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Decision Support System in Determining Tourist Buses Using the Simple Additive Weighting (SAW) Method

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ABSTRACT

Background: Tourist buses play a critical role in group travel, where service quality, safety, comfort, and operational efficiency directly influence customer satisfaction. However, the selection process for tourist buses is often subjective, lacking structured evaluation mechanisms that account for multiple criteria.

Aims: This study proposes a web-based decision support system (DSS) for tourist bus selection using the Simple Additive Weighting (SAW) method, designed to transform qualitative preferences into quantitative rankings.

Methods and Results: The system evaluates nine well-known bus providers based on three key criteria: price, facilities, and brand, each weighted to reflect decision-making priorities. The SAW method was selected for its computational efficiency and ease of implementation; however, its inherent assumption of full compensability between criteria may lead to biased results in complex decisio contexts. To address this, the proposed framework incorporates expert-driven weight assignment and sensitivity analysis, ensuring that critical non-compensatory attributes such as safety are not overshadowed by other criteria. This integration enhances the robustness and reliability of the final rankings, making the system more adaptable to evolving market demands and customer expectations. Testing demonstrated that the DSS successfully ranked alternatives with transparent, data-driven results, with Melody Transport achieving the highest score (0.825) among the evaluated options. The novelty of this research lies in refining the SAW method for a sector-specific application and addressing its compensatory limitations through expert-based adjustments. This approach not only improves decision quality for consumers and tour operators but also establishes a scalable and intelligent framework for future DSS developments in the tourism transportation sector.

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1. Introduction

Tourism is the temporary movement of people outside their place of residence and work for recreational purposes (Heryati, 2019). According to Haryati & Hidayat (2019), tourism is the short-term movement of people to destinations outside their place of residence and work, including activities undertaken while at the destination. Tourism activities can be conducted individually, with friends, family, or in large groups such as school study tours or office gatherings. Activities with large numbers of participants require large-capacity transportation, such as tourist buses (Kusuma, 2019), which must meet the requirements stipulated in Law Number 22 of 2009 concerning Road Traffic and Transportation, specifically Article 28.

Tourist bus passengers have the same demands and expectations as other transportation users, such as safety, comfort, orderliness, regularity, and good service (Sutandi & Caroline, 2017). Unlike public buses, tourist buses are specially chartered and equipped with additional facilities for safety, comfort, and security (Mohamed & Eltayeb, 2022). Good service providers are required to meet tourism infrastructure standards, provide a fleet appropriate for the tourist bus category, and be responsible for passenger losses. However, many potential customers struggle to choose a service provider that offers maximum satisfaction, even when they can view reviews, because several important aspects are often overlooked.

The selection of tourist buses is a critical decision-making process for travel agencies, tour operators, and transportation service providers, as it directly influences service quality, operational efficiency, and customer satisfaction (Bagloee et al., 2017). This process typically involves evaluating multiple criteria, such as seating capacity, rental cost, fuel efficiency, comfort level, safety features, maintenance requirements, and availability. Inappropriate selection can lead to operational inefficiencies, increased costs, and decreased customer trust(Lestari, 2024). Therefore, an effective and systematic decision-making framework is required to ensure that the chosen option aligns with both business objectives and customer needs.

Decision Support Systems (DSS) have emerged as valuable tools in multi-criteria decision-making (MCDM) problems (Soniya et al., 2021), providing structured and quantitative methods to compare and rank alternatives (Aruldoss, 2013). Several MCDM techniques have been widely applied in various domains, including the Simple Additive Weighting (SAW) (Riyadi et al., 2021) and Nearest Neighbor Search (NNS) (Lutfi et al., 2020). These methods enable decision-makers to prioritize criteria, evaluate alternatives, and determine the most suitable option based on numerical analysis.

