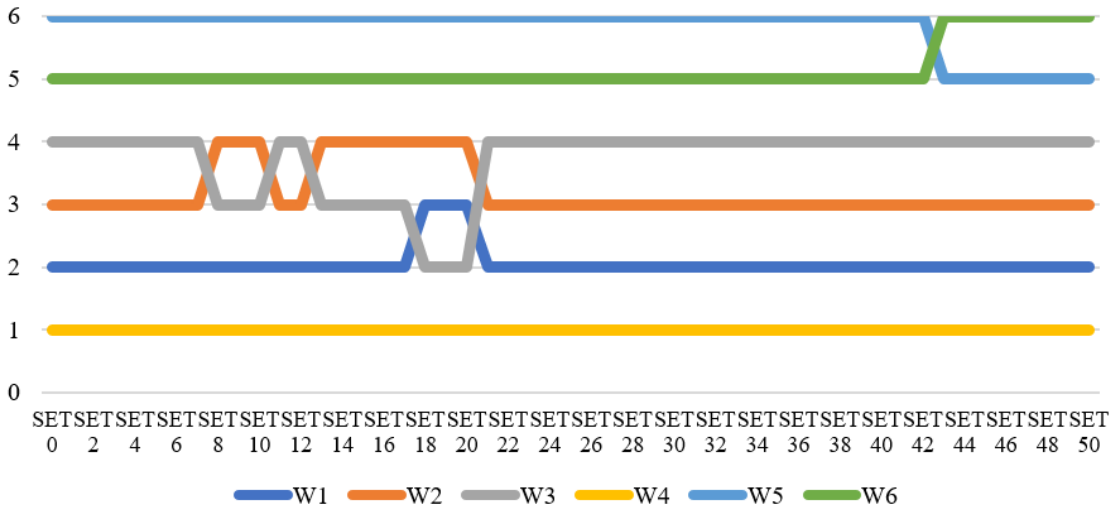


Figure 2. SA results for the first category of workers

The obtained results for the first category of workers show that there are certain deviations in the rankings, but they do not refer to the best worker, who remains in first place regardless of the value of any criterion. It is important to note that the second criterion, which has a dominant value compared to others, plays a significant role because a reduction in its importance leads to changes in the positions of workers. Figure 3, who was initially ranked fourth, moves to second place with a reduction in the dominance of the second criterion.

