Development of a Web-Based Decision Support System Using VIKOR Method for Optimizing Venue and Vendor Selection in MICE Event Planning

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Abstract. The event industry plays a crucial role in supporting tourism, particularly in Bali. As the need for organizing meetings, incentives, conferences, and exhibitions increases, the MICE (Meetings, Incentives, Conventions, and Exhibitions) industry is also growing rapidly. At the event planning stage, selecting locations and vendors becomes crucial and requires complex coordination. So far, decision-making has been done manually and subjectively, often resulting in less-than-optimal decisions. This study aims to develop a web-based Decision Support System (DSS) utilizing the VIKOR method, which focuses on ranking and selecting the best alternatives from multiple choices based on various conflicting criteria. The system was developed using the System Development Life Cycle (SDLC) approach, in six stages: system engineering, analysis, design, coding, testing, and maintenance. Based on ten assessment criteria, testing was conducted using a case study on MICE event planning in Bali, with five alternative locations and five vendors. The results show that the VIKOR method can produce accurate and transparent rankings with increased selection efficiency compared to conventional methods. This system also provides additional benefits as an interactive learning medium in MICE practice courses at Politeknik Negeri Bali (PNB).

Keywords: MICE, Decision Support System, VIKOR, Event Planning, Venue Selection

1 Introduction

The event and MICE industry is increasingly important in the global economy (Siregar et al., 2024; Silva et al., 2024; Getz, 2024) and is increasing the competitiveness of the tourism industry (Getz, 2024; Yao et al., 2024). In addition to tourism, Bali is often used for national and international events. MICE industry emerged due to the high demand and need to organize meetings, incentives, exhibitions, and conferences. The MICE industry is part of the tourism and hospitality (Bueno et al., 2020). MICE contributes to economic diversification and actively encourages the use of cultural, historical, and natural recreational resources (Aburumman, 2020). The application of Information and Communication Technology (ICT) has become a crucial component

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of the MICE industry. In addition, higher education in the field of MICE is expected to equip graduates with essential management knowledge and ICT operational skills to meet the growing industry demand (Liu et al., 2022). One of the implementations of ICT digitalization and innovation is the use of virtual or hybrid events (Hagen, 2021; Yung et al., 2022). The event planning stage requires complex coordination, especially when selecting the location and vendors for the event. Selecting a location and vendor using a manual system or based on subjective experience results in inappropriate decisions and will impact the quality of the event and client satisfaction. To overcome these problems, it is necessary to implement ICT in the form of a DSS to help determine the location and vendor accurately, based on predetermined assessment criteria, in an event-driven manner. DSS is a system developed using computers in decision-making (Ramadhan et al., 2021) and help companies make more detailed and objective decisions (Cindy & Hasibuan, 2024). One of the DSS methods is the *VlseKriterijumska Optimi-zacija I Kompromisno Resenje* (VIKOR). This method focuses on ranking and selecting from a series of alternatives and conflicting criteria to make informed decisions and reach an outcome (D. Siregar et al., 2018). This approach is suitable for conflicting event location and vendor selection criteria, such as optimizing multiple objectives, including minimum price and maximum facilities. The VIKOR method is a method for determining the ranking of solutions that are closest to the ideal solution. Several studies have implemented the VIKOR method in various fields, such as determining creditworthiness (Syaifuddin et al., 2023), selecting quality family villages (Nasution, 2024), selecting waste banks (Papua et al., 2024), selecting suppliers (Yalçın, 2024; Jafari, 2023; Luo et al., 2023; Baki et al., 2025; Purwanto & Susilawati, 2024), selecting activity locations (Amanda et al., 2023). Based on the problems explained, this study builds a Web-Based DSS to optimize location and vendor selection in MICE event planning using the VIKOR method. With the implementation of the VIKOR method, the resulting decisions are more optimal and transparent. Additionally, this system offers flexibility in adjusting the weight of the criteria according to the specific needs of an event. The DSS developed in this study is designed for industry needs and is focused on supporting MICE practical learning and internships at the Politeknik Negeri Bali (PNB). No previous research has developed a VIKOR-based DSS as a learning aid in MICE event planning for vocational students. This system will provide students with direct experience using technology-based tools in the decision-making process relevant to industrial practices. In addition, the novelty of this study is that no research has specifically developed a web-based DSS with the VIKOR method for optimizing location and vendor selection in MICE event planning.

