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VISION-BASED WEIGHTING SYSTEM (VIWES) IN PROSPECTIVE MADM

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Abstract: *Policy-making is an undeniable decision-making process in every company where different kinds of decisions are taken based on different goals and preferences in each vision. "Prospective Multiple Attribute Decision Making (PMADM)" is one of the well-known decision-making frameworks that have been used as a flexible decision-making tool for developing policies and making future decisions over different periods. This study presents a multi attribute problem with three different visions where a decision-making process is required for each vision in order to prioritize the potential set of alternatives. Evaluation Based on the Distance from the Average Solution (EDAS) is used as a MADM model to show the applicability and feasibility of the PMADM framework. A vision-based weighting system (ViWeS) prepares a new opportunity to take proper decisions in different visions and time requirements. This research is analyzed three-time vision (Current, 2025, and 2030) and showed by changing the time, the rank of the alternatives also is changed. In numerical example is indicated in the current vision, Alternative 5 gets rank one and alternative six get rank 2, for 2025 vision, the rank one and two don't change, and in vision 2030, the rank of one does not change, but the rank of second change from Alternative 6 to 3.*

Key words: *Prospective Multiple Attribute Decision Making (PMADM), Vision-based weighting system (ViWeS), Evaluation Based on the Distance from the Average Solution (EDAS), Policy-Making, Weighting system*

1. Introduction

Multiple Attribute Decision Making (MADM) models are considered reliable decision-making models that can help decision-makers and policymakers address

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complex evaluation problems such as supplier selection problems. Logistics provide problem, waste management, location selection problem considering multiple attributes (Ignatius *et al.* 2016; Yazdani *et al.* 2017; Ebadi Torkayesh *et al.* 2019; Hashemkhani Zolfani *et al.* 2020). MADM models such as BWM (Fazlollahtabar *et al*. 2021; Pamučar and Savin, 2020), SWARA (Radović and Stević, 2018), AHP (Alosta *et al.* 2021), FUCOM (Durmić et al. 2020) are applied to determine the importance of decision criteria, while models such as EDAS (Stević et al 2016), CoCoSo (Biswas *et al.* 2019), CODAS (Badi *et al.* 2018), TOPSIS, MARCOS (Đalić *et al*. 2021) are applied to evaluate alternatives of a multi attribute problem (Mardani *et al.* 2016; Kumar *et al.* 2017). MADM models are able to address a complex problem with *n* criteria and *m* alternatives for a specific time. However, the decision-making process can be due to several changes in weight of criteria and then an evaluation framework, considering a decision maker's or a company's visions and goals for different periods. Therefore, the decision-making process and obtained results from traditional MADM models may not be reliable in the following years. So, nonexistent a MADM model which considers the future makes more sense than previously.

Prospective MADM (PMADM) is a new framework that can be used to process different companies' visions. The MADM models make decisions in a steady and stable state (fix situation), but PMADM expands this decision environment and considers the time that hasn't happened. The PMADM uses two items for studying the future, limiters and boosters. These items in the different situations given different values to alternatives in evaluation.

Companies can facilitate their policy-making process using PMADM, where several visions can be defined based on companies' goals. By this method, managers can survey and evaluate their future outcomes and modify their decisions and plan.

There are many MADM methods like PROMETHEE (Brans 1982) and VIKOR (Opricovic, 1988), and TOPSIS (Hwang and Yoon in 1981), but they don't consider the future, and this shortage of them causes managers less willing to use them. In contrast, these methods could help them make better policy decisions. For developing and make more efficient methods, this idea formed in our minds that using the PMADM framework can promote their performance and activities. The PMADM approach considers future vision and changes the value of criteria. This conversion affects the rank of alternatives. The researchers who study in the MADM context usually consider the current time in their studies - considering the future in decision making expressed by the PMADM method. But, researchers don't use this method in their studies. This paper considers the future in decision-making by the use of the PMADM method.

In this paper, we develop a PMADM framework and define three visions for a numerical decision-making example where weights of criteria are different in each vision based on goals and preferences and possible events that may happen in the future. For the evaluation part, the EDAS model, as a reliable and frequently used tool, is applied to prioritize the alternatives for each vision.

2. Literature review

As said before, most of the time, Managers concentrate on future actions and goals and make plans to reach them. Due to a lot of factors, managers are confused about set or ranking company priorities. Therefore head manager or an administrator needs to see the future more clearly and make an appropriate decision. To determine the direction and guide policymakers or officers to make a better decision. This section first reviewed the PMADM model and its uses in various contexts and then described a MADM model. Because according to the subject of the article and for futuristic decisions, researchers want to use the PMADM framework for a MADM model.

