

APPLICATION OF ENTROPY BASED TOPSIS IN ANALYSIS OF SUSTAINABILITY PERFORMANCE OF SRI LANKA HOTELS

Aplicação da TOPSIS baseada em entropia na análise do desempenho de sustentabilidade de Sri Lanka Hotels

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ABSTRACT

Sustainability is the limelight of many industries, especially in developing countries. In the hospitality industry, in particular, sustainability plays a pivotal role since it contributes immensely to the economy of a country. However, the hospitality industry is increasingly facing various challenges due to the uncertainty and instability in the business environment. Thus, the central focus of this study is to evaluate the sustainability performance of Sri Lankan hotels industry. For this purpose, 25 hotels were selected from the hotels listed in the Colombo Stock Exchange (CSE). In order to determine the sustainability performance of the selected hotel, we identified 18 indicators that represent the economic, environmental, and social and governance sustainability. Then, we developed a multidimensional sustainability performance index system and using entropy-based TOPSIS, the values of the individual indicators were aggregated. Eventually, we rank the hotels based on the TOPSIS scores, which represent the sustainability performance of hotels. The resulted TOPSIS scores reveal that the Sri Lanka hotels' sustainable performance is moderately high. This indicates that there is a growing tendency to adopt more sustainable practices among hotels companies in Sri Lanka. Recently, stakeholders in the state and private sector have paid much attention to the tourism industry because it has tremendous potential and many prospects, and the same is reflected in our results. While we are providing important implications for managers and policymakers, our findings urge the hotels with a low-level sustainability performance to go for more sustainable practices.

Keywords: Sustainability performance, Hotel industry, Entropy-based TOPSIS, Sri Lanka.

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RESUMO

A sustentabilidade é o centro das atenções de muitas indústrias, especialmente nos países em desenvolvimento. No setor de hospitalidade, em particular, a sustentabilidade desempenha um papel fundamental, pois contribui imensamente para a economia de um país. No entanto, a indústria da hospitalidade enfrenta cada vez mais vários desafios devido à incerteza e instabilidade no ambiente de negócios. Assim, o foco central deste estudo é avaliar o desempenho de sustentabilidade da indústria hoteleira do Sri Lanka. Para o efeito, foram seleccionados 25 hotéis entre os hotéis listados na Bolsa de Valores de Colombo (CSE). Para determinar o desempenho de sustentabilidade do hotel seleccionado, identificamos 18 indicadores que representam a sustentabilidade económica, ambiental e social e de governança. Em seguida, desenvolvemos um sistema de índice de desempenho de sustentabilidade multidimensional e usando o TOPSIS baseado em entropia, os valores dos indicadores individuais foram agregados. Por fim, classificamos os hotéis com base nas pontuações TOPSIS, que representam o desempenho de sustentabilidade dos hotéis. As pontuações TOPSIS resultantes revelam que o desempenho sustentável dos hotéis do Sri Lanka é moderadamente alto. Isso indica que há uma tendência crescente de adoção de práticas mais sustentáveis entre as empresas hoteleiras do Sri Lanka. Recentemente, as partes interessadas no estado e no setor privado têm prestado muita atenção à indústria do turismo porque ela tem um enorme potencial e muitas perspectivas, e o mesmo se reflete em nossos resultados. Embora estejamos fornecendo implicações importantes para gerentes e formuladores de políticas, nossas descobertas incentivam os hotéis com desempenho de sustentabilidade de baixo nível a buscar práticas mais sustentáveis.

Palavras-chave: Desempenho em sustentabilidade, Hotelaria, TOPSIS baseado em entropia, Sri Lanka.

