AN MCDM APPROACH TO TOURISM PROJECTS EVALUATION: THE UPPER DANUBE BASIN CASE

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Abstract: *Essentially, this paper intends to emphasize the applicability of MCDM methods, i.e. the recently introduced Extended Pivot Pairwise Relative Criteria Importance Assessment (PIPRECIA-E), in the field of tourism projects evaluation. The usefulness of the proposed method is demonstrated through a real case study involving the evaluation of projects pointed at the development of the tourism of the Upper Danube Basin. The performed assessment that has generated quite reliable results contains an estimation of the four alternative projects against the four principal criteria and the 21 sub-criteria.*

Keywords: *PIPRECIA-E method, MCDM, tourism projects evaluation, Upper Danube Basin*

1. INTRODUCTION

The tourism activity has a significant impact on the economic development of a certain area. With the aim of inciting the progress of tourism that will lead to the beneficial economic results, there is a need for planning and implementing appropriate projects involving all interested stakeholders. These projects are usually directed towards the development of hotel property and ancillary leisure facilities, which demands a significant amount of resources – financial, nonfinancial and human. Because of a considerable consumption of available resources, these projects are investment projects and require a carefully conducted analysis and planning before their implementation. Developing countries are especially interested in the preparation and implementation of this kind of projects because they have a positive impact on the social and economic situation in a certain region or a certain country.

The Republic of Serbia has good preconditions for the development of different types of tourism despite the fact that it has no access to the sea. This deficiency will not have a serious negative effect on a future expansion of tourism because the Republic of Serbia is rich in the possibilities for the development of the tourism offer that contains the spa, wellness, sport and other types of tourism. The fact that the number of tourists increased from 2013 to 2017 by nearly 41% in total arrivals and by nearly 27% in total overnight stays shows that the global trend of the increasing number of tourists did not circumvent the Republic of Serbia, either. In the number of the total arrivals for the year 2017, foreign tourists participate with 49%, whereas in the total overnight stays for the same year, foreign tourists account for 38%. The most attractive tourist regions were the regions of Šumadija and Western Serbia, and Belgrade, whereas the least alluring was the region of Eastern and Southern Serbia [1].

In cooperation with domestic and foreign institutions and organizations, the Ministry of Trade, Tourism and Telecommunications of the Republic of Serbia compiled the master plans for the development of the tourism of different attractive destinations, which involves: mountains, spas,

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lakes and rivers. Each master plan consists of several investment projects to be implemented in order to improve the present conditions in a certain area and also to enhance a share on the domestic and foreign tourism markets. These projects, directed towards the development of a particular destination, are very expensive, time-consuming and complex, and there is no possibility of their implementation at the same time. Because of that, the question of how to evaluate these projects in light of often conflicting criteria and how to define which one of them is more appropriate for the actualization in the present conditions arises.

Multiple-Criteria Decision-Making (MCDM) methods imply suitable techniques, potentially very useful in a situation when a decision-maker (hereinafter referred to as the *DM*) should evaluate available alternatives against a greater number of opposing criteria. Until now, these techniques have been applied to the solving of various business problems, and certainly could have contributed to the process of the evaluation of available tourism projects. In this paper, the recently proposed Extended Pivot Pairwise Relative Criteria Importance Assessment (PIPRECIA-E) method is used in the tourism projects evaluation process aimed at the touristification of the Upper Danube Basin area.

The main objective of this paper is to emphasize the usefulness and importance of the application of appropriate methods in the decision-making process that will enable the promulgation of reliable decisions and also to indicate the possibilities of the PIPRECIA-E method. Beside the Introduction and the Conclusion, the paper is organized as follows: the second section of the paper contains a Literature Review; the explanation of the PIPRECIA-E method is given in the third section, and a case study inclusive of the application of the proposed model and a discussion about the obtained results are demonstrated in the last section of the paper.