Hashemkhani Zolfani *et al.* (2016) developed a new framework for MADM problem, called Prospective MADM, which not only facilitate the decision-making process at the moment but also enables decision-makers to consider future visions and extend the decision making process using different sets of inputs based on possible events or goals that are planned for each vision. Later, Zolfani *et al.* (2018) studied the prospective MADM framework for sustainability assessment problems, focusing on a multi-aspect set of criteria that can be used for multi-attribute problems. They consider futures sustainability an umbrella for sustainability, which consists of the future economy, environment, and social position. As to the importance of development in sustainability, they introduced a trend for Exergy, which consists of energy, environment, and sustainable development. In this trend, energy is presented as a core item.

Zolfani and Masaeli (2020) presented a comprehensive framework for the prospective MADM approach and its application for the health device industry of Iran, considering several visions during sanctions. By the PMADM, they achieved their goal to increase the medical device market share ten times more like a sustainable market for the country. In this research, Max capacity, ideal directed scenario, and supportive backup criteria are used in the PMADM framework.

Hashemkhani Zolfani *et al.* (2020) used a text-mining tool, latent semantic analysis, as a criteria selection and weighting system in prospective MADM. They use this for machine tool selection and introduce five criteria as (1) Cost and Serviceability; (2) Technical Features and Safety; (3) Size and Precision; (4) Flexibility; and (5) Productivity. After calculating and ranking them, they report that Cost and Serviceability have the highest priority among these criteria.

After explaining the uses of PMADM in various contexts, it talks about a MADM method and its uses in articles or case studies. Evaluation Based on the Distance from the Average Solution (EDAS) is one of the recently developed MADM models that is used to prioritize a set of alternatives concerning multiple factors (Keshavarz Ghorabee *et al.* 2015). Kahraman *et al.* (2017) proposed a new extension of the EDAS model under fuzzy set theory to evaluate the waste disposal location selection process. In this research, they determined three alternatives and three criteria. The criteria uses are water pollution (w), distance to residential areas (D), and slope (S). For solving, they decided to use the interval-valued intuitionistic fuzzy EDAS (IVIF EDAS) method. In the IVIF method, membership and non-membership function and unknown degree (hesitancy degree) are calculated.

Ecer (2018) integrated AHP and EDAS models under fuzzy set theory to address third-party logistics (3PLs) provider selection problems. First, fuzzy AHP was used to determine the importance of decision criteria, and then fuzzy EDAS was used to prioritize alternatives. He determined that cost, quality, and professionalism are the most critical factors for 3PLs provider selection.

Li et al. (2019) developed another extension of the EDAS method using a neutrosophic set to consider the uncertainty that may happen in the decision-making process. They proposed a convex weighted average operator of multivalued neutrosophic numbers (MVNNs) to calculate the average solution of criteria.

Torkayesh *et al.* (2020) proposed an integrated MADM model using the Shanon Entropy and EDAS methods. The proposed decision-making model has applied a neighborhood selection problem for a new international student who wants to be located in Istanbul, Turkey. The usability and capacity of five renewable resources: solar PV, Solar thermal, wind power, geothermal, and biomass concerning economic, technical, social, and environmental aspects are measured. By EDAS method are ranked these resources and showed wind power is the most suitable energy for their case study.

Behzad *et al.* (2020) used a hybrid decision-making model by using BWM and EDAS models to make an evaluation framework in order to assess waste management status in Nordic countries. They use seven criteria as waste generation, composting waste, recycling waste, landfilling waste, recycling rate, waste to the energy rate, and greenhouse gas emissions from waste. Comparing these criteria concludes that Sweden has the best waste management profile.

2.1. Main contribution

In this article, researchers are trying to develop a decision-making policy to consider the future in decision-making furthermore to the current time. In most conventional decision-making methods, only the present time is considered. This paper attribute to this issue attempt to introduce a vision-based weighting system that facilitates the decision processes. This system is a combination of the PMADM framework with the MADM method. The ViWeS helps administers or managers decide by considering time vision. Finding or verdict in current time is different from the future because the weight of criteria to time vision changes. For example, suppose someone has a plan for reaching a specific goal in two years and wants to determine his alternative priorities; if he doesn't consider the future vision, he may gain the wrong rank of alternatives and doesn't reach his aim. In the numerical example section, this rank changing by time vision changing is shown by an example.