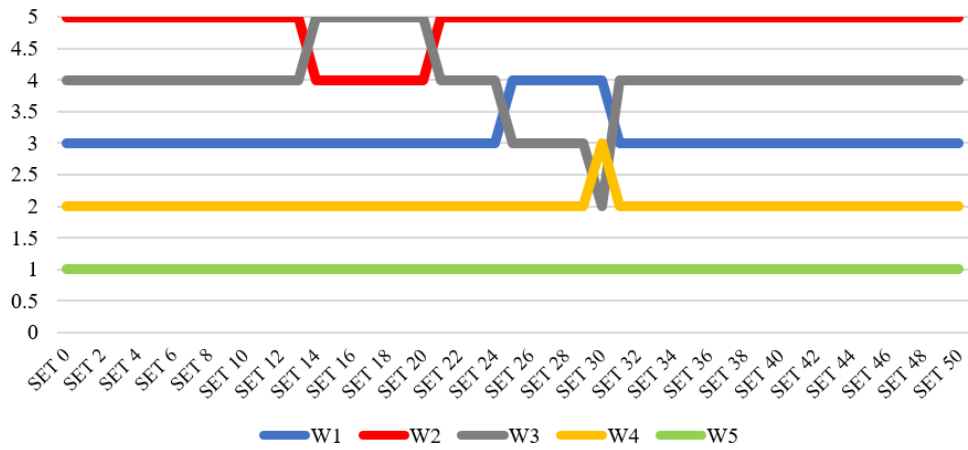


Figure 3. SA results for the second category of workers

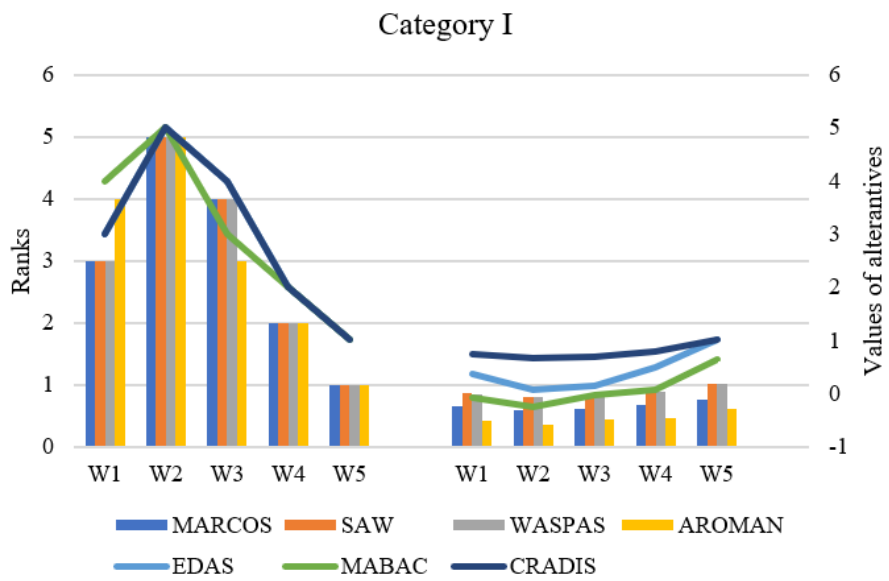


Figure 4. Results of comparative analysis for the first category of workers

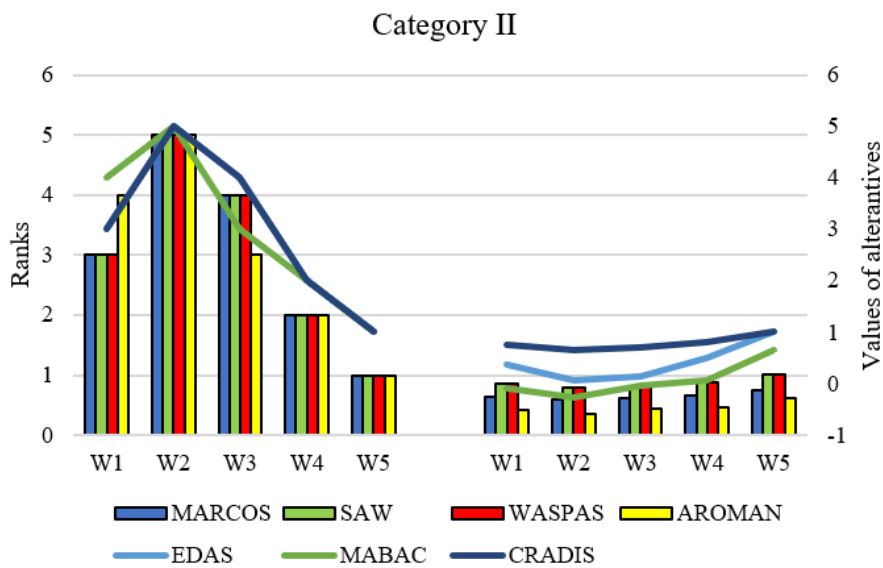


Figure 5. Results of comparative analysis for the second category of workers

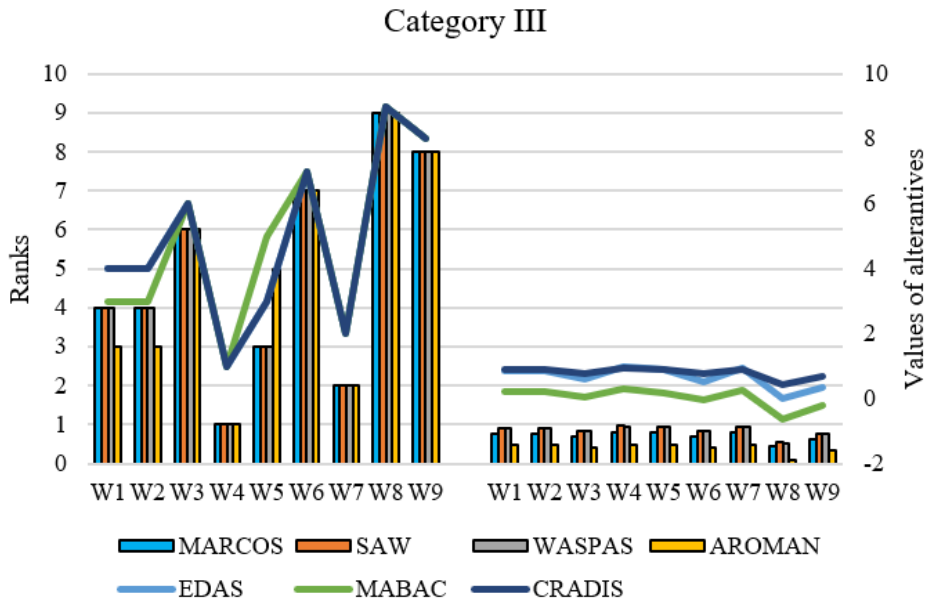


Figure 6. Results of comparative analysis for the third category of workers

Considering that the third category of workers is the most numerous, certain changes in the positions of human resources are also considered expected. The fifth criterion plays no role in changing rank positions, while the others have an impact on the changes. The second, third, and fourth criteria affect changes in the positions of workers, with the second criterion being the most dominant in terms of position, as expected. In scenarios S15-S20, when the value of the second criterion drastically decreases and tends to zero, W4 loses its top position and yields it to W7.

To assess the existing results, a comparative analysis was conducted for each group of workers individually, and the results are presented in Figure 4, Figure 5, and Figure 6.

When it comes to the results for the first group of workers, it can be seen that there are no deviations; the rankings of all workers remain the same as in the initial solution, i.e., the application of the IMF SWARA-MARCOS model.

Within the comparative analysis for the second group of workers, there are minor changes in the positions related to W1 and W4, which change their positions when applying the AROMAN and MABAC methods.

When it comes to the comparative analysis for the third group of workers, there are no significant deviations; rather, the situation is similar to the previous group when there are minor changes when applying the AROMAN and MABAC methods.

6. Conclusion

Countries in transition constantly “lag behind” the modern world, both due to a lack of material resources and a shortage of skilled workers, who are necessary for modern society to perform tasks both in low-accumulative branches of the economy (for example, utility services) and in developed industries.