2 Methodology

The object of this research is MICE event planning, especially the selection of locations and vendors. Data collection in this study was conducted through observation, interviews, and the distribution of questionnaires to the MICE Lab at Politeknik Negeri Bali (PNB) and companies in the MICE sector. The method used is research and development. The application development process utilizes the SDLC method which consists of six stages, including (1) system engineering, (2) analysis, (3) design, (4) coding, (5) testing, and (6) maintenance (Gurung et al., 2020) (Khan et al., 2020).

3 Result and Discussion

3.1 Result

System Engineering. At this stage, information needs related to the MICE event planning process are identified. The information needed includes the venue and event selection process, the criteria used to select the venue and event, and the finalization process for the venue and vendors used in the event. Information is collected through interviews and observations conducted at the MICE Lab of Politeknik Negeri Bali and the MICE organizing company.

Software Requirements Analysis. At this stage, a Web-Based DSS's functional needs are analyzed. Based on the results of observations and interviews with the MICE event organizing company, the functional needs of the system as follows: The Login feature enables users to obtain access rights from the system. The Manage User, Manage Venue, Manage Vendor, Manage Item Category Vendor, Manage Item feature contains features for data manipulation and the SPK feature will calculate the results of the SPK using the VIKOR method. VIKOR is a multi-criteria optimization and compromise solution, one of many MCDM techniques (Ramachandran et al., 2024; Mousavi et al., 2021). With the VIKOR method, multi-criteria decision-making is based on the best solution obtained based on the closest ideal solution (Safrizal et al., 2021), and then ranking is carried out by comparing the distance to the ideal solution. This method is useful in situations where criteria are conflicting, helping to find the optimal solution through a multi-criteria ranking index. Especially in discrete decision-making, VIKOR helps determine the ideal solution from conflicting alternatives (Purwanto & Susilawati, 2024). At this stage, an analysis of the calculation of the selection of MICE event locations and vendors using the VIKOR method is also carried out. The stages of calculating the VIKOR method are as follows:

1. Determining the weight for each criterion
   The criteria used in selecting a venue are rental price and capacity. The criteria used in selecting a vendor are professionalism, average item price, average frequency, and ease of communication. The weight is determined according to the weight of each MICE event organizer. The total weight must produce a value of 1. An example of giving weights can be seen in Table 1.

Table 1. Determination of Criteria Weight

Venue rental price	Professionalism	Total capacity	Average quality	Average item	Price freq	Ease of communication
0.2 cost	0.1 benefit	0.2 benefit	0.1 benefit	0.2 cost	0.1 benefit	0.1 benefit

2. Arrange the criteria and alternatives into a matrix form, as in Table 2.

Table 2. Criteria and Alternative Matrix

Venue rental price	Professi onalism	Total capacity	Average quality	Average item	Price freq	Ease of communication	Venue
300000000	5	3000	5	550000	1	5	Intercontinental Jimbaran
300000000	5	3000	5	420000	1	5	Intercontinental Jimbaran
300000000	5	3000	5	450000	1	1	Intercontinental Jimbaran
300000000	5	3000	5	400000	1	5	Intercontinental Jimbaran
300000000	5	3000	5	500000	1	5	Intercontinental Jimbaran
100000000	5	1000	5	550000	1	5	Westin
100000000	5	1000	5	420000	1	5	Westin
100000000	5	1000	5	450000	1	1	Westin
100000000	5	1000	5	400000	1	5	Westin
100000000	5	1000	5	500000	1	5	Westin
500000000	5	4000	5	550000	1	5	Mulia
500000000	5	4000	5	420000	1	5	Mulia
500000000	5	4000	5	450000	1	1	Mulia
500000000	5	4000	5	400000	1	5	Mulia
500000000	5	4000	5	500000	1	5	Mulia

3. Calculate the positive and negative values as the ideal solution for each criterion. The calculation uses the following formula:

$$fj^{+} = \max (f_{1j},f_{2j},f_{3j}, \dots, f_{mj}) \quad (1)$$

$$fj^{-} = \min (f_{1j},f_{2j},f_{3j}, \dots, f_{mj}) \quad (2)$$

For benefit type criteria

$$fj^{+} = \min (f_{1j},f_{2j},f_{3j}, \dots, f_{mj}) \quad (3)$$

$$fj^{-} = \max (f_{1j},f_{2j},f_{3j}, \dots, f_{mj}) \quad (4)$$

For cost type criteria: fj+ = best/positive criteria element *j*; fj- = worst/negative criteria element ***j*.** The results of calculating positive and negative values can be seen in Table 3.