2. LITERATURE REVIEW

The effects of tourism development on the economic and social prosperity of a country are quite an interesting topic bearing significant scientific attention in recent years. For example, Pablo-Romero and Molina (2013) examined the literature analyzing tourism- and economic prosperity related issues [2]. Panahi et al. (2015) explored the effect of tourism on economic growth in Turkey by applying the time-varying parameter and the approaches based on the Kalman Filter for the period 1970-2011 [3]. Ohlan (2017) investigated the connection between tourism and economic growth in India during the period 1960-2014 and discovered that tourism development considerably contributed to the economic prosperity of the country [4]. On the contrary, Pulido-Fernández et al. (2014) discussed in their paper whether tourism development really contributed to the economic prosperity of poor countries. Their standpoint showing that they do not agree upon the statement that tourism indeed imparted to the economic expansion of a poor country [5]. Kuliš et al. (2018) used dynamic panel data for the assessment of the impact of tourism in 19 Central and Eastern European developing countries and provided policy-makers with considerable directions [6].

The formulation and implementation of appropriate tourism projects is necessary because of the improvement of the current state in the field of tourism in a certain country, the animation of the tourism activity and attracting a greater number of tourists, which leads to satisfactory economic results. The authors recognized the importance of tourism projects, and as a result, there are the papers that observed the mentioned topic. The examples of sustainable projects in the field tourism business doing [7]-[8], as well as investments in the projects of the development

of different types of tourism [9]-[10] and the influences of tourism development on a particular area [11], are topics frequently subjected to elaboration. Also, authors make an effort to define sociocultural criteria suitable for the estimation of projects for rural tourism development by applying the Delphi technique [12].

Usually, *DM*s have several projects at their disposal and have to evaluate them and decide which one to implement first. This is quite a complex task because the criteria which an evaluation is based on are often conflicting and divergent. Prioritizing a certain group of criteria would lead to inappropriate evaluation results due to disregarding other criteria in such a case. This kind of decision-making problems could be overcome by applying the MCDM methods that are a part of the operational research study undergoing a rapid development in recent years. The fundamental characteristic of the MCDM is that the evaluation of alternatives is performed by acknowledging all of the conflicting criteria. In that way, the subjectivity of the decision-making process is reduced to an acceptable degree, and the results obtained are more reliable and credible. In order to determine the optimal solution to many real-world problems, the authors proposed a wide range of MCDM methods. Some of the most popular and most often used methods are as follows: SAW or WS [13]-[14], AHP [15], TOPSIS [16], PROMETHEE [17], ELECTRE [18], COPRAS [19] and VIKOR [20]. Recently, because of enabling a further facilitation of the decision-making process, new MCDM methods have been developed, some of them being: MULTIMOORA [21], SWARA [22], WASPAS [23], WS PLP [24] and EDAS [25]. Decision-making is usually connected with uncertainty and imprecise data, for which reason appropriate extensions of the MCDM methods have been developed by introducing fuzzy, intuitionistic fuzzy and grey numbers.

In the tourism field, the MCDM methods were used for developing an improved plan for the upgrading of the tourism policy [26]. The application of different combinations of MCDM techniques in the evaluation of the quality of hotel and tourism websites is also the topic that attracts scientific attention [27]-[28]. Some authors used MCDM techniques as a decision -making instrument in developing a sustainable tourism offer based on renewable energy resources [29]. There are examples of the application of MCDM methods in the cases of the selection of investment in an appropriate type of a hotel [30]. Besides, the multiple-criteria approach is used in the estimation of the competitiveness of tourism industries [31]. The selection of a tourism destination selection and the evaluation of the available marketing strategy in the field of tourism, too, were the subject matter of the application of a multiple-criteria analysis [32]-[34].

With the aim of performing an evaluation of projects directed towards the development of the tourism of the Upper Danube Basin area, the PIPRECIA-E method, proposed by Stanujkic et al. (2017), is used [35]. This method is easy to use and has a comprehensive procedure which could facilitate the solving of different kinds of decision-making problems. To date, it has been mentioned in a few papers [36]-[37], which leads us to conclude that disposable possibilities of this method are not fully examined and the benefits it generates are not completely utilized. Additionally, the evaluation and selection of the optimal project for the development of the tourism of the considered area in light of the multiple criteria analysis is a very interesting topic that has not been much exposed in former research studies.

3. PIPRECIA-E METHOD

Until now, different methods have been proposed for criteria relative significance determination. The most popular is certainly the AHP method, applied for the purpose of solving various business and real-world problems. Later, new methods have been proposed for the very same purpose, one of them being the SWARA method [22], quite simple and easy to use, applied in a certain number of papers [38]-[40].

Stanujkic et al. (2017) proposed the PIPRECIA method [35] as an adjustment of the SWARA method for application in the cases of group decision-making. In the original SWARA method, the list of evaluation criteria should be sorted according to the expected significance in the first step of the procedure. This could complicate the evaluation process very much in the cases when decision-making is performed by a larger number of *DM*s. In order to overcome the existing problem, Stanujkic et al. (2017) performed a modification, which entailed the evaluation of the previously unsorted list of criteria according to their significances, which represents the main contribution of this newly introduced method [35].
Together with the inverse PIPRECIA method, the PIPRECIA method represents a part of the PIPRECIA-E method due to its being based on a bidirectional approach to criteria weights defining. The computation procedure of PIPRECIA-E is slightly more complex than that of the PIPRECIA method, and requires a clear explanation to respondents. The assessment of available criteria in both directions, from the most to the least significant and vice versa, however, only contributes to a greater reliability of the obtained results. The following phases that include a certain number of steps create the computational procedure of the PIPRECIA-E method.

Phase 1. The PIPRECIA Method

***Step* 1**. In this step, the evaluation criteria included in the decision-making process should be selected, their presorting not being mandatory.

***Step* 2**. Define the relative significance s_j starting from the second criterion in the following way:

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

***Step* 3**. Determine the coefficient k_j as follows:

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

***Step* 4**. Distinguish the recalculated value q_j by applying the following Eq.:

$$q_j = \begin{Bmatrix} 1 & j=1 \\ \dfrac{q_{j-1}}{k_j} & j>1 \end{Bmatrix} \tag{3}$$

***Step* 5**. Determine the relative weights of the estimated criteria in the following manner:

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

where w_j is the relative weight of the criterion j.

***Phase* 2. The Inverse PIPRECIA Method**

***Step* 1**. Based on the same list of the criteria as in ***Phase* 1**, define the inverse relative significance S'_j starting from the second least significant criterion in the following way:

$$s'_j = \begin{cases} >1 & when \quad c_j > c_{j+1} \\ 1 & when \quad c_j = c_{j+1} \\ <1 & when \quad c_j < c_{j+1} \end{cases} \tag{5}$$

***Step* 2.** Distinguish the inverse coefficient k'_j as follows:

$$k'_j = \begin{cases} 1 & j = n \\ 2 - s'_j & j < 1 \end{cases} \tag{6}$$

***Step* 3.** Define the inverse recalculated weight q'_j by applying the following Eq.:

$$q'_j = \begin{cases} 1 & j = n \\ \dfrac{q'_{j+1}}{k'_j} & j < n \end{cases} \tag{7}$$

***Step* 4.** Distinguish the inverse relative weights of the considered criteria in the following manner:

$$w'_j = \frac{q'_j}{\sum_{k=1}^{n} q'_k} \tag{8}$$

where w'_j denotes the inverse weight of the criterion *j*.

***Phase* 3. Defining the Final Weights of Criteria**

The weight w''_j of the criteria in PIPRECIA-E is calculated by applying the following Eq.:

$$w''_j = \frac{1}{2}(w_j + w'_j) \tag{9}$$

where: w_j, w'_j and w''_j stand for the weights of the criterion *j* obtained by applying the PIPRECIA, inverse PIPRECIA and PIPRECIA-E methods, respectively.

4. A CASE STUDY

In order to demonstrate the applicability of the proposed PIPRECIA-E method, a real case study related to the evaluation of the projects for the development of the tourism of the Upper Danube Basin destination is carried out. The input data are retrieved from the *Master Plan for the Upper Danube Basin Tourism Destination*, drafted by the Scientific-Research Center of the Belgrade Faculty of Economics upon request made by the Ministry of Trade, Tourism and Telecommunications of the Republic of Serbia [41]. In the mentioned Master Plan, the 9 main investment projects connected with the specific areas of the considered Upper Danube Basin destination are presented. In this paper, the four of them are selected and submitted for further evaluation.

The projects evaluated in this paper are as follows: *Banja Junaković Spa*, *Zelena Glava (Green Head) Lake*, *Schwartzwald Ethno Village and Sports Complex* and *The Touristic Reception Complex on the Danube River*. In this case, the projects represent the appropriate areas convenient for touristification. The common denominator for all of them is the fact that the tourism

activity will be based on natural resources utilization. In the mentioned Master Plan, these areas are subjected to consideration from the point of view of the investor, the guest and the social community. On the basis of the given pieces of information, the authors of the paper perform their own evaluation based on the four groups of the criteria elaborated in a certain number of the sub-criteria. The criteria and the sub-criteria are formulated by referring to the list of the perspectives, criteria and sub-criteria shown in a paper by Chou et al. (2008) [42]. The input data relative to the mentioned groups of the criteria, sub-criteria, as well as the considered alternatives, are given in the Table 1.

	Criteria		Sub-criteria		Alternatives
G_1	Geographical characteristics	G_{11}	Closeness to public facilities	A_1	Banja Junaković Spa
		G_{12}	Closeness of the competition		
		G_{13}	Public security		
		G_{14}	Natural resources attributes		
		G_{15}	Closeness of rest facilities		
T_1	Traffic characteristics	T_{11}	Closeness of highway/airport/ railway station	A_2	Green Head Lake
		T_{12}	Closeness of the city area		
		T_{13}	Closeness of tourist attractions		
		T_{14}	Parking area		
		T_{15}	Accessibility of the highway, the airport or another type of transport facilities		
		T_{16}	Range of travel routes		
		T_{17}	Accessibility of tourist attractions		
H_1	Hotel characteristics	H_{11}	Indoor rest facilities	A_3	Schwartzwald Ethno Village and Sports Complex
		H_{12}	Variety of restaurants in the hotel		
		H_{13}	Fusion with local culture		
		H_{14}	Outdoor rest facilities		
		H_{15}	Possibilities of acquiring neighboring land		
O_1	Operation characteristics	O_{11}	Sufficient human resources	A_4	Touristic Reception Complex on the Danube River
		O_{12}	Quality personnel		
		O_{13}	Land cost		
		O_{14}	Legal regulation		

Table 1: The evaluation criteria, sub-criteria and alternatives

By applying Eqs (1)-(9), the local relative significance of the main criteria is determined. The obtained results are presented in Table 2.

	w_j	w'_j	w''_j
G_1	0.2660	0.2584	*0.2622*
T_1	0.2660	0.2584	*0.2622*
H_1	0.2217	0.2842	*0.2530*
O_1	0.2463	0.1990	*0.2226*

Table 2: The local relative significance of the main criteria

As can be concluded, the greatest significance is that of the criteria G_1 – *Geographical characteristics* and T_1 – *Traffic characteristics*, and they would have a crucial impact on the final ranking order of the alternative projects.

In Table 3, the evaluation and determination of the local significances of the sub-criteria that belong to the group of the "*geographical characteristics*" are presented. The same Eqs as in the previous case are applied with that aim. Eqs (1)-(9) will be used throughout the numerical procedure.

	w_j	w'_j	w''_j
G_{11}	0.2308	0.1969	*0.2138*
G_{12}	0.1775	0.2362	*0.2069*
G_{13}	0.1972	0.1890	*0.1931*
G_{14}	0.1972	0.1890	*0.1931*
G_{15}	0.1972	0.1890	*0.1931*

Table 3: The local relative significance of the "*geographical characteristics*" sub-criteria

The obtained results show that the most significant criterion is G_{11} – *Closeness to public facilities*.

Next, the local significance of the sub-criteria that involve the "*traffic characteristics*" group is determined in the previously explained manner, and the results obtained are given in Table 4.

	w_j	w'_j	w''_j
T_{11}	0.1481	0.1650	*0.1590*
T_{12}	0.1481	0.1650	*0.1590*
T_{13}	0.1481	0.1650	*0.1590*
T_{14}	0.1235	0.1485	*0.1381*
T_{15}	0.1235	0.1188	*0.1230*
T_{16}	0.1543	0.1188	*0.1387*
T_{17}	0.1543	0.1188	*0.1230*

Table 4: The local relative significance of the "*traffic characteristics*" sub-criteria

In this case, the three sub-factors share the first rank, and they are as follows: T_{11} – *Closeness of the highway/airport/railway*, T_{12} – *Closeness of the city area*, and T_{13} – *Closeness of tourist attractions*.