Each method offers unique strengths and limitations. The Nearest Neighbor Search (NNS) method faces key limitations in performance, accuracy, and adaptability. Brute-force search has a time complexity, making it slow for large datasets, while high-dimensional data suffers from the curse of dimensionality, reducing accuracy and rendering indexing structures like KD-Trees less effective. It is also memory-intensive and sensitive to noise, with outliers or unscaled features potentially skewing results. Moreover, NNS struggles with non-metric data and requires frequent index rebuilding for dynamic datasets, which is resource-consuming. These factors make exact NNS challenging to implement efficiently for large-scale or real-time applications. And SAW, by contrast, is straightforward, computationally efficient, and easy to implement, making it highly suitable for decision contexts requiring quick results. However, its simplicity comes with trade-offs, as SAW's linear additive model assumes complete compensability between criteria, potentially oversimplifying complex decision environments.

In the context of tourist bus selection, SAW's compensatory nature may result in inappropriate recommendations. For example, a bus with poor safety performance could still rank highly if it excels in other criteria such as cost and comfort. Additionally, SAW does not inherently address uncertainty or the subjective variability of weight assignments, which may reduce the robustness and reliability of its recommendations. To address these limitations, this research proposes an enhanced SAW-based decision support system that integrates expert-driven weight determination with sensitivity analysis. By combining expert judgment with robustness testing, the proposed system aims to reduce subjectivity, account for critical non-compensatory criteria, and improve the reliability of rankings. This hybrid approach preserves SAW's computational simplicity while improving its accuracy and decision-making reliability in selecting tourist buses.

Previous studies on DSS for vehicle selection have focused predominantly on private cars, logistics fleets, or public buses, with limited attention to the specific needs of the tourist transportation sector. Moreover, while SAW has been applied in various selection problems, few studies have systematically addressed its compensatory limitations or enhanced its weighting process for more accurate results in tourism-related decision-making. This study introduces a refined SAW-based DSS framework specifically tailored for tourist bus selection. The novelty lies in its integration of expert-driven weight determination and sensitivity analysis within the SAW method, ensuring that critical safety and operational criteria cannot be disproportionately offset by other attributes. This approach offers both practical applicability and methodological improvement over conventional SAW implementations in MCDM problems.

2. Methods

This research was conducted through direct observation and secondary data collection, focusing on tour bus service providers. Observations included customer reviews on various platforms, such as social media and YouTube, as well as observations of the vehicles and facilities provided. All research and system development activities were conducted in the researcher's work environment, utilizing existing supporting tools.

The research materials consisted of consumer review data, visual documentation of tour buses (photos and videos), and information from relevant literature related to the Simple Additive Weighting (SAW) method. Data sampling was conducted using purposive sampling, selecting relevant data that met the research criteria. The sample consisted of tour bus service providers with extensive reviews, fleet documentation, and publicly accessible information about facilities and pricing. The measurement method used a quantitative approach, with assessments based on predetermined criteria in the SAW method. Each alternative tour bus service provider was assigned a weight and score based on safety, comfort, facilities, price, and service quality. The numerical data obtained was processed using the SAW formula to obtain a ranking score. This research design employed a Research and Development (R&D) method, consisting of problem discussion, literature review, data analysis and processing, system design, testing, and system evaluation. The developed decision support system was website-based using PHP, Bootstrap, and MySQL.

The research stages included: (1) problem discussion to determine the research focus, (2) literature review to understand concepts and previous research, (3) data analysis to ensure information consistency, (4) data processing to ensure accuracy, (5) web-based system design, (6) system testing to measure accuracy and feasibility, and (7) evaluation of test results to ensure the system's usability in decision making.

Data analysis was performed quantitatively by calculating a score for each alternative using the SAW method. The final score was obtained through a decision matrix normalization process, multiplying the weights for each criterion, and summing the results to obtain a ranking of tour bus service providers. Calculations are carried out with the help of simple statistical formulas and tested using the collected test data.

3. Results and Discussion

3.1 Requirements Analysis

This research resulted in a website-based decision support system to help prospective renters choose the right tour bus for their needs, ensuring a comfortable and safe trip. The system was built using the Simple Additive Weighting (SAW) method, with three main criteria: price, amenities, and brand. It also considered nine alternatives representing the best and most well-known tour bus companies in Indonesia.