Table 3. Positive and Negative Values

	Venue rental price	Professionalism	Total capacity	Quality average	Average item	Price freq	Ease of communication
Positive Value F+	100000000	5	4000	5	400000	1	5
Negatifve Value F-	500000000	5	1000	5	550000	1	1

The first row shows the positive values, and the second row shows the negative values of each criterion.

4. Perform matrix normalization using the following formula:

$$\text{Nij} = \frac{(f+ -fij)}{(fj+ -fj-)} \tag{5}$$

Nij = normalized matrix element; fj+ = best/positive criteria element j; fj- = worst/negative criteria element j

Table 4. Matrix Normalization

Venue rental price	Professionalism	Total capacity	Quality average	Average item	Price freq	Ease of communication
0.5	0	0.3333333	0	1	0	0
0.5	0	0.3333333	0	0.133333333	0	0
0.5	0	0.3333333	0	0.333333333	0	1
0.5	0	0.3333333	0	0	0	0
0.5	0	0.3333333	0	0.666666667	0	0
0	0	1	0	1	0	0
0	0	1	0	0.133333333	0	0
0	0	1	0	0.333333333	0	1
0	0	1	0	0	0	0
0	0	1	0	0.666666667	0	0
1	0	0	0	1	0	0
1	0	0	0	0.133333333	0	0
1	0	0	0	0.333333333	0	1
1	0	0	0	0	0	0
1	0	0	0	0.666666667	0	0

Determine the weighted value of the normalized data using the following formula:

$$F_{ij}^* = wj.N_{ij} \tag{6}$$

F_{ij} = Normalized and weighted data value for alternative i on criterion j; wj = Weighted value for criterion j; N_{ij} = Normalized data value for i and j.

Table 5. Weighted value of normalized data

Venue rental price	Professionalism	Total capacity	Quality average	Average item	Price freq	Ease of communication
0.1	0	0.0666667	0	0.2	0	0
0.1	0	0.0666667	0	0.026666667	0	0
0.1	0	0.0666667	0	0.066666667	0	0.1
0.1	0	0.0666667	0	0	0	0
0.1	0	0.0666667	0	0.133333333	0	0

0	0	0.2	0	0.2	0	0
0	0	0.2	0	0.026666667	0	0
0	0	0.2	0	0.066666667	0	0.1
0	0	0.2	0	0	0	0
0	0	0.2	0	0.133333333	0	0
0.2	0	0	0	0.2	0	0
0.2	0	0	0	0.026666667	0	0
0.2	0	0	0	0.066666667	0	0.1
0.2	0	0	0	0	0	0
0.2	0	0	0	0.133333333	0	0

5. Calculate the Utility Measure (S) and Regret Measure (R) values using the following formula:

$$S_i = = \sum_{j=1}^{n} \text{wj} \frac{(fj+ -fij)}{(fj+ -fj-)} \tag{7}$$

S_i is the normalized and weighted Manhattan distance. The result is shown in Table 5. The total column is the Utility Measure Value, and the highest value column is the Regret Measure of the weighted value.

6. Calculate the VIKOR Index Value using the following formula:

$$Q_i = \text{v} \frac{Si- S-}{S+ -S-} + (1\text{-v}) \frac{Ri-R-}{R+ -R-} \tag{8}$$

$$S- = mini(Si);\ S+ = maxi(Si);\ R- = mini(Ri);\ R+ = maxi(Ri) \tag{9}$$

To get the final score (Q). From these numbers, the smaller the number, the more desired. The smallest index value indicates the best alternative. Then, the ranking is made from the best to the worst.

