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Table of contents

ARTICLES

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Resort Project Selection by Using Compromise Programming

Introduction

The tourism industry is an important part of every national economy and contributes to local and regional growth and development [Komppula 2014]; [De Vita and Kyaw 2016]. As a landlocked country, Serbia is deprived of the possibility of developing maritime tourism, but still has the resources suitable for developing and improving other types of tourism. In the period 2007–2010, the Serbian Ministry of Trade, Tourism and Telecommunications ordered that masterplans for the development of several tourism destinations involving spas, mountains and routes should be produced. The masterplans have been finished and the planned projects should be realised in the future.

Tourists' requirements have changed over time and have become more demanding, especially where the quality of accommodation and the offered tourism content are concerned. The number and quality of the accommodation facilities in Serbia are not satisfactory and there is sufficient room for its improvement, which has been confirmed by the above-mentioned masterplans. In order to respond to the demand placed by the tourist market, the existing accommodation facilities should be supplemented by new ones that would have supporting facilities in order to satisfy tourists' different tastes.

A decision on the type of the facility that should be constructed and its location is a very delicate issue that requires a detailed analysis. Criteria incorporated into the decision-making process are often mutually conflicting and prioritising only one of them could ultimately lead to neglecting the others, which could produce bad decisions. By applying the Multiple Criteria Decision Making methods (MCDM), the decision-maker can avoid the unilateral decisions that can have a negative impact on future business and revenue.

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MCDM methods are widely used for solving different kinds of business and other real-world problems. Many MCDM methods have been proposed, such as: SAW or WS [Churchman and Ackoff 1954]; [Fishburn 1967], AHP [Saaty 1980], TOPSIS [Hwang and Yoon 1981], PROMETHEE [Brans and Vincke 1985], ELECTRE [Roy 1991], COPRAS [Zavadskas, Kaklauskas and Sarka 1994] and VIKOR [Opricovic 1998]. Also, new MCDM methods have been developed so as to overcome the potential, if any, deficiencies of the older ones, some are: ARAS [Zavadskas and Turskis 2010], MULTIMOORA [Brauers and Zavadskas 2010], SWARA [Keršuliene, Zavadskas and Turskis 2010], WASPAS [Zavadskas et al. 2012], WS PLP [Stanujkic and Zavadskas 2015]. Because many decision-making problems are very delicate and complex, the aforementioned methods are adapted by the incorporation of fuzzy, intuitionistic fuzzy or grey numbers.

In the field of tourism, many MCDM methods are used for different purposes. Zhang et al. (2011) proposed using these methods for the assessment of tourism destination competitiveness, whereas Liu, Tzeng and Lee (2012) used hybrid MCDM models for improving the implementation of tourism policy. Corporate social responsibility and costs in an international tourist hotel could also be evaluated by using an MCDM approach [Tsai et al. 2010]. Zoraghi et al. (2013) proposed the fuzzy MCDM model with objective and subjective weights for the assessment of the service quality in hotel industries. The selection of hotel location is also an interesting topic that occupies the attention of researchers who confirm research studies such as Chang et al. (2015).

In this paper, Compromise Programming (CP) is proposed for the ranking and selection of the appropriate resort projects regarding the type and location for the construction of certain accommodation facilities. The Case Study is focused on the geographical location of Bačka, situated in the western part of Vojvodina in Serbia. The four sites have been envisaged by the plan for the construction of a different type of facility, so by selecting the location the type of such a facility is also selected. In this case, the weights of the criteria have been determined by applying the SWARA method. The paper is organised as follows: first the SWARA method is explained, followed by the explanation of the basis of the CP method; then the case study is demonstrated; and finally, the conclusions are given at the end of the paper.

SWARA Method

Many different procedures can be used for the determination of the weights of criteria, such as: the AHP method [Saaty 1977, 1980], the Entropy method [Shannon 1948], the SWARA method [Keršulienė et al. 2010], and so forth. In this paper, the SWARA method is proposed and presented through the following steps:

***Step* 1**. First, the evaluation criteria should be selected and sorted in descending order, according to the expected significances.

***Step* 2**. In the second step, the respondent should express the relative importance of the criterion *j* in relation to the previous criterion (*j-1*) for each criterion, starting from the second.

***Step* 3**. The determination of the coefficient k_j is performed in the following manner:

$$k_j = \begin{cases} 1 & j = 1 \\ s_j + 1 & j > 1 \end{cases}, \tag{1}$$

where s_j represents the ratio of the comparative importance of the average value.

***Step* 4**. The determination of the recalculated weight q_j is as follows:

$$q_j = \begin{cases} 1 & j = 1 \\ \dfrac{k_j - 1}{k_j} & j > 1 \end{cases}. \tag{2}$$

***Step* 5**. The determination of the relative weights of the criteria by using the following equation.:

$$w_j = \frac{q_j}{\sum_{k=1}^{n} q_k}, \tag{3}$$

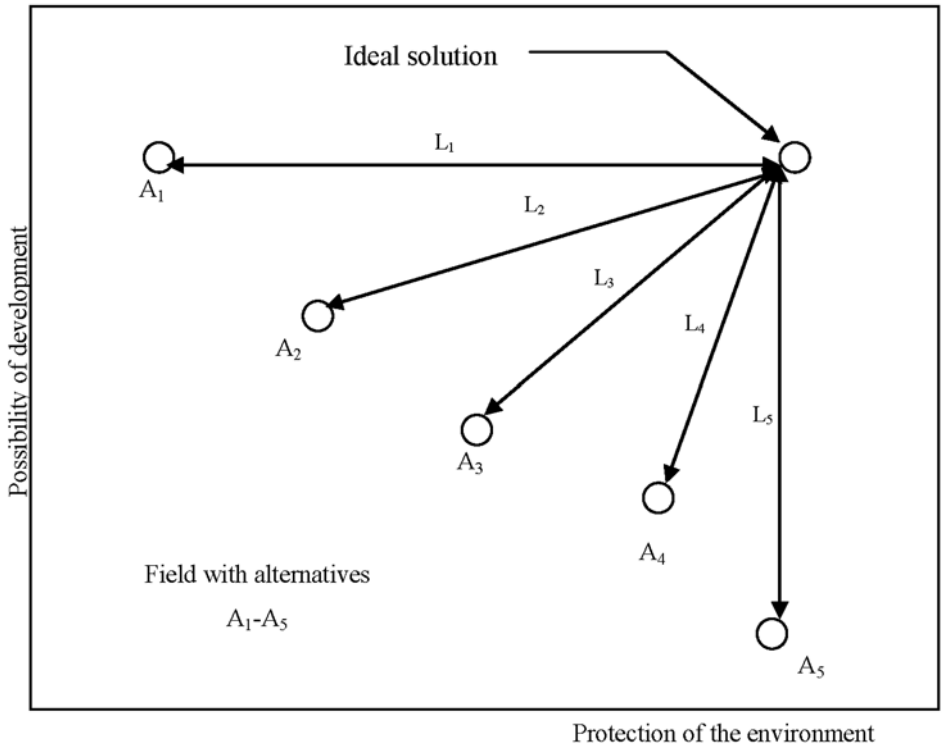
where w_j denotes the relative weights of the criterion *j*.

Compromise Programming

Compromise Programming (CP), the method proposed by Zeleny (1973) and Yu (1973), focuses on the determination of the alternative that has the smallest distance from the reference point (Figure 1).

The CP method has been used in the field of water resource management and papers by the following authors: Abrishamchi et al. (2005), Hajkowicz and Higgins (2008), Fattahi and Fayyaz (2010), and others are mentioned herein as examples. Also, it is used for portfolio selection [Bilbao-Terol et al. 2006]; [Amiri, Ekhtiari, Yazdani 2011], in the area of production planning [Wu and Chang 2004], the planning of dangerous goods transportation [Li and Leung 2011], and so forth.

Figure 1. An illustration of Compromise Programming



Source: [Prodanovic and Simonovic, 2003].

The CP method could be represented by the following equation:

$$\min L_{p,i} = \left\{ \sum_{j=1}^{n} w_j^p \left(\frac{x_j^* - x_{ij}}{x_j^* - x_j^-} \right)^p \right\}^{1/p}, \tag{4}$$

where $L_{p,i}$ denotes the L_p – metrics of the ith alternative for the given parameter p, w_j is the weight of the criterion j, x_j^* and x_j^- are the best and worst performance ratings of the criterion j, x_{ij} is the performance rating of the ith alternative relative to the jth criterion, and i = 1,2,..., m and j = 1,2,..., n. The alternative with the minimal L_p – metrics is the best-ranked and the rankings are performed according to increasing L_p – metrics.