3. Methodology

This section describes the EDAS model that can be applied for PMADM problems that consider different types of weighting visions based on events that may happen in the future and affect the decision-making process. One of the reasons which opt EDAS method is it needs fewer computations concerning most of the other multi-attribute decision-making methods. At the same time, it can produce the same ranking of alternatives (Kahraman et al. (2017)).

3.1. Evaluation Based on the Distance from the Average Solution (EDAS)

Keshavarz Ghorabaee et al. 2017 proposed a new brand Multiple Attribute Decision Making (MADM) method, called EDAS, to address multi-attribute problems such as supply chain management, transportation problem, waste management, etc. By measuring the distance from ideal and nadir solutions, is determined the best alternative. After calculating these distances, the one that has a lower distance from the ideal solution and a higher distance from the nadir solution is our perfect answer. The EDAS method calculating these distances from the average solution (AV). This method defines the positive distance from average (PDA) and negative distance from average (NDA) and specified the best alternative after comparing these distances. For more detail of this method in continuing to explain the steps of this.

The steps of the EDAS method are explained below.

Step 1. In this step, the decision-maker constructs the initial decision matrix.

$$X = \left[X_{ij} \right]_{n*m} = \begin{bmatrix} X_{11} & X_{12} & \dots & X_{1m} \\ X_{21} & X_{22} & \dots & X_{2m} \\ . & . & . & . \\ . & . & . & . \\ . & . & . & . \\ X_{n1} & X_{n2} & \dots & X_{nm} \end{bmatrix} \tag{1}$$

Step 2. The average solution for each criterion is calculated based on equations.

$$AV = \left[AV_j \right]_{1*m} \tag{2}$$

$$\mathrm{AV}_j = \frac{\sum_{i=1}^{n} X_{ij}}{n} \tag{3}$$

Step3. Positive distance from average (PDA) and negative distance from average (NDA) are calculated.

$$PDA = \left[PDA_{ij} \right]_{n*m} \tag{4}$$

$$\mathrm{NDA} = \left[NDA_{ij} \right]_{n*m} \tag{5}$$

if j th criterion is beneficial,

$$\mathrm{PDA}_{ij} = \frac{\max(0, (X_{ij} - AV_j))}{AV_j}, \tag{6}$$

$$\mathrm{NDA}_{ij} = \frac{\max(0, (AV_j - X_{ij}))}{AV_j}, \tag{7}$$

if j th criterion is non-beneficial,

$$\mathrm{PDA}_{ij} = \frac{\max(0, (AV_j - X_{ij}))}{AV_j}, \tag{8}$$

$$\mathrm{NDA}_{ij} = \frac{\max(0, (X_{ij} - AV_j))}{AV_j}, \tag{9}$$

Step 4. We calculate the weighted sum of PDA and NDA for all alternatives which are denoted as SP and SN.

$$SP_i = \sum_{j=1}^{m} w_j * PDA_{ij}; \tag{10}$$

$$SN_i = \sum_{j=1}^{m} w_j * NDA_{ij}; \tag{11}$$

Step 5. We normalize the obtained values in step 4. These values are then added and construct a new vector, called NSP (normalized weighted sum of PDA) and NSN (normalized weighted sum of NDA).

$$NSP_i = \frac{SP_i}{\max_i (SP_i)}; \tag{12}$$

$$\mathrm{NSN}_i = 1 - \frac{SN_i}{\max_i (SN_i)}; \tag{13}$$

Step 6. Finally, appraisal score (AS) for each alternative is calculated.

$$AS_i = \frac{1}{2}(NSP_i + NSN_i), \tag{14}$$

4. Numerical example

In this part, define a numerical example in order to show the applicability and feasibility of the EDAS based PMADM framework. A multiple attribute problem is considered in the numerical example, which includes five decision criteria and six alternatives that should be evaluated accordingly. Weight of decision criteria is proposed for three different visions as current vision, vision 2025, and vision 2030. The importance of decision criteria varies in each vision due to the possible changes that may happen and affect the decision-making process. For each set of weights, the EDAS model is used to solve the decision-making problem and identify the ranking order of alternatives for each time vision. In Table 1, the initial decision matrix including scores of alternatives concerning each criterion is reported. The weight of criteria for each time vision is also reported in Table 1.