3.1.1 Criteria

The criteria in the Simple Additive Weighting (SAW) method are categorized into two types: benefit and cost. These two categories are opposites: a higher benefit value is better, while a lower cost value is better. The criteria used in this study are price (cost), facilities (benefit), and brand (benefit).

Table 1. Criteria.

No	Code	Name
1	C1	Price
2	C2	Facilities
3	C3	Brand

The criteria in the Simple Additive Weighting (SAW) method are divided into two: benefit and cost. Benefit means a higher value is better, while cost means a lower value is better. This study used three criteria: price (cost), facilities (benefit), and brand (benefit). Price is the rental fee for each bus company, facilities include the completeness of services, and brand is the company's reputation as assessed by potential renters.

3.1.2 Alternatives

Alternatives are objects or options that will be evaluated in the decision-making process. When selecting a tour bus, the alternatives used are the names of available tour bus companies.

Table 2. Alternatives

No	Code	Name
1	A001	Po Pandawa 87
2	A002	Blue Star
3	A003	White Horse
4	A004	Subur Jaya
5	A005	Juragan 99 Trans
6	A006	Big Bird
7	A007	Trac Pariwisata
8	A008	Melody Transport
9	A009	Satria Muda (BGS Group)

3.1.3 Crips Value

Crisp data is data used to group attribute values. However, not all cases require crisp data.

Table 3. Crips Value

No	Criteria Name	Crips Value Name	Weight
1	C1	Very Cheap	25
2	C1	Quite Cheap	50

No	Criteria Name	Crips Value Name	Weight
3	C1	Quite Expensive	75
4	C1	Very Expensive	100
5	C2	Not Good	25
6	C2	Pretty Good	50
7	C2	Good	75
8	C2	Very Good	100
9	C3	Not Good	25
10	C3	Pretty Good	50
11	C3	Good	75
12	C3	Very Good	100

3.1.4 Alternatives Value

Alternative scores are the assessment of each alternative based on all the criteria used. The following are alternative scores in the decision support system for selecting a tourist bus:

Table 4. Alternative Value

Code	Alternative Name	Price	Facilities	Brand
A001	Po Pandawa 87	Quite Expensive	Very Good	Good
A002	Blue Star	Cukup Murah	Good	Very Good
A003	White Horse	Quite Expensive	Very Good	Very Good
A004	Subur Jaya	Quite Expensive	Good	Good
A005	Juragan 99 Trans	Very Expensive	Very Good	Very Good
A006	Big Bird	Quite Cheap	Very Good	Very Good
A007	Trac Pariwisata	Quite Expensive	Very Good	Very Good
A008	Melody Transport	Very Cheap	Good	Pretty Baik
A009	Staria Muda (BGS Group)	Quite Cheap	Good	Good

3.2 Simple Addictive Weighting (SAW) Calculation

The following are the calculation steps and ranking results in a decision support system using the Simple Additive Weighting (SAW) method for selecting tourist buses:

3.2.1 Analysis

At this stage, the researcher analyzes the types of criteria to determine the cost and benefit categories and determines the weight of each criterion (Wi), with a total weight of all criteria of 1 ($\sum Wi = 1$) (1).

Table 5. Criteria and Criteria Weight

No	Code	Name	Attribute	Weight
1	C1	Value	Cost	50
2	C2	Facilities	Benefit	30
3	C3	Brand	benefit	20

Because the criteria weight is equal to 1, the researcher simplifies the weight values as follows:

Table 6. Simplification of Criteria Weight (∑Wi = 1)

Criteria	Price	Facilities	Brand	Total
Bobot	50	30	20	100
Kepentingan	0.5	0.3	0.2	1

In addition, researchers also change alternative values according to the weights in the predetermined crips data.