Table 6. Utility Measure (S) and Regret Measure (R) Values

Total	The highest score
0.366666667	0.2
0.193333333	0.1
0.333333333	0.1
0.166666667	0.1
0.3	0.133333333
0.4	0.2
0.226666667	0.2
0.366666667	0.2
0.2	0.2

0.333333333	0.2
0.4	0.2
0.226666667	0.2
0.366666667	0.2
0.2	0.2
0.333333333	0.2

Table 7. VIKOR Index Value and Ranking

Final score (Q)	Rank
0.928571429	11
0.057142857	2
0.357142857	3
0	1
0.452380952	4
1	14
0.628571429	7
0.928571429	11
0.571428571	5
0.857142857	9
1	14
0.628571429	7
0.928571429	11
0.571428571	5
0.857142857	9

System Design. The system design is described using a use case diagram. There are three main actors in the DSS, namely the super admin, staff, and manager. Each actor is connected to the use case to manage users, venues, vendors, vendor item categories, items, and SPK VIKOR, as shown in Figure 1.

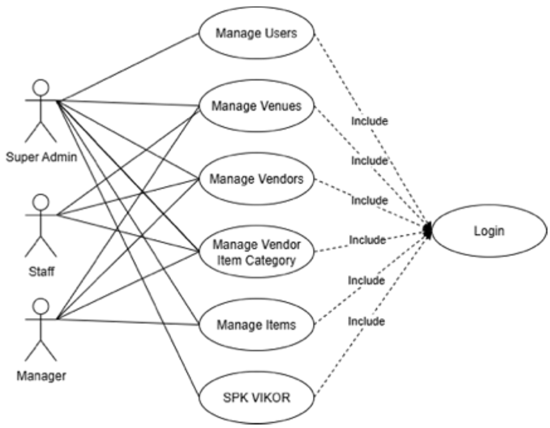

Figure 1. Use Case Diagram

3.2 Discussion

The ranking of the selected venues and vendors is obtained based on the results of manual calculations. Then, the results of the manual calculation are implemented into the DSS, and the results are compared. Based on the testing and comparison results, the manual calculations and DSS results yield the same outcomes, indicating that the system is operating according to the stages of the VIKOR method.

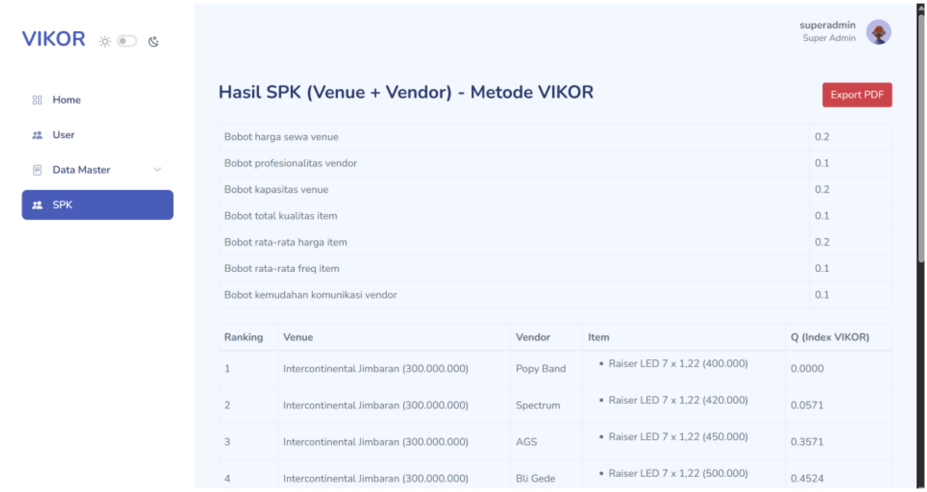

Figure 2. Venue and Vendor SPK Results on DSS (in Indonesian)

Testing. Testing the system functionality using black box testing resulted in all features being usable and running well.

4 Conclusion

This research produces a DSS with the VIKOR method for selecting event venues and vendors. Based on the results of testing and comparing manual calculations of the VIKOR method with the system, it was found that a match already existed, and the system function was running smoothly. The study results indicate that the VIKOR method can produce accurate and transparent rankings with higher selection efficiency than conventional methods. This system provides additional benefits as an interactive learning medium in MICE practice courses at the Politeknik Negeri Bali (PNB).

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