Educated workers, equipped with all necessary knowledge and skills, represent an urgent need but also a challenge today. The constant migration of workers for better-paid jobs within cities leads to market instability and potential concerns about whether the set goals will be met within defined deadlines.

Only materially motivated workers (monthly incentives, employee of the month, etc.) are willing to contribute to the organization through their maximum dedication to work. Teamwork represents the starting point upon which the successful completion of daily, weekly, and monthly tasks depends. Furthermore, the long-term success of the company depends on its teamwork ability to withstand new challenges and overcome any potential obstacles.

In this paper, we have come to the conclusion that the most important criterion for evaluating workers’ performance is indeed teamwork, i.e., the willingness of colleagues in the remaining two categories to sacrifice the rest of their free time (if they finish their tasks earlier or have enough time to assist other workers without affecting their own work) in order to help their colleagues complete the tasks within the given deadline. This is because all 20 workers belong to the same work unit within the company and are driven by a common interest, which is primarily a higher personal income.

Through analysis, we have concluded that workers who alert their supervisor to potential on-site issues, which could affect the successful completion of assigned tasks, are better rated and belong to the highest (first) category, where the best-paid workers are, as well as all those workers who take care of the company’s assets (tools for work)

and behave with the care of good hosts.

Guidelines for future actions include implementing the model results in terms of worker advancement into higher categories and providing material incentives for the best worker in the first group. In addition, constant evaluation of workers in the future is deemed necessary.

Data Availability

The data used to support the research findings are available from the corresponding author upon.

Conflicts of Interest

The authors declare no conflicts of interest.