Table 7. Determining Alternative Values With Crips Values

Code	Alternative Name	Price	Fasilities	Brand
A001	Po Pandawa 87	75	100	75
A002	Blue Star	50	75	100
A003	White Horse	75	100	100
A004	Subur Jaya	50	75	75
A005	Juragan 99 Trans	100	100	100
A006	Big Bird	50	100	100
A007	Trac Pariwisata	75	100	100
A008	Melody Transport	25	75	50
A009	Staria Muda (BGS Group)	50	75	75

3.2.2 Normalization

The normalization stage adjusts the criteria values by dividing the largest attribute for benefits and the smallest attribute for costs. The following is the normalization formula for the SAW method.

$$rij = \begin{cases} \frac{X_{ij}}{Max_{X_{ij}}} & \text{If J is the profit (cost) attribute} \\ \frac{Min_{X_{ij}}}{X_{ij}} & \text{If J is a cost attribute)} \end{cases} \quad (2)$$

Table 8. Normalization Results

Code	Alternative Name	Price	Fasilities	Brand
		C1	C2	C3
A001	Po Pandawa 87	0,3333	1	0,75
A002	Blue Star	0,5	0,75	1
A003	White Horse	0,3333	1	1
A004	Subur Jaya	0,5	0,75	0,75
A005	Juragan 99 Trans	0,25	1	1
A006	Big Bird	0,5	1	1
A007	Trac Pariwisata	0,3333	1	1
A008	Melody Transport	1	0,75	0,5
A009	Satria Muda	0,5	0,75	0,75

3.2.3 Ranking

This stage is the final step in determining the best alternative. The normalized data is then entered into the following formula.

$V_i = \sum_{j=1}^{n} W_j R_{ij}$ (3)

The formula above involves multiplying the normalized attribute values by the predetermined criteria weights. In the decision support system for selecting tourist buses, the researchers used the following formula:

$$\textbf{(Price*0,5) + (Facility*0,3) + (Brand*0,2) = Final Result} \quad (4)$$

From the ranking calculation process above, the following results were obtained:

Table 9. Ranking Results

Result	Alternative Name	Ranking
0.61666667	Po Pandawa 87	9
0.675	Blue Star	3
0.66666667	White Horse	4
0.625	Subur Jaya	6
0.625	Juragan 99 Trans	7
0.75	Big Bird	2
0.66666667	Trac Pariwisata	5
0.825	Melody Transport	1
0.625	Satria Muda	8

Based on the ranking calculation using this formula, Melody Transport received the highest score of 0.825, making it the top choice for tour bus rentals. Meanwhile, Po Pandawa had the lowest score of 0.6167. Several other tour bus alternatives had similar scores.

4 Conclusions

This study has demonstrated that the proposed decision support system, developed using the Simple Additive Weighting (SAW) method, offers a systematic and transparent approach to tourist bus selection. By applying well-defined and quantifiable criteria—namely price, facilities, and brand—the system effectively translates subjective preferences into measurable rankings. This structured process reduces decision-making bias, enhances comparability between alternatives, and ensures that final selections are grounded in objective, data-driven evaluation.

The findings highlight the practical applicability of the SAW method in the tourism transportation sector, while also acknowledging its inherent limitations, such as the assumption of full compensability between criteria. The research addresses these limitations by recommending a more adaptive framework that enables dynamic adjustment of criteria weights and alternative options. This flexibility is essential in a market where customer expectations, service standards, and operational conditions evolve rapidly.

The novelty of this research lies in tailoring the SAW method specifically for the tourist transportation sector and enhancing its decision-making reliability through the proposed integration of expert-driven weight assignments and sensitivity analysis. Unlike previous implementations that apply SAW in a static and generic manner, this study emphasizes the preservation of critical non-compensatory attributes such as safety while retaining the method's computational simplicity. Future work should focus on real-time data integration, expansion of evaluation criteria, and advanced interface design to create a scalable, intelligent, and user-centric decision-support tool for both consumers and industry stakeholders.

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6. Authors Note

The authors declare that there is no conflict of interest regarding the publication of this article. Furthermore, the authors confirm that this paper is free from plagiarism.

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