The parameter p in equation (4) is used for the purpose of expressing the importance of the maximal deviation from the reference point. Varying the given parameter from 1 to infinity leads to moving from the minimal sum of individual deviations to the minimisation of the maximal deviation from the reference point in the decision-making process [Prodanovic and Simonovic 2003]. The selection of a certain value of the parameter p depends on the

type of problem and the desired result [Yu 1973]. The parameter p is 1, if compensation between the criteria is allowed. In the case when the marginal value of the objective function is decreasing, p must be bigger than 1. In the case, however, when only the best alternative is important, the parameter p has an infinite value.

The best x_j^* and the worst x_j^- performance ratings of the criterion j are calculated as follows:

$$x_j^* = \left\{ \begin{matrix} \max\limits_i x_{ij}; j \in \Omega_{\max} \\ \min\limits_i x_{ij}; j \in \Omega_{\min} \end{matrix} \right\} \text{, and} \tag{5}$$

$$x_j^- = \left\{ \begin{matrix} \min\limits_i x_{ij}; j \in \Omega_{\max} \\ \max\limits_i x_{ij}; j \in \Omega_{\min} \end{matrix} \right\}, \tag{6}$$

where Ω_{max} and Ω_{min} represent the set of the benefit and cost criteria, respectively.

Case Study

As previously stated, Serbia has a potential for tourism development. This case study is focused on the destination of Bačka, or more precisely the municipalities of Bač, Bački Petrovac and Bačka Palanka. The main advantage of these destinations is reflected in the fact that they are still unknown in Europe and have to develop their tourism image. The resource-base is appropriate for developing the following tourism products: nautical tourism, rural tourism, events and culture, recreation in nature and gastronomy. According to that, the four main resort projects that imply the construction of a different type of the accommodation facility are distinguished, and they are [Horwath HTL 2010]:

- **Karadjordjevo „Lifestyle" Mixed-Use Resort**. A luxury 4- or 5-star hotel and villas located near the villa of Tito, a well-known historical person who was the former president of the Republic of Yugoslavia. This oasis will be designed for tourists of 45+ years of age who can afford to stay there on vacation, for relaxation and recreation. In this case study, the hotel planned to be built is taken into consideration.
- **Urban Riverfront Resort *Tikvara***. A mixture of urban and recreational facilities, an aparthotel and luxury residences, located by the lake, with a beautiful view, intended for tourists of 35+ years of age who can afford it. In the following numerical example, the data for the aparthotel is used.
- **Pannonian Youth Village**. As this site is located near the border crossing, the main idea for this project refers to the development of a tourist

resort that will connect young people from Serbia and foreign countries, an art, culture and educational village intended for young people from 15 to 30 years of age. For the purpose of this work, the data estimated for the bungalows' construction is used.

- **Recreational Resort *Glozan***. Different types of accommodation are planned for this tourism destination, located near the Danube River, an area rich in thermal waters, intended for local and regional tourists who seek recreation, active vacation and relaxation of medium affordability. Bed & breakfast accommodation is taken into account in the numerical example.

The observed resort projects will be compared by using the following criteria:

- the number of accommodation units;
- the number of beds;
- the deadline for project completion (expressed in years);
- investment per accommodation unit (expressed as €/year);
- the average price per stay (expressed as €/day);
- the estimated number of nights (per year).

As previously stated, the weights of the criteria need to be determined in the first place. The weights obtained by equations (1) – (3) are shown in Table 1.

Table 1. The weights of the criteria, determined using the SWARA method

	Criteria	s_j	k_j	q_j	w_j
C_1	investment per accommodation unit (€/year)		1	1	0.26
C_2	average price per stay (€/day)	0.10	1.10	0.91	0.24
C_3	the deadline for project completion (in years)	0.30	1.30	0.70	0.18
C_4	the estimated number of nights (per year)	0.40	1.40	0.50	0.13
C_5	the number of beds	0.30	1.30	0.38	0.10
C_6	the number of accommodation units	0.20	1.20	0.32	0.08
				3.81	1.00

Source: Author's calculations.

Table 2 presents the initial decision-making matrix and the weights of individual criteria.

Table 2. The decision-making matrix

		C_1	C_2	C_3	C_4	C_5	C_6
	w_j	0.26	0.24	0.18	0.13	0.10	0.08
A_1	Karadjordjevo	140,000.00	63.89	7.00	59,130	300.00	150.00
A_2	Tikvara	120,000.00	47.22	5.00	19,710	100.00	50.00
A_3	Panonian resort	34,000.00	22.22	7.00	118,260	750.00	150.00
A_4	Glozan	50,000.00	27.78	5.00	11.826	90.00	45.00

Source: Author's calculations.

The ranking results obtained by using equations (4) – (6) are shown in Table 3.

Table 3. The ranking results

	$L_{p,i}$	Rank	$L_{p,i}$	Rank	$L_{p,i}$	Rank
	$p=1$		$p=2$		$p=\infty$	
A_1	0.5804	2	0.3315	2	0.5804	2
A_2	0.6020	1	0.2893	1	0.6020	1
A_3	0.4200	3	0.3000	4	0.4200	3
A_4	0.5572	4	0.2795	3	0.5572	4

Source: Author's calculations.

According to the results shown in Table 3, the best alternative for investment under the present conditions is the alternative A_2 – Urban Riverfront Resort *Tikvara*, regardless of the variation of the coefficient *p*. This alternative represents the compromise solution that successfully reconciles the differences between the criteria.

Summary

Tourism development represents the impetus of the regional and national economic development of a country. Serbia has good propositions for the improvement of the existing tourism and development of the future tourism offering, which is confirmed in the masterplans that have been prepared for the Ministry of Trade, Tourism and Telecommunications. Many projects for enhancing the development of the tourism industry in different parts of Serbia have been planned for implementation in the future. In this paper, resort projects for developing tourism facilities in Bačka are considered.

Considering the fact that frequently there are a number of projects which could be invested in, the main question is: which project should be the priority? Different criteria are usually involved in the decision-making process and ignoring any of them could lead to making a bad decision. Because of that, the use of the MCDM methods is proposed in this paper. For the ranking and selection of the four resort projects in Bačka, the CP method is applied. The main reason for applying this method is reflected in the fact that the obtained ranking results represent an intermediate solution, i.e. the solution characterised by the smallest distance from the desired condition. As can be seen from the given numerical example, for the present conditions, the best solution is investment in the Urban Riverfront Resort *Tikvara*, whereas the worst alternative is Recreational Resort *Glozan*.

The application of MCDM methods in the decision-making process is entirely justified because that can help find the most appropriate solution. The

final ranking order mainly depends on the weights of criteria. In this paper, the SWARA method is used for that purpose because it is simple and easy to use. The decision-making process, however, gains in importance when a few decision-makers are involved. In that case, the possibility of the subjectivity of results is avoided and the results gained are more reliable. Therefore, the proposed model could be improved by the incorporation of group decision-making.Crisp numbers are used in this paper, so there is a possibility of the incorporation of fuzzy numbers, grey numbers or neutrosophic sets in order to respectfully treat vagueness and uncertainty.

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Wybór projektu ośrodka przy użyciu programowania kompromisowego

Streszczenie

Wybór obiektu noclegowego i jego lokalizacji jest kwestią bardzo delikatną, ponieważ właściwy wybór ma wpływ na przyszłe operacje i przychody. Podjęcie decyzji bez rozważenia każdego możliwego aspektu tego zagadnienia może prowadzić do nieoczekiwanych rezultatów. Stosuje się metodę wielokryterialnego podejmowania decyzji (ang. *multiple criteria decision making*, MCDM), ponieważ logiczne podejście do skutecznego rozwiązywania problemów jest nieefektywne. W niniejszym artykule proponuje się zastosowanie programowania kompromisowego do wyboru optymalnego projektu ośrodka dla inwestycji. Zastosowanie tej metodologii ukazano na przykładzie czterech projektów resortów w Bačce, zachodniej Wojwodinie, w Serbii. Zostały one wybrane na podstawie sześciu kryteriów, których wagi są określane przy użyciu metody SWARA.

Słowa kluczowe: MCDM, inwestycje, rozwój turystyki, Bačka

Resort Project Selection by Using Compromise Programming

Abstract

Serbia is a landlocked country deprived of the possibility of developing maritime tourism. On the other hand, it has the opportunity to develop the other types of tourism, such as: mountain tourism, spa tourism, rural tourism, etc. Serbia has to improve its tourism infrastructure in order to achieve better quality and meet tourists' requirements. In that sense, it is necessary to enhance the number of the accommodation facilities that will meet set standards. The selection of the type of the accommodation facility, as well as its location, is a very delicate issue because the right choice influences future operations and revenue. Making a decision without considering the problem from every available aspect could lead to making the wrong decisions. Multiple Criteria Decision Making methods are imposed as the logical approach to solving problems in an effective manner. In this paper, the ranking and selection of the optimal resort project focused on the tourism development of Bačka and is performed using compromise programming.

Key words: MCDM, investment, tourism development, Bačka

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