INTRODUCTION

Despite the recent downturn, the tourism industry is the most vibrant and robust sector in the Sri Lankan economy, with the exponential growth in the number of visitors arriving and the burgeoning foreign exchange earnings. A satisfactory political and economic stability maintained in the nation after the end of the tragic war of 30 years in 2009, combined with the increasing reputation of the Island as a popular tourist destination, has caused the growth of the tourism industry at a pace never achieved in history (Jayawardhana, Silva, & Athauda, 2015; Kularatne, Wilson, Månsson, Hoang, & Lee, 2019). Over the past decade, the hotel sector has also shown significant growth as an integral of the tourism industry in terms of infrastructure development and level of sophistication. SLTDA report (2017) shows that the number of Tourist Hotels has increased from 245 in 2008 to 401 in 2017. Similarly, No. of rooms has also been tripled during the last decade. Apart from the tourist hotels, the other supplementary establishments which provide the accommodation facility have also increased from 513 units in 2008 to 1693 units in 2017. However, because of high capital investments and increased competition, corporate hotels are more inclined to make profits than to be more socially responsible. Nevertheless, corporate hotels' obligation goes beyond merely creating profit to take care of their employees, the environment, and the society at large.

At the global level, with the realization of the increasing importance of corporate social responsibility, a growing number of hotels companies have moved towards a value-based stakeholder management approach. Such approach enables the managers to maximize the economic value for all stakeholders- shareholders, employees, creditors, suppliers, customers, and society as a whole- by building a strong coalition of all interest groups surrounding the company (Wagner & Svensson, 2014). Moreover, the natural and socio-cultural environment being an important aspect of the tourist destination, hotels can gain a competitive advantage by displaying their accountability towards the social and environmental impact of their operations. (Assaf, Josiassen, & Cvelbar, 2012; Cvelbar & Dwyer, 2013; Wagner & Svensson, 2014). Therefore, sustainability performance for the hotel industry is increasingly important.

Given the great emphasis on sustainability performance, the main purpose of our study is to empirically analyse the sustainability performance of Sri Lankan corporate hotel sector. For this purpose, listed hotel companies were selected, and the required data was obtained from annual reports and websites. Sustainability performance of each hotel was determined using the author developed a multidimensional evaluation index. Finally, Hotels are ranked based on the sustainable performance score obtained using one of the popular Multi-Criteria Decision-Making approaches (MCDM): Technique for Order Preference by Similarity Ideal Solution (TOPSIS).

1 EVALUATION OF SUSTAINABILITY PERFORMANCE

1.1 Development of sustainability performance evaluation Index

The crucial stage in developing the Sustainable Performance Evaluation Index is to identify appropriate indicators. Since the company's sustainability performance consists of three dimensions, namely Economic, social and governance, and environmental, the indicators should be drawn to cover all the aspects. Following a comprehensive analysis of sustainability literature and experts' opinion, we recognized eighteen indicators, as shown in Table 1. Moreover, these indicators were divided into two groups as positive contributors and negative contributors. Furthermore, the values for the indicators were determined based on the information disclosed in the annual reports and the official web sites of hotel companies.

Table 1 Sustainability performance Evaluation Indicators

Dimension	Indicator	Description	Measurement	Contribution
Economic Sustainability	C1	Five years' Revenue Growth	(Revenue t - Revenuet-5)/ Revenuet-5	Positive
	C2	Market Share	Hotel's Revenue/ Industry Revenue	Positive
	C3	Operational cost to total assets	Cost/ Total Assets	Negative
	C4	Amount of donations and charitable contribution to the total revenue	Donation/ Total Assets	Positive
	C5	Benefits provided to employees out of Income earned	Staff Cost/ Total Assets	Positive
	C6	Number of social initiatives to uplift the living condition of local community		Positive
	C7	Number of Initiatives to promote education, health, culture etc.		Positive
	C8	Number of initiatives to ensure guests' privacy, health & safety, and foods safety	Seven Assessment Levels on a 1 to 7 Scale, where 1 is the lowest and 7 is the highest	Positive
	C9	Analysis of employees based on gender, age, and region and number of initiatives to increase employee welfare (i.e., occupational health, training & education, evaluation, promotion, and recognition & rewards)		Positive
	C10	Number of initiatives taken and discussion of supply chain management		Positive
Social and Governance Sustainability	C11	Awards and certification in recognition of the social contribution of the hotel	1 score for each award and certification	Positive
	C12	Number of committees related to governance	1 score for each committee	Positive
	C13	Number of board of directors' meetings held during the year	1 score for each board meeting	Positive
	C14	Gender diversity in the director board	Ratio of female to male directors	
Environmental Sustainability	C15	Method adopted to reduce energy and water consumption, greenhouse gas emission and initiative to preserve natural resources	Seven Assessment Levels on a 1 to 7 Scale, where 1 is the lowest and 7 is the highest	Positive
	C16	Methods and processes adopted to reuse, recycle effluents and waste.		
Other	C17	Awards and certification in recognition of environmentally friendly operations.	1 score for each award and certification	Positive
	C18	Level of non-compliance to Law and regulation related social, economic and environmental areas	Five Assessment Levels on a 1 to 5 Scale, where 1 is the lowest and 5 is the highest	Negative