Table 1. Initial decision matrix

Criteria	C_1	C_2	C_3	C_4	C_5
Max/Min	Max	Min	Max	Max	Max
		Weights			
Current vision	0.2	0.25	0.2	0.15	0.2
Vision 2025	0.22	0.21	0.18	0.2	0.19
Vision 2030	0.25	0.18	0.18	0.24	0.15
A_1	7	6	8	6	7
A_2	6	7	8	7	8
A_3	8	6	7	6	7
A_4	7	7	7	7	8
A_5	8	7	8	7	7
A_6	6	5	8	6	7

In the next step, the EDAS model is used based on the steps explained in the previous section to solve the decision-making process. For this purpose, the SP, SN, NSP, NSN, AS, and the final ranking of each alternative for each set of weights for each time vision is calculated. In Table 2, the results for EDAS parameters and the corresponding ranking order of each alternative are reported. Alternatives A_5 and A_6 are selected as the most preferred alternatives with respect to the current vision. In table 3, the results of the EDAS model for vision 2025 are reported. As same as the current vision, alternatives A_5 and A_6 are selected as the most preferred alternatives. For vision 2030, the results of the EDAS model are reported in table 4. Alternatives A_5 and A_3 are selected as the most preferred alternatives.

Table 2. EDAS values for current vision

	SP	SN	NSP	NSN	AS	Ranking
A_1	0.022	0.021	0.356	0.781	0.569	3
A_2	0.038	0.094	0.626	0.000	0.313	5
A_3	0.042	0.064	0.680	0.318	0.499	4
A_4	0.030	0.083	0.485	0.118	0.302	6
A_5	0.049	0.009	0.796	0.904	0.850	1
A_6	0.061	0.049	1.000	0.479	0.739	2

Table 3. EDAS values for vision 2025

	SP	SN	NSP	NSN	AS	Ranking
A_1	0.019	0.024	0.346	0.723	0.534	3
A_2	0.040	0.087	0.741	0.000	0.370	6
A_3	0.042	0.062	0.777	0.287	0.532	4
A_4	0.033	0.071	0.598	0.182	0.390	5
A_5	0.055	0.009	1.000	0.900	0.950	1
A_6	0.052	0.055	0.952	0.360	0.656	2

Table 4. EDAS values for vision 2030

	SP	SN	NSP	NSN	AS	Ranking
A_1	0.017	0.025	0.279	0.696	0.487	4
A_2	0.040	0.083	0.644	0.000	0.322	6
A_3	0.045	0.060	0.729	0.279	0.504	2
A_4	0.032	0.063	0.518	0.241	0.380	5
A_5	0.062	0.007	1.000	0.918	0.959	1
A_6	0.046	0.061	0.737	0.266	0.502	3

Figure 1 shows the ranking order of each alternative with respect to each time vision defined in this study. Alternative A_5 is selected as the top alternatives in all visions. Although alternative A_6 is selected as the second important alternative, it is ranked as the third one in vision 2030. The ranking order of other alternatives is also slightly changed concerning each time vision.

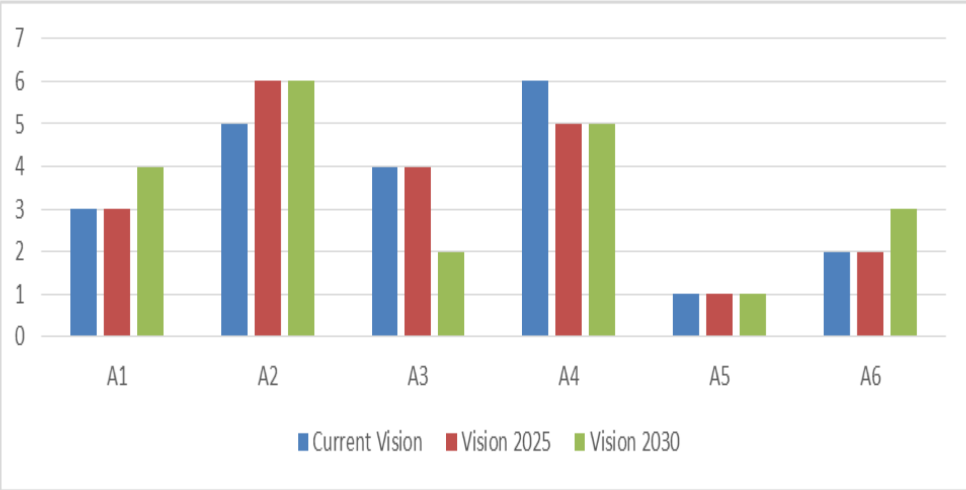

Figure 1. Ranking order of alternatives in different time visions

The main idea for this part is to show that essence could be changed in the current vision to future vision in a particular case. This numerical example is showing this issue of what a proper decision when considering the future is. This example shows in vision 2030, our alternative could be changed, and to reach the company's aim, this issue should be considered. The priorities in time vision could be changed. This issue helps decision-makers to set their decision by this long-term vision.