References

- Adekoya, O. D., Mordi, C., & Ajonbadi, H. A. (2023). Green human resource management: An introduction. In *Global Perspectives on Green HRM: Highlighting Practices Across the World*. Cham: Springer Nature. pp. 1-22. https://doi.org/10.1007/978-3-031-35795-4_1.
- Aslih, S. (2021). *Changing the world together? Exploring motivations and barriers to social change efforts*. [Doctoral Dissertation. University of Groningen], Netherlands. <https://doi.org/10.33612/diss.172155928>.
- Badi, I. & Bouraima, M. B. (2021). Development of MCDM-based frameworks for proactively managing the most critical risk factors for transport accidents: A case study in Libya. *Spectr. Eng. Manage. Sci.*, 1(1), 38-47. <https://doi.org/10.31181/sems1120231b>.
- Bloom, N. & Van Reenen, J. (2011). Human resource management and productivity. In *Handbook of Labor Economics*. Elsevier. pp. 1697-1767. [https://doi.org/10.1016/S0169-7218\(11\)02417-8](https://doi.org/10.1016/S0169-7218(11)02417-8).
- Bodin, M. (2018). Unapređenje kompetencija menadžera u svetlu razvoja ljudskih i društvenih resursa. *Administracija I Javne Politike*, 8(1), 25-42. <https://doi.org/10.22182/ajp.812018.2>.
- Đorđević, G. (2012). Unapređenje poslovne komunikacije primenom savremenih IT rešenja. *EMC Rev. Economy Market Commun. Rev.*, 4(2), 237-251. <https://doi.org/10.7251/emc1202237dj>.
- Fang, C. L. (2004). HRM in China - Recent developments. In *HRM, Work and Employment in China*. London: Taylor & Francis Group. pp. 184-205. <https://doi.org/10.4324/9780203390702-13>.
- Gajdoš, N. (2021). Uticaj komunikacije na timski rad. *Zbornik Radova Fakulteta Tehničkih Nauka U Novom Sadu*, 36(10), 1756-1758. <https://doi.org/10.24867/14gi13gajdos>.
- Gilmore, S. (2023). Introducing human resource management. In *Human Resource Management*. Oxford: Oxford University Press. <https://doi.org/10.1093/hebz/9780199605484.003.0001>.
- Gittell, J. H. (2000). Organizing work to support relational co-ordination. *Int. J. Hum. Resour. Manage.*, 11(3), 517-539. <https://doi.org/10.1080/095851900339747>.
- Hong, E. N. C., Hao, L. Z., Kumar, R., Ramendran, C., & Kadiresan, V. (2012). An effectiveness of human resource management practices on employee retention in institute of higher learning: A regression analysis. *Int. J. Bus. Res. Manage.*, 3(2), 60-79. <http://doi.org/10.1287/mksc.12.2.125>.
- Ivkov, M. (2021). Ljudski resursi i stres na radu. *Zbornik Radova Fakulteta Tehničkih Nauka U Novom Sadu*, 36(5), 840-843.
- King, K. G. (2017). Measuring teamwork and team performance in collaborative work environments. In *Evidence-based HRM: A Global Forum for Empirical Scholarship*. Bradford: Emerald Publishing Limited. pp. 196-205. <https://doi.org/10.1108/ebhrm-11-2016-0028>.
- Liang, H., Wang, M. M., Wang, J. J., & Xue, Y. (2018). How intrinsic motivation and extrinsic incentives affect task effort in crowdsourcing contests: A mediated moderation model. *Comput. Hum. Behave.*, 81, 168-176. <https://doi.org/10.1037/t66192-000>.
- Liang, X. D., Li, B. S., Gong, Q. X., Li, S. P. & Guo, G. X. (2022). Organizational green climate and employee green behavior: A moderated mediation model. In *Proceedings of the 1st International Conference on Public Management, Digital Economy and Internet Technology*. Changsha, China. SciTePress. pp. 280-284. <https://doi.org/10.5220/0011734900003607>.
- Lončarić, I., Kovač, I., Rilović Đurašin, M., Habuš, R., & Kauzlarić, N. (2016). Interdisciplinarni timski rad-izazov u suvremenoj rehabilitaciji. *Jahs*, 2(2), 147-54. <https://doi.org/10.24141/2/2/7>.
- Mićić, R. & Arsić, L. (2017). Human resources in a sustainable development function. *Ekonomski Pogledi*, 19(2), 31-48. <https://doi.org/10.5937/ekopog1702031m>.
- Mittal, E. & Kaur, P. (2023). Green HRM, green innovation and environmental performance: The moderating role of servant leadership. *Hum. Syst. Manage.*, 42(1), 27-40. <https://doi.org/10.3233/hsm-220066>.
- Nakić, S. & Lindov, K. (2020). Motivacija kao čimbenik razvoja ljudskih resursa. *Glasilo Future*, 3(3), 1-16. <https://doi.org/10.32779/gf.3.3.1>.