1.2 Sustainability performance Score

Use of Multiple Criteria Decision Making (MCDM) methods-for instance, Analytical Hierarchy Process (AHP) Data Envelopment Analysis (DEA) Technique for Order Performance Similarity to Ideal Solution (TOPSIS) is common in the literature on performance assessment. Hsu (2013) used the TOPSIS technique to suggest an investment analysis model based on different financial ratios. Initially, he selected 21 indicators as economic measurement factors and lowered them using dimension reduction methodology to ten most representative factors. Similarly, Deng, Yeh, & Willis (2000), Wang (2009), Seçme et al. (2009) used the TOPSIS technique to assess financial and non-financial performance. Number of other researches also used TOPSIS as an MCDM strategy to evaluate and rank financial and non-financial performance of various industries (Bulgurcu, 2013; Chang, Lin, Lin, & Chiang, 2010; Ertuğrul & Karakaşoğlu, 2009; Kaynak, Altuntas, & Dereli,

2017; Kumar, 2016; Weerathunga, Xiaofan, & Samarathunga, 2019). In light of the previous studies, the sustainability performance of hotels was evaluated using the TOPSIS method developed by (Hwang & Yoon, 1981). This method is used for four reasons. First, the logic behind TOPSIS is rational and easily understandable, second the calculation process is straightforward, third TOPSIS allows us to determine the best alternative based on a number of criteria using a simple mathematical process and fourth each criterion can be weighted based on different rationales.

The application of the TOPSIS method need to determine appropriate weights for each criterion considered in sustainable performance evolution process. For this purpose, Entropy method as proposed by Shannon (1948) was used. Entropy method is one of the most popular methods for determining weights for indicators (Hsu, 2013). Employing entropy method needs to follow certain steps as mention below.

Step 1: Normalization of $m \times n$ evaluating matrix.

$$A = [x_{ij}]_{m \times n} \quad (1)$$

Where,

m = Number of alternatives, $i=1, 2, \dots, m$ n = Number of criteria, $j= 1, 2, \dots, n$

x_{ij} = the performance indicator of i^{th} alternative with respect to j^{th} criteria.

The original matrix $A = (x_{ij})$ should be normalized to the evaluation matrix $R = (r_{ij})$, where r_{ij} is the normalized value of i^{th} alternative with respect to j^{th} criteria, and $r_{ij} \in [0,1]$. The initial values can be normalized using one of two methods (Chang et al., 2010) below depending on the nature of the data.

For the positive value:

$$r_{ij} = \frac{\max_i x_{ij} - x_{ij}}{\max_i x_{ij} - \min_i x_{ij}}, \quad (2)$$

For the negative value:

$$r_{ij} = \frac{x_{ij} - \min_i x_{ij}}{\max_i x_{ij} - \min_i x_{ij}}, \quad (3)$$

Consequently, we have following normalized evaluation matrix

$$R = [r_{ij}]_{m \times n} \quad (4)$$

Step 2: Calculation of weights for each criterion based on entropy.

Weights can be calculated as follows according to (Chang et al., 2010);

- Compute the p_{ij} values using formula (6)

$$p_{ij} = -k \frac{X_{ij}}{\sum_{n=1}^m} p_{ij} \ln p_{ij}, \forall j \quad (5)$$

- computed the d_i value using formula (7)

$$d_i = 1 - E_j, \forall j \quad (6)$$

- Calculated weights (w_j) for each criterion using formula (8). One condition must be satisfied,

$$\sum_{j=1}^n w_j = 1.$$

$$w_j = \frac{d_{ij}}{\sum_{j=1}^n d_{ij}}, \forall j \quad (7)$$

Third, we calculated the TOPSIS score for each alternative (hotels) using entropy weights obtained in the in the previous section. TOPSIS score is representative of the best alternative from a set of finite alternatives. The best alternative is decided based on the closeness to the positive ideal solution and farthest to the negative ideal solution.

Following is the procedure for TOPSIS score calculation:

Step 1: Obtain the original matrix as shown in equation (1).

Step 2: Constrict the normalized matrix $[r_{ij}]_{m \times n}$.

Since each evaluation contain in original does not uniform dimension, normalized using following procedures with Y.-J.Wang (2009) and Y.- J.Wang & Lee (2007).

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{n=1}^m x_{ij}^2}}, \quad (8)$$

Negative contributors are normalized as:

$$r_{ij} = \frac{\frac{1}{x_{ij}}}{\sqrt{\sum_{n=1}^m (\frac{1}{x_{ij}})^2}}, \quad (9)$$

Step 3: The normalized decision matrix $[r_{ij}]_{m \times n}$ is converted to weighted normalized decision matrix as follows.

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$$V = (v_{ij})_{m \times n} = \begin{bmatrix} w_1 r_{11} & w_2 r_{12} & \dots & w_n r_{1n} \\ w_1 r_{21} & w_2 r_{22} & \dots & w_n r_{2n} \\ w_1 r_{31} & w_2 r_{32} & \dots & w_n r_{3n} \\ \vdots & \vdots & \dots & \vdots \\ w_1 r_{m1} & w_2 r_{m3} & \dots & w_n r_{mn} \end{bmatrix} \quad (10)$$

Where, $w_j, j = 1, 2, \dots, n$ is entropy weights for each criteria calculated from equation (8), and $\sum_{j=1}^n w_j = 1$.

Step 4: Determined the positive ideal solution and negative ideal solution by using equation (12) and (13) respectively.

$$A^+ = \{v_1^+, v_2^+, \dots, v_n^+\} = \{(max_i v_{ij} | j \in J), (min_i v_{ij} | j \in J)\} \quad (11)$$

$$A^- = \{v_1^-, v_2^-, \dots, v_n^-\} = \{(max_i v_{ij} | j \in J), (min_i v_{ij} | j \in J)\} \quad (12)$$

Step 5: Calculated distance (separate measures) for each company for each period from positive ideal solution, d_a^+ and negative ideal solution, d_a^- as follows:

$$d_a^+ = \sqrt{\sum_{n=1}^n (v_{ai} - v_i^+)^2}, a = 1, \dots, m, \quad (13)$$

$$d_a^- = \sqrt{\sum_{n=1}^n (v_{ai} - v_i^-)^2}, a = 1, \dots, m, \quad (14)$$

Step 6: Calculated closeness coefficients for each company for each period separately by using following formula.

$$C_i = \frac{d_a^-}{d_a^+ + d_a^-}, a = 1, \dots, m \quad (15)$$

The calculated value of c_i is indicative of multidimensional sustainability performance score for each hotel company in our sample. The higher value of c_i indicative of higher sustainability performance whereas lower value of c_i indicates lower sustainability performance.

2.3 Sample and data

In order to select an appropriate sample of hotels companies for our performance evaluation, the annual reports and the web sites of the all 39 hotels listed under Hotels and Travel sector in the Colombo Stock Exchange at the year-end 31st December 2018 were analyzed. This process allows us to identify 25 hotels that match with evaluation criteria in the study. The rest of the hotels were excluded from the analysis since they have not disclosed sufficient information related to their sustainable performance. The information required for performance analysis were extracted from both web sites and the annual reports published at the end of 2017/2018 financial year.

3 RESULTS

Table 3 presents the sustainability performance scores and the respective ranks for each hotel in our analysis. The performance scores are calculated using TOPSIS method. Two different methods – entropy weights, equal weights- were used to determine the weights for the selected criteria in each dimension of sustainability performance. The process of determining entropy weights are presented in equations (1) to (7). By equations (8) to (15), the TOPSIS scores were obtained.

Table 3 Sustainability Performance Score and Respective Ranks of the Hotels

Entropy Weights			Equal Weights		
Hotel	Score	Rank	Hotel	Score	Rank
Hotel A	0.710	1	Hotel A	0.758	1
Hotel B	0.657	4	Hotel B	0.674	5
Hotel C	0.651	5	Hotel C	0.680	4
Hotel D	0.391	21	Hotel D	0.474	22
Hotel E	0.462	15	Hotel E	0.546	13
Hotel F	0.434	17	Hotel F	0.551	12
Hotel G	0.585	7	Hotel G	0.499	19
Hotel H	0.409	19	Hotel H	0.514	17
Hotel I	0.528	10	Hotel I	0.540	15
Hotel J	0.691	2	Hotel J	0.743	2
Hotel K	0.169	25	Hotel K	0.195	25
Hotel L	0.434	16	Hotel L	0.542	14
Hotel M	0.539	9	Hotel M	0.523	16
Hotel N	0.411	18	Hotel N	0.509	18
Hotel O	0.367	23	Hotel O	0.421	23

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Hotel P	0.515	11	Hotel P	0.622	7
Hotel Q	0.563	8	Hotel Q	0.591	9
Hotel R	0.327	24	Hotel R	0.401	24
Hotel S	0.491	12	Hotel S	0.611	8
Hotel T	0.468	13	Hotel T	0.567	11
Hotel U	0.408	20	Hotel U	0.481	21
Hotel V	0.386	22	Hotel V	0.483	20
Hotel W	0.464	14	Hotel W	0.572	10
Hotel X	0.664	3	Hotel X	0.716	3
Hotel Y	0.621	6	Hotel Y	0.641	6

According to the results presented in Table 3, 11 hotels have TOPSIS score above 0.5 under the entropy weights. When equal weights are used in the weighting process, 18 hotels' scores go beyond 0.5. Both of these results indicate the sustainability performance is in the selected hotel are moderately high. The top three hotels under entropy weights are Hotel A, J, and X having sustainability scores of 0.710, 0.691, and 0.664. The ranking

of these top three hotels is same under the equal weights but with different scores. Practically, these three hotels are the largest hotels in term of size and its operations. They have established the best practices within their companies in order to achieve sustainable development. The analysis of their official websites and annual reports revealed that they have fully adopted the Global Reporting Initiative (GRI) guidelines in disclosing their information to the stakeholders. Moreover, these hotels have been recognized with different awards and certification for their achievements in an effort of sustainable development.

CONCLUSION

The hotel sector as an integral part of the tourism industry is paramount to the economic growth of Sri Lanka. Therefore, the main aim of this study was to analyze the sustainability performance of the hotel sector in Sri Lanka. Our analysis was carried out using the information disclosed by hotel companies in their annual reports and official websites. In order to identify the commitment of hotels towards sustainable development, first, we developed a sustainable performance evaluation index following previous studies and experts' opinion. We identified 18 indicators that could represent the different dimension of sustainable performance such as economic, environmental, and social and governance. Then, each hotels' annual reports of the financial year 2017/18 and websites were analyzed against the developed sustainability index. Following this process, the initial decision matrix was constructed. We use entropy based TOPSIS in determining the sustainability scores for each hotel. The results of the study indicate that the sustainability performance in selected hotels is moderately high. This may be because of the increased attention of different stakeholders of the tourism industry. Moreover, fierce competition in the hotel industry following the recent tourism boom in the country urge the hotel companies to be more vigilant about their operation. As a result, hotels managers have paid more attention to stakeholder-oriented business practices.

The main contribution of this study is the proposed novel approach to determining the sustainability performance of the hotel industry. Moreover, for the best of our knowledge, this is the first attempt to analyze the sustainability of Sri Lankan hotel industry using such a quantitative approach. This research offers significant perspectives for hotel executives, owners, and other hotel sector stakeholders. According to results, certain hotels have a low level of sustainability performance. These hotels should concentrate more on sustainability practices to level up with their peers. Policymakers should encourage hotels through the development of appropriate strategies to adopt sustainable practices.

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