5. Managerial tips

Managers usually write the company's goals and attempt to reach them. For reaching goals and make a decision, a suitable plan should be set. This plan is consists of a set of alternatives and criteria, and managers should rank these alternatives and consider them according to priorities. Since in the real situation, various criteria involve in decision making, managers should use multiple criteria decision making for finding the best alternative. As previously mentioned, the future vision is one of the crucial issues managers should consider in their decision-making. If a multi-criteria decision-making method exists that considers the future vision, it helps stakeholders take a proper decision in the current time. The current decision that considers the future facilitates the way for achieving the company's goals.

6. Conclusions

Decisions need to be taken according to the current needs and strategic plans and situations. When a policymaker wants to decide by classic MADM form of study, everything must be considered fix in an acceptable primary evaluation. PMADM outline changes the previous games as a game-changer. New items have been developing the class MADM structure since 2016 by introducing PMADM. In this study, a new flexible weighting system, as Vision-based Weighting System (ViWes), presented shows how a decision can be made now but with proper preparation for all possible changes in the decisions.

Moreover, it can enhance this ability to show when we need to consider all the new changes in the priorities and alternatives due to the importance of the criteria in different periods and future visions. It is illustrated in the numerical example to see how the importance of alternatives can vary due to different criteria's expectations. As a suggestion for future studies, something can be mentioned as to how policymakers and decision-makers can make a flexible vision-based decision making when alternatives can be different when they agree to change according to the essential needs and rules. When decision alternatives want to be adopted by necessary changes, a dynamic situation will happen in the classic way of decision making, and that would be a new challenge in the field of MCDM and Prospective MADM. This research is used the PMADM structure for considering the future in the EDAS MADM model. Comparing table 1 to 4 found that in the current vision, Alternative 5 gets rank one and alternative six get rank 2, for 2025 vision, the rank one and two don't change, and in vision 2030, the rank of one does not change, but the rank of second change from Alternative 6 to 3. These conclusions show that makes the decision is changed over time and should consider the vision of time in decision making. The PMADM is a method that helps managers or stakeholders to consider time vision in their decision policy. By this, managers could reach their goals and plan.

The limitation of this study was there isn't an actual case study for this method, and future research, using the real case study is beneficial, and the combination of other MADM methods with PMADM could be actionable.

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Reference

Alosta, A., Elmansuri, O., & Badi, I. (2021). Resolving a location selection problem by means of an integrated AHP-RAFSI approach. *Reports in Mechanical Engineering*, *2*(1), pp. 135-142.

Badi, I., Abdulshahed, A. M., & Shetwan, A. (2018). A case study of supplier selection for a steelmaking company in Libya by using the Combinative Distance-based ASsessment (CODAS) model. *Decision Making: Applications in Management and Engineering*, *1*(1),pp. 1-12.

Biswas, T. K., Stević, Ž., Chatterjee, P., & Yazdani, M. (2019). An integrated methodology for evaluation of electric vehicles under sustainable automotive environment. In *Advanced multi-criteria decision making for addressing complex sustainability issues* (pp. 41-62). IGI Global.

Brans. J.P., (1982). L'ingénièrie de la décision; Elaboration d'instruments d'aide à la décision. La méthode PROMETHEE. In R. Nadeau and M. Landry, editors, L'aide à la décision: Nature, Instruments et Perspectives d'Avenir, pp. 183–213, Québec, Canada, 1982. Presses de l'Université Laval.

Đalić, I., Stević, Ž., Ateljević, J., Turskis, Z., Zavadskas, E. K., & Mardani, A. (2021). A novel integrated MCDM-SWOT-TOWS model for the strategic decision analysis in transportation company. *Facta Universitatis, Series: Mechanical Engineering*.

Durmić, E., Stević, Ž., Chatterjee, P., Vasiljević, M., & Tomašević, M. (2020). Sustainable supplier selection using combined FUCOM–Rough SAW model. *Reports in mechanical engineering*, *1*(1), pp. 34-43.

Ebadi Torkayesh, A., Fathipoir, F. and Saidi-Mehrabd, M., (2019). Entropy-based multi-criteria analysis of thermochemical conversions for energy recovery from municipal solid waste using fuzzy VIKOR and ELECTRE III: case of Azerbaijan region, Iran. *Journal of Energy Management and Technology*, *3*(1), pp. 17-29.

Ecer, F., (2018). Third-party logistics (3PLs) provider selection via Fuzzy AHP and EDAS integrated model. *Technological and Economic Development of Economy*, *24*(2), 615-634.

Fazlollahtabar, H., & Kazemitash, N. (2021). Green supplier selection based on the information system performance evaluation using the integrated best-worst method. *Facta Universitatis, Series: Mechanical Engineering*.

Hashemkhani Zolfani, S. and Derakhti, A., (2020). Synergies of Text Mining and Multiple Attribute Decision Making: A Criteria Selection and Weighting System in a Prospective MADM Outline. *Symmetry*, *12*(5), 868.

Hashemkhani Zolfani, S. and Masaeli, R., (2020). From Past to Present and into the Sustainable Future. PMADM Approach in Shaping Regulatory Policies of the Medical Device Industry in the New Sanction Period. *Sustainability Modeling in Engineering*, pp. 73-95.

Hashemkhani Zolfani, S., Maknoon, R. and Zavadskas, E.K., (2016). An introduction to prospective multiple attribute decision making (PMADM). *Technological and Economic Development of Economy*, *22*(2), pp. 309-326.

Hashemkhani Zolfani, S., Yazdani, M., Ebadi Torkayesh, A. and Derakhti, A., (2020). Application of a Gray-Based Decision Support Framework for Location Selection of a Temporary Hospital during COVID-19 Pandemic. *Symmetry*, *12*(6), 886.

Hwang, C.L., Yoon, K., (1981). *Multiple Attribute Decision Making: Methods and Applications*. New York: Springer-Verlag.

Ignatius, J., Rahman, A., Yazdani, M., Šaparauskas, J. and Haron, S.H., (2016). An integrated fuzzy ANP–QFD approach for green building assessment. *Journal of Civil Engineering and Management*, *22*(4), pp.551-563.

Keshavarz Ghorabaee, M., Zavadskas, E.K., Olfat, L. and Turskis, Z., (2017). Multi-criteria inventory classification using a new method of evaluation based on distance from average solution (EDAS). *Informatica*, *26*(3), pp.435-451.

Kumar, A., Sah, B., Singh, A. R., Deng, Y., He, X., Kumar, P., and Bansal, R. C., (2017). A review of multi criteria decision making (MCDM) towards sustainable renewable energy development. *Renewable and Sustainable Energy Reviews*, *69*, 596-609.

Li, Y. Y., Wang, J. Q., & Wang, T. L., 2019. A linguistic neutrosophic multi-criteria group decision-making approach with EDAS method. *Arabian Journal for Science and Engineering*, *44*(3), 2737-2749.

Mardani, A., Zavadskas, E. K., Khalifah, Z., Jusoh, A., and Nor, K. M., (2016). Multiple criteria decision-making techniques in transportation systems: A systematic review of the state of the art literature. *Transport*, *31*(3), 359-385.

Opricovic S., (1988). Multicriteria optimization in civil engineering systems. PhD Thesis, 302 Faculty of Civil Engineering, Belgrade.

Pamučar, D. S., & Savin, L. M. (2020). Multiple-criteria model for optimal off-road vehicle selection for passenger transportation: BWM-COPRAS model. *Vojnotehnički glasnik*, *68*(1), 28-64.

Radović, D., & Stević, Ž. (2018). Evaluation and selection of KPI in transport using SWARA method. *Transport & Logistics: The International Journal*, *8*(44), 60-68.

Stević, Ž., Tanackov, I., Vasiljević, M., & Vesković, S. (2016, September). Evaluation in logistics using combined AHP and EDAS method. In *Proceedings of the XLIII International Symposium on Operational Research, Belgrade, Serbia* (pp. 20-23).

Torkayesh, S. E., Amiri, A., Iranizad, A., and Torkayesh, A. E., (2020). Entropy based EDAS decision making model for neighborhood selection: A case study in Istanbul. *Journal of Industrial Engineering and Decision Making*, *1*(1), 1-11.

Yazdani, M., Chatterjee, P., Zavadskas, E.K. and Zolfani, S.H., (2017). Integrated QFD-MCDM framework for green supplier selection. *Journal of Cleaner Production*, *142*, pp.3728-3740

Zolfani, S.H., Zavadskas, E.K., Khazaelpour, P. and Cavallaro, F., (2018). The multi-aspect criterion in the PMADM outline and its possible application to sustainability assessment. *Sustainability*, *10*(12), 4451.