- Ndlovu, T. & Ndlovu, S. (2023). Green HRM: A Zimbabwean perspective. In *Global Perspectives on Green HRM: Highlighting Practices Across the World*. Cham: Springer Nature. pp. 187-212. https://doi.org/10.1007/978-3-031-35795-4_8.
- Palamar, S. (2022). Menadžment ljudskih resursa. *Zbornik Radova Nauka I Društvo*, 1(1). <https://doi.org/10.7251/znd2106165p>.
- Quick, J. C., Macik-Frey, M., & Cooper, C. L. (2007). Managerial dimensions of organizational health: The healthy leader at work. *J. Manage. Stud.*, 44(2), 189-205. <https://doi.org/10.1111/j.1467-6486.2007.00684>.
- Radosavac, Z. M. (2016). Razvoj ljudskih resursa kao preduslov organizacione uspješnosti/Human resource development as a condition of organizational success. *EMC Rev. Economy Market Commun. Rev.*, 11(1), 161-176. <https://doi.org/10.7251/emc16161r>.
- Saifulina, N., Carballo-Penela, A., & Ruzo-Sanmartín, E. (2020). Sustainable HRM and green HRM: The role of green HRM in influencing employee pro-environmental behavior at work. *J. Sustainability Res.*, 2(3), e200026. <https://doi.org/10.20900/jsr20200026>.
- Shah, R., Woydt, M., & Zhang, S. (2021). The economic and environmental significance of sustainable lubricants. *Lubr.*, 9(2), 21. <https://doi.org/10.3390/lubricants9020021>.
- Slavković, M. & Mitić, M. (2023). Stavovi o zelenom menadžmentu ljudskih resursa: Poređenje potencijalnih i trenutnih zaposlenih u Srbiji/Perceptions of green human resource management: A Comparison between prospective and current employees in Serbian context. *Ecologica*, 30(111), 357-364. <https://doi.org/10.18485/ecologica.2023.30.111.3>.
- Stanković, A., Pečić, M., & Ostojić, B. (2018). Važnost ljudskih resursa u poslovnom odlučivanju. *Vojno Delo*, 70(7), 431-446. <https://doi.org/10.5937/vojdela1807431s>.
- Stević, Ž., Pamučar, D., Puška, A., & Chatterjee, P. (2020). Sustainable supplier selection in healthcare industries using a new MCDM method: Measurement of alternatives and ranking according to compromise solution (MARCOS). *Comput. Ind. Eng.*, 140, 106231. <https://doi.org/10.1016/j.cie.2019.106231>.
- Stojadinović, J. S., Bojović, I., & Dašić, B. (2021). Team and teamwork in the function of effective management. *Ekonomski Signali: Poslovni Magazin*, 16(1), 95-112. <https://doi.org/10.5937/ekonsig2101095s>.
- Taylor, S. (2006). Emerging motivations for global HRM integration. In *Multinationals, Institutions and the Construction of Transnational Practices: Convergence and Diversity in the Global Economy*. London: Palgrave Macmillan UK. pp. 109-130. https://doi.org/10.1057/9780230502307_5.
- Tirno, R. R., Islam, N., & Happy, K. (2022). Effect of green HRM on the green behavior of employees: A study on service industry. *Bus. Manage.*, 9(4), e14632. <https://doi.org/10.2139/ssrn.4169431>.
- Vrtagić, S., Softić, E., Subotić, M., Stević, Ž., Dordevic, M., & Ponjavic, M. (2021). Ranking road sections based on MCDM model: New improved fuzzy SWARA (IMF SWARA). *Axioms*, 10(2), 92. <https://doi.org/10.3390/axioms10020092>.
- Williams, S. (2023). Redundancy and human resource management. In *Human Resource Management*. Oxford: Oxford University Press. <https://doi.org/10.1093/hebz/9780199605484.003.0009>.
- Wonki, L. & Hoyoung, K. (2013). Effects of employee training and reward system on motivation of employee. *Korea Int. Accounting Rev.*, 51, 1-22. <https://doi.org/10.21073/kiar.2013.51.001>.
- Živković, N. (2019). Uticaj osobina ličnosti na timski rad. *Zbornik Radova Fakulteta Tehničkih Nauka U Novom Sadu*, 34(10), 1845-1848. <https://doi.org/10.24867/04gi07zivkovic>.