Research Article

Decision Support System for Selecting a Bus Company Using the SMART Method: A Case Study at Nuansa Utama Tour and Travel

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Abstract: The rapid development of bus transportation has a significant impact on the selection of bus companies, especially travel services. Nuansa Utama Tour, a travel service agency, still uses conventional methods in selecting a Bus Company, requiring more time and process. Each Bus Company has its characteristics, so it requires a decision-weighing method that is easy to understand. This research aims to build a system that helps travel owners choose Bus Company recommendations according to the conditions and criteria needed. This system uses the Simple Multi-Attribute Rating Technique (SMART) method to determine the best Bus Company based on various criteria needed. The system development process uses the waterfall method to facilitate systematic design with the simplest possible design and the data used is taken from case study needs through the interview process so that as a result of this system, travel owners get the most Bus Company recommendations according to their needs and the best ranking, and facilitate decision making with a more flexible time before use.

Keywords: Bus Transportation; Bus Company; Travel Service Agency; SMART Method; Decision Support System

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1. Introduction

According to [1] In tourism etymology "Travel comes from Sanskrit with the meaning of travel, which is currently developing with the motivation of a "Recreational" nature, namely with vacation purposes. The rapid development of the world of bus transportation today has a significant impact on the aspect of choosing a bus company in travel services. Nuansa Utama Tour is a service or service bureau that provides tour planning, including ticketing, accommodation, and travel document management. The system for selecting the Bus Company to be used is still conventional, where travel owners still make selections by coming directly to the Bus Company garage to make comparisons before use, this is on the positive side providing clear monitoring by directly seeing the condition of the bus to be used, on the negative side it also makes travel owners have to set aside more time to come directly to the garage location which is not certain that the desired bus is following the needs to be used.

The Bus Company certainly has characteristics in each fleet they use, both in terms of fleet facilities, the quality of the Bus Company, and so on [2]. The differences in each Bus Company require a method that will be easy to understand for decision-makers so that the future selection process is used following the desired provisions or needs [3] in the service or service bureau.

Decision Support System (DSS) is an information system used to assist decision-making using data, mathematical models, and certain analytical techniques [4]. The purpose of a decision support system is to help make more informed and effective decisions by providing relevant and reliable information [5]. Many methods can be used such as the MOORA method where this method according to [6] has a form of system model that can provide the best decision results based on predetermined criteria and weights, there is also the TOPSIS method where this method according to [7] has advantages in terms of ranking, because in determining alternative preferences based on positive ideal solutions and negative ideal solutions. And also the SMART method where this method is based on the theory that each alternative consists of several criteria that have values and each criterion has a weight that describes how important it is compared to other criteria [8].

Moreover, from the problems, researchers get the idea of thinking with the aim of building and developing a system aimed at travel owners to make it easier to choose recommendations for Bus Company according to the desired conditions and criteria before use. In this case, the system to be built and developed is a system that can provide decision support for selecting the best Bus Company according to the needs of travel criteria by applying the Simple Multi-Attribute Rating Technique (SMART) method because it has criteria or sub-criteria that have their respective weights in determining how important these criteria are used. The SMART method is suitable for application in the selection of a Bus Company because in the case study of selecting a Bus Company, there are many alternatives and different criteria/sub-criteria in each Bus Company such as Vehicle Type, Rental Fee, Bus facilities, and safety factors in the Otobus Company. Each alternative can be calculated and ranked based on the final value, so that the priority recommendation of the Bus Company is obtained according to the needs [9] of the travel and then used as decision support to be used for Nuansa Utama travel.

The Bus Company Selection Decision Support System using the SMART method is designed using the PHP programming language, with the help of the CodeIgniter and bootstrap frameworks and MySQL as a database manager. This decision support system is designed only to provide recommendations to users in this case, namely the main nuances of tour travel according to the needs used by the travel party in the system cannot be ordered because the system will only perform calculations to get the best value from the preferences used by users, where the alternative data used is taken from several methods, both interviews, literature studies and from the official internet of the bus company. So that if later used by users the data presented follows the attributes of the bus company.

2. Theory

Contains theoretical studies that support this research. The theory comes from books and or articles in accredited journals and international journals or from proceedings. According to Herry Gunawan in [10] in a book entitled Introduction to Transportation and Logistics. Bus Company is a term or designation of a company engaged in the automotive field, especially buses, both large and small buses. This public vehicle transportation has been the favorite choice of many people since long ago until now there are various Bus Companies in Indonesia that are even 50 years old. So it's no wonder that bus companies are competing to prove who is the best on the streets [11].

2.1 Design of Decision Support System

Decision Support System (DSS) was first revealed in the early 1970s by Michael S. Scott Morton [12] with the term Management Decision System. according to (Wyatt & Taylor, 2008 in [13] Decision Support System (DSS) also called Decision Support System (DSS) is an approach model using an easy data interface and combining thinking in making decisions. In making decisions, DSS uses several models and in its development has an interactive process accompanied by a knowledge component to enter it. In

determining decision making DSS has characteristics, the characteristics are described in Figure 1.

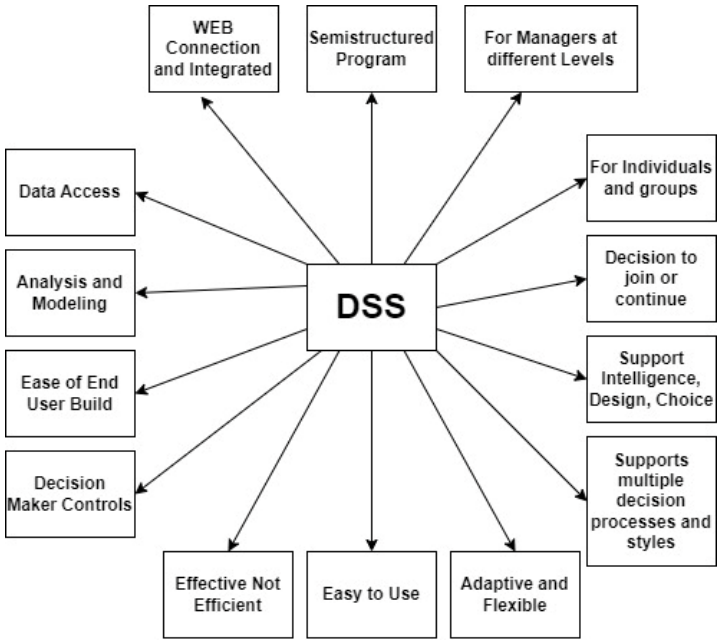

Figure 1. DSS Characteristics

From the explanation of the definition above, it can be concluded that the decision support system is in principle a tool to provide choice options for users in the process of making decisions on an object of interest. The decision is not fully done by the system, the system will only calculate based on the data then the system will display the priority of the decision to the user, and then the user will determine whether to make a decision or not on that matter [14].

2.2 Simple Multi-Attribute Rating Technique Method

According to [15] in a journal entitled "Study of the Simple Multi-Attribute Rating Technique For Decision Support", Simple Multi-Attribute Rating Technique (SMART) is a method developed by Edward in 1977 and is a decision support method with many attributes. In making multi-attribute decisