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SELECTION A DEVELOPMENT STRATEGY OF MINING TOURISM BASED ON THE GREY RELATIONAL ANALYSIS

Abstract

Today, more attention is paid to development of mining tourism, which constitutes one of the important components of development of not only tourism, but also of integrated and sustainable development of the region as a whole. To select a strategy for positioning of mining tourism in the tourist map of the region, it is necessary to consider the economic importance of development the specific regions. Therefore, the aim of this paper is to propose the right approach to the choice of development strategy of mining tourism on Stara planina (Old Mountain), a tourist destination located in eastern Serbia, on its border with Bulgaria. The proposed approach for selection of strategies is based on the use the grey relational analysis. The usability and efficiency of the proposed approach is considered on the conducted numerical example.

Keywords: mining tourism; development tourism strategy; MCDM; GRA

INTRODUCTION

Many former mining areas have lost their industrial function and turn now to the tourism for the purpose of regional revitalization and economic development of communities, [6]. There is no doubt that the abandoned mining areas may become significant objects of tourism and recreation, and among other things, have scientific and educational significance. By including of these objects in the tourism program, a compromise has to be found between the interests of tourists, miners and environmental protection programs, which in some cases will not be easy [31].

Observed as a potential for development the new forms of tourism, mining tourism can be harmonized with already developed conventional tourism. Mining tourism is such a form of tourism that includes every type of the tourist activity in the area of an

abandoned or active mine. A large number of abandoned mine sites overgrown with weeds have their own values, but what they have in common is the fact that they surely will perish. Instead, they can be transformed into an environmentally healthy environment or organized as an industrial cultural heritage which local and foreign tourists often visited and stayed in them.

Development of mining tourism can be an effective tool to mitigate the impact of economic crisis in mining, because it is focused on the applied mining research as well as the function of museum exhibitions representing a technology of the past used for exploitation of mineral resources [39, 27, 2]. This implies that tourism demand is increasingly striving towards avoiding usual tourist destinations, and requires return to the traditional and typical values and au-

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thenticity. Tourist demand seeks various kinds of adventures and a deeper knowledge of where new tourist products appear with new environmental, ecological and social [30, 15] ones. In contemporary modern tourism, the aim of every tourist destination is to create a unique identity, or a difference in relation to competition, which will provide the basis for further growth and development in a competitive market [11].

According to Streimikiene and Bilan [34], tourism in general can also be seen as a natural process of change, because a proper understanding of this process enables a dynamic development of tourism and mining tourism, which also allows the identification of the main factors affecting changes in development of tourism, as well as the selection of appropriate strategies that have an impact on identification and evaluation the strategic directions of development the mining tourism.

To select a strategy for the purpose of positioning mining tourism in the tourist map of the region, it is necessary to research the economic impact of development the specific regions as well as the potential heritage of these regions. Cole [5], describes the existing social, environmental and economic perspective of sustainability of this form of tourism. Such an approach to development of mining tourism represents the basis for development the quality tourist offer, as well as its placement on the tourism market.

Multiple - criteria decision - making (MCDM) is one of the fastest - growing fields of operations research. The MCDM has found its application for solving the most diverse and complex decision-making problems. Over time, many MCDM methods have been developed; therefore, a good overview and comparisons of some prominent MCDM methods are given by Mardani *et al.* [21, 22, 23], Kahraman *et al.* [13], Turskis and Zavadskas [35].

The MCDM is successfully used for the solving complex problems in tourism industry, such as the MCDM application to the sustainable urban development of the Naples

port area [3], a hybrid delfi-anp-vikor approach for financing the tourism industry [1], the application of the fuzzy benchmarking approach for the strategic planning of tourism destination [19], creating an MCDM hybrid model for improving the tourism policy implementation [18], developing sustainable tourism using the multicriteria analysis [24], and so on.

The manuscript is organized as follows: Section 1 presents the primary objectives for development the mining tourism; Section 2 shows the potential for development the mining tourism on Stara planina (Old Mountain); Section 3 presents the potential strategies for development the mining tourism on Stara Planina; Section 4 shows the grey relational analysis, whereas in Section 5, a numerical example is presented, only to be followed by the final conclusions.

THE PRIMARY OBJECTIVES FOR DEVELOPMENT THE MINING TOURISM

The primary objective of development the mining tourism is the opening of new and providing support to the existing business entities and accelerating development of entrepreneurship, job creation, redundant workers, increasing the tax base, reconstruction and further use the existing facilities, improving the infrastructure and creation an image of community as the future center for innovation and entrepreneurship [28].

Mining tourism is certainly a real advantage of revitalization of many smaller and larger mining spatial units. The development of tourism in these areas can stop the emigration of young people through creation the basic conditions for general, significantly higher comfort. In such circumstances, young people can find not only economic, but also social and cultural themes in order to continue to live in this environment. Therefore, in countries with a developed tourism offer, there is an increasing focus on development the mining tourism, which today constitutes one of the im-

portant components of not only development of tourism, but also of integrated and sustainable development of the region as a whole [20].

The tourism and mining sectors are interacting, but the mining sector is often considered to be destroying the environment on which tourism is based, although that relationship does not necessarily have to be negative. The mining sector can actively participate in tourism by providing an access to industrial, mining attractions. Mining tourism can cause significant structural changes in the economy and society [4].

Revitalization and transformation of old mines into cultural tourism and museum centers have a tremendous support in Europe, where former mining areas are converted into the new tourist destinations [2]. A good example is the mine of "Idrija" in Slovenia, a former mercury mine, while an even better example is the former coal mine in Labin in Istra, Croatia, which has been transformed into a cultural center, with the already-created project of decorating the "underground city" on 60,000 square meters of space in corridors and abandoned mining areas.

Another good example is the Wieliczka Salt Mine, Kraków, Poland the most unusual salt mine in the world that on the surface has a nothing special view; however, 200 meters below the surface, the place hides a startling secret. The salt mine has become a unique art gallery, with a cathedral and underground lake. Over a million visitors a year come to see this amazing salt mine. For the security reasons, less than one percent of the mine is open for visitors, but its almost 4 kilometers long corridors are more than enough for tourists to spend an hour or two on a tour of these amazing rooms.

The copper mine in Bor, Serbia is yet another good example. There, at the eleventh underground mining horizon, a large space was built, with the capacity of up to 60 people, where tourists are enabled to descend to a depth of 700 meters every 15 days, to take photos or talk with the miners,

whereas on the surface, visitors have an opportunity to take a look at the oldest open pit mine, with the old open pit about 500 meters deep; a safari trail on the old flotation tailing dump with a length of 17 km and width of 10 meters is also under construction.

POTENTIAL OF STARA PLANINA MOUNTAIN POTENTIAL FOR DEVELOPMENT THE MINING TOURISM

According to Nikolić *et al.* [27], the tourist destinations of Stara planina, located in eastern Serbia, on the border with Bulgaria, are an attractive area with great prospects for entering the world tourism scene.

On the slopes of Stara planina, in the east of the village of Kalna, in the belt of beech forests, there is the mine field "Janja". As a part of this ore field, at the end of the nineteen-fifties in the last century, uranium was exploited from the three mines: "Mezdreja", "Gabrovnica" and "Srneći Do", that stopped working in 1966. In the mining field, along with the separation in Kalna, there were more than 800 miners working in three shifts. The miners were mostly locals from the area, who, during active operation, were materially well-situated and the mine field is hinted to be the rebirth of eastern Serbia.

The all mines were with underground exploitation. Within the mine "Mezdreja", there was a plant for ore processing, with the capacity of 60 tons/day, while in the mine "Gabrovnica", there was a plant for ore processing, with the capacity of 200 tons/day. Nikić *et al.* [25], state that the processing plants were the hydrometallurgical ore type, so there was no possibility of air pollution. Tailings from the mines were delayed near the mining pits. At the end of the nineteen-sixties, mining stopped and all of the three mines were closed. At that point, a certain conservation of the mines and the processing plants was executed. The mine field "Janja" covers an area of about

30 km², at an altitude ranging from 500 to 950 m above sea level, and now is covered with forest vegetation. In the wider area of the ore field “Janja”, next to the settlement of Kalna, there are large settlements of the rural type, namely Gabrovnica, Inova, Vrtovac, Janja, Balta Berilovac and Mezdreja, which, in the process of migration, have been largely left with no residents or with a small number of them, mostly elderly households [25].

This area then started to languish and the villages began to die. All of this has been attributed to industrialization because, at that time, the rural population went to the cities in masses, where they earned for their living better. However, a desire to preserve country life and open up the new opportunities for safe existence has caused many to return to the village and found their own businesses there. Thus, many households began to engage in tourism

This mining site has its own characteristics, although there are mining facilities falling into disrepair which can be converted into ethno- and eco-centers, an ecologically healthy environment which European tourists will be happy to visit and stay in, whereas the second part can be organized as an industrial cultural heritage that has to be put under the state protection.

THE STRATEGIES FOR DEVELOPMENT THE MINING TOURISM ON STARA PLANINA MOUNTAIN

Three strategies are proposed for development the mining tourism on Stara Planina Mountain, namely:

- Strategy A₁ - human resource development in the field of mining tourism;
- Strategy A₂ - the use of aggressive marketing, advertising and market approach of mining tourism;
- Strategy A₃ - creation of needed tourism and accompanying infrastructure that will help development of mining tourism.

On the basis of relevant literature and factual situation within the field, the ranking of the mentioned strategies will be carried out in order to select the best among them, with the aim of better positioning mining tourism on the tourist map of Serbia.

Strategy A1 - Human Resource Development in the Field of Mining Tourism

Parallel to development of tourism, the personnel also developed, they who gave their lives, as well as their work orientation, economic and existential interests tied to tourism as a social and economic activity [33]. Tourism is an economic activity largely depending on the human factor because in tourism, people and personnel are highly-integrated with consumers (tourists) [7].

The quality of tourism services largely depends on the quality of engagement, goodwill and training of human resources at all levels. That immediately implies questions about how the importance of human factor, as the bearer and executor of tourist activity in an area, is perceived. A positive attitude towards tourism, above all, shows the degree of social and cultural development the population of an area, which is the basic prerequisite for development of tourism.

Tourism is a labor-intensive industry, which means that, for that economic activity to be performed, it takes a lot of human potential. Modern technical aids mainly contribute to the accelerating certain work processes, technologies change work, but, as a rule, are less effective in reducing the number of employees, particularly in the hospitality industry. The human resources that have already worked or prepared to work in mining tourism are forced to constantly innovate and improve their professional knowledge due to the increasing competition of knowledge and ideas. Personnel must be trained specifically for the reason of being able to establish a direct contact with guests and provide them with comprehensive information [38].

Strategy A2 - The Use of Aggressive Marketing, Advertising and Market Approach of Mining Tourism

This strategy is aimed to establish an efficient marketing system in order for destinations to penetrate into the target markets and market niches, as well as to constantly identify the new sources of competitive advantage and monitor the capacity of loyalty or recommendation to visit the destination.

Tourist propaganda is one of the tourist policy instruments for achieving the certain goals, which means that actions of tourist propaganda must well thought out. Tourist propaganda has an influence on development tendency and a desire for tourist trips [41]. Tourist propaganda should be viewed integrally with the other instruments of tourist or business policies, such as the pricing policy, the policy of development of tourism and so forth [36], and it can be a stimulus for both the public and private sectors aiming at increasing the volume of visitors and rational use of energy and other resources [29].

Strategy A3 - Creation of Needed Tourism and Accompanying Infrastructure that will Help Development of Mining Tourism

The existing facilities caught after leaving the mines, are mostly in poor condition and need to be rebuilt in order to continue work on their development. It is necessary that such an infrastructure that would consist of extra accommodation, sports facilities, new access roads, training camps and places for excursions and active entertainment should be developed [27].

In accordance with the available resources of local community, the desired effect can be produced with minimum investment and minimum tourism demand, such as the opening of the mining museum and reuse the industrial tracks for tourist purposes, can be met.

THE GREY RELATIONAL ANALYSIS

The grey relational analysis (GRA) was developed by Deng [8], as a part of the grey system theory. Since then, it has been widely used to solve many uncertainty problems involving discrete data and incomplete information, optimization problems and multiple criteria decision-making (MCDM) problems, such as the application of the GRA method on the performance evaluation of airlines [9], the application of the GRA for evaluation the financial performance [17], the application of the GRA method for corrosion failure of oil tubes [10], the supplier selection based on the use of the GRA method [40, 12], the application of the GRA method in the high-speed machining of aluminum alloy [16], etc.

The procedure of the GRA method can be shown as follows [32]: Let $A = \{A_1, A_2, \dots, A_m\}$ be a discrete set of alternatives, $C = \{C_1, C_2, \dots, C_n\}$ be a set of criteria and $w = \{w_1, w_2, \dots, w_n\}$ the weighting vector, where $w_j \in [0,1]$ and $\sum_{j=1}^n w_j = 1$. Then, the determination of the most acceptable alternative applying the GRA can be described through the following steps:

Step 1. Determine the ideal solution. The ideal solution (the reference point) is a solution that maximizes the benefit criteria and minimizes the cost criteria, and can be determined by using the following formula:

$$\begin{aligned} A^* &= \{r_1^*, r_2^*, \dots, r_n^*\} = \\ &= \{(\max_i r_{ij} \mid j \in \Omega_{\max}), \\ &(\min_i r_{ij} \mid j \in \Omega_{\min})\}, \end{aligned} \quad (1)$$

where A^* is the ideal solution, r_j^* is the j -th coordinate of the ideal solution, r_{ij} is the normalized rating of the i -th alternative to the j -th criterion, and $\Omega_{\max}$ and $\Omega_{\min}$ are sets of benefit and cost criteria, respectively.

Step 2. Calculate the grey relational coefficient of each alternative from the ideal solution using the following formula:

$$\xi_{ij} = \frac{\min_i \min_j |r_j^* - r_{ij}| + \varsigma \max_i \max_j |r_j^* - r_{ij}|}{|r_j^* - r_{ij}| + \varsigma \max_i \max_j |r_j^* - r_{ij}|}, \quad (2)$$

where ξ_{ij} is the grey relational coefficient of the i -th alternative to the j -th criterion, ς is the distinguish coefficient, and $\varsigma \in [0,1]$.

Step 3. Calculating the grey relational grade of each alternative from the ideal solution using the following formula:

$$G_i = \frac{1}{n} \sum_{j=1}^n w_j \xi_{ij}, \quad (3)$$

where G_i is the grey relational grade of the i -th alternative, and w_j is the weight of the j -th criterion

Step 4. Rank the considered alternatives and select the best one(s) in accordance with G_i . The alternatives with a higher G_i are better ranked, and the alternative with the highest G_i is the most appropriate / preferable one.

A NUMERICAL EXAMPLE

With the goal to briefly demonstrate the proposed approach and show the efficiency and usability of the GRA method, a numerical example will be conducted in this section. Suppose that a decision maker should evaluate the three strategies A_1 , A_2 and A_3 in relation to the five evaluation criteria: C_1 – The implementation of strategy feasibility; C_2 – The speed of implementation; C_3 – Compliance with the strategy of development the tourism and local economic development; C_4 – An economic profit and C_5 – satisfaction of service users.

At the beginning of evaluation, the decision maker evaluates an alternative in relation to the selected criteria. The ratings of the considered alternatives are shown in Table 1.

Table 1 Ratings of the considered strategies

	C_1	C_2	C_3	C_4	C_5
A_1	4	4	3	4	3
A_2	4	3	3	4	2
A_3	2	2	3	4	3

After that, the ideal point is determined using Eq. (1). The Ideal point A^* and distances from alternatives to the Ideal Point are accounted for in Table 2.

Table 2 Ideal Point and distances between the alternatives and ideal point

	C_1	C_2	C_3	C_4	C_5
A^*	4	4	3	4	3
A_1	0	0	0	0	0
A_2	0	1	0	0	1
A_3	2	2	0	0	0

In the next step, using Eq. (2), the grey relational coefficient of each alternative in rela

tion to the ideal point is calculated, as it is shown in Table 3. In this case, ζ is set to 0.5.

Table 3 *The grey relational coefficient of each alternative to the Ideal Point*

	C_1	C_2	C_3	C_4	C_5
A_1	1.00	1.00	1.00	1.00	1.00
A_2	1.00	0.50	1.00	1.00	0.50
A_3	0.33	0.33	1.00	1.00	1.00

Finally, using Eq. (3), the grey relational grade of each alternative is calculated. The grey relational grades, and the

rank order of alternatives, are shown in Table 4. In this case, the same weight $w_j=0.2$ was assigned to all the criteria.

Table 4 *The grey relational grades and the rank order*

	G_i	Rank
A_1	0.20	1
A_2	0.16	2
A_3	0.15	3

The data from Table 4 indicate that the strategy labeled as A_1 has the best ranked alternative. The strategy labeled as A_1 is based on development of human resources in mining tourism.

CONCLUSIONS

At the destination of Stara Planina Mountain, there is an untapped potential of the three former uranium mines, which, once appropriately adapted, may become an interesting tourist attraction for visitors, as well as a new type of tourism - i.e. mining tourism, which is already represented and developed in Europe and the world. This paper has proposed the three mining tourism development strategies, where, on the basis of relevant literature and factual situation on the field, the ranking and selection of development strategy is performed using the GRA method. The purpose of selection a strategy for development the mining tourism is to provide assistance to the employees in

understanding the key elements necessary for efficient business management as well as the possibility of familiarizing themselves with the essential components used in development a business plan, as well as the assessment of profitability of business ventures in mining tourism. This study shows the three potential development strategies of mining tourism on Stara planina (Old Mountain) and also proposes one approach to make a selection of the best of them in accordance with the defined evaluation criteria. In accordance with the conducted numerical example, the development strategy designated as A_1 , which is based on development the human resources in mining tourism, ranks as the best one in terms of evaluation criteria. The study also shows that the abandoned mining areas on Stara planina could be the tourism development possibilities, just like similar examples in the world. The manuscript proposes one effective method that could be used for selection of development strategies.

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