Now, the evaluation procedure is directed towards the determination of the relative weights of the sub-criteria under the "*hotel characteristics*" criteria group (Table 5).

	w_j	w'_j	w''_j
H_{11}	0.2105	0.2390	*0.2248*
H_{12}	0.1754	0.1912	*0.1833*
H_{13}	0.1754	0.1912	*0.1833*
H_{14}	0.2193	0.2103	*0.2148*
H_{15}	0.2193	0.1683	*0.1938*

Table 5: The local relative significance of the "*hotel characteristics*" sub-criteria

When the "*hotel characteristics*" are in question, the results reflect that the sub-criterion with the greatest local significance is the sub-criterion H_{11} – *Indoor rest facilities*.

Ultimately, the local relative significance of the sub-criteria from the "*operation characteristics*" group is determined and presented in Table 6.

	w_j	w'_j	w''_j
O_{11}	0.2045	0.1969	*0.2007*
O_{12}	0.2273	0.2362	*0.2317*
O_{13}	0.2841	0.2835	*0.2838*
O_{14}	0.2841	0.2835	*0.2838*

Table 6: The local relative significance of the "*operation characteristics*" sub-criteria

As results show, the sub-criteria O_{13} – *Land cost* and O_{14} – *Legal regulation* would have the main impact on the further evaluation process.

The global significance of the considered sub-criteria is defined by multiplying the local significance of the criteria and the sub-criteria, and the final results are accounted for in Table 7.

Criteria	Importance of the criteria	Sub-criteria	Local importance of the sub-criteria	*The global importance of the sub-criteria*
G_1	0.2622	G_{11}	0.3070	*0.0561*
		G_{12}	0.2262	*0.0542*
		G_{13}	0.1916	*0.0506*
		G_{14}	0.1515	*0.0506*
		G_{15}	0.1237	*0.0506*
T_1	0.2622	T_{11}	0.1590	*0.0417*
		T_{12}	0.1590	*0.0417*
		T_{13}	0.1590	*0.0417*
		T_{14}	0.1381	*0.0362*
		T_{15}	0.1230	*0.0323*
		T_{16}	0.1387	*0.0364*
		T_{17}	0.1230	*0.0323*
H_1	0.2530	H_{11}	0.2248	*0.0569*
		H_{12}	0.1833	*0.0464*
		H_{13}	0.1833	*0.0464*
		H_{14}	0.2148	*0.0543*
		H_{15}	0.1938	*0.0490*
O_1	0.2226	O_{11}	0.2007	*0.0447*
		O_{12}	0.2317	*0.0516*
		O_{13}	0.2838	*0.0632*
		O_{14}	0.2838	*0.0632*

Table 7: The global importance of the sub-criteria

The obtained relative global significance of the sub-criteria is a part of the future procedure for the evaluation of the given four alternative projects.

The considered alternative projects are evaluated relative to the given sets of the sub-criteria by applying Eqs (1)-(9). The obtained results are shown in Tables 8a to 8d, respectively.

	G_{11}	G_{12}	G_{13}	G_{14}	G_{15}
A_1	0.2529	0.2711	0.2500	0.2748	0.2504
A_2	0.2483	0.2554	0.2500	0.2286	0.2504
A_3	0.2483	0.2367	0.2500	0.2286	0.2265
A_4	0.2505	0.2367	0.2500	0.2680	0.2726

Table 8a: The overall importance of the alternative projects according to the "*geographical characteristics*" sub-criteria

	T_{11}	T_{12}	T_{13}	T_{14}	T_{15}	T_{16}	T_{17}
A_1	0.2853	0.2771	0.2036	0.2679	0.2561	0.2914	0.2625
A_2	0.2188	0.2400	0.2380	0.2440	0.2561	0.2523	0.2625
A_3	0.2298	0.2171	0.2792	0.2440	0.2561	0.2282	0.2375
A_4	0.2661	0.2658	0.2792	0.2440	0.2317	0.2282	0.2375

Table 8b: The overall importance of the alternative projects according to the "*traffic characteristics*" sub-criteria

	H_{11}	H_{12}	H_{13}	H_{14}	H_{15}
A_1	0.2525	0.2615	0.2224	0.2863	0.2863
A_2	0.2407	0.2134	0.2224	0.2379	0.2379
A_3	0.2661	0.2360	0.2459	0.2379	0.2379
A_4	0.2407	0.2891	0.3093	0.2379	0.2379

Table 8c: The overall importance of the alternative projects according to the "*hotel characteristics*" sub-criteria

	O_{11}	O_{12}	O_{13}	O_{14}
A_1	0.2812	0.2780	0.2780	0.2500
A_2	0.2544	0.2407	0.2407	0.2500
A_3	0.2322	0.2407	0.2407	0.2500
A_4	0.2322	0.2407	0.2407	0.2500

Table 8d: The overall importance of the alternative projects according to the "*operation characteristics*" sub-criteria

The results regarding the global significance of the sub-criteria shown in Table 7 and the results showing the overall significance of the alternative projects according to the sub-criteria shown in Tables 8a to 8d are multiplied in order to define the overall ranking of the alternative projects. The obtained results and the final ranking order of the evaluated projects are demonstrated in Table 9.

Alternative project	Overall result	Rank
A_1	0.2638	1
A_2	0.2304	4
A_3	0.2313	3
A_4	0.2424	2

Table 9: The overall ranking of the alternative tourism projects

According to the results, the alternative project which is the most suitable project for implementation under the present conditions is Project A_1 – *Banja Junaković Spa* (0.2638), which is followed by Project A_4 – *Touristic Reception Complex on the Danube River* (0.2424). The third-ranked is Project A_3 – *Schwartzwald Ethno Village and Sports Complex* (0.2313), while the worst ranked is Project A_2 – *Green Head Lake* (0.2304).

5. CONCLUSION

This paper mainly attempts to indicate the possibilities of the PIPRECIA-E method as an innovative tool enabling easier decision-making in the tourism field. The applicability of the proposed method is presented by reference to a real case study consisting of the four alternative projects aimed at developing the tourism of the four areas located at the destination of the Upper Danube Basin. The projects included in the evaluation process are: *Banja Junaković Spa*, *Zelena Glava (Green Head) Lake*, *Schwartzwald Ethno Village and Sports Complex* and *Touristic Reception Complex on the Danube River*. The evaluation process was based on the four main criteria and the 21 sub-criteria, against which the mentioned projects have been assessed. The final results reveal that the most suitable project which should be given a priority in implementation under the present conditions is the *Banja Junaković Spa* Project. The second-ranked is the *Touristic Reception Complex on the Danube River* Project, only to be followed by the *Schwartzwald Ethno Village and Sports Complex* Project, whereas the project ranked the last is the *Green Head Lake.*

In spite of the fact that PIPRECIA-E is slightly more complicated than the PIPRECIA method, it is very useful for application in the decision-making process, entailing the application of the bidirectional approach, where one and the same respondent evaluates the given data in both directions, i.e. from the first to the last, and vice versa. Data reliability could be verified by using some correlation coefficients, which now overleap because the proposed procedure of the PIPRECIA-E method allows that. Also, only one *DM* is involved in the evaluation procedure in this particular case, but the proposed method is also applicable in the cases of group decision-making. The final conclusion is that this method could very appropriately apply in the processes of finding optimal solutions to real-world problems not only in tourism, but in other fields of business doing as well.

The commitment of the evaluation process to only one *DM* is one of the main limitations of this paper. By involving a greater number of *DM*s, the obtained results would be more reliable and more realistic. Also, the computational process is based on crisp numbers. Bearing in mind the fact that input data are often imprecise due to the vagueness of the environment, the application of fuzzy, intuitionistic fuzzy, or grey numbers is strongly recommended. In that manner, by introducing appropriate extensions, the final results and solutions to a considered problem would be better. Beside these deficiencies, the PIPRECIA-E method represents a method with a potential, which is simultaneously very interesting for the purposes of further scientific and practical observations of the possibilities of its application in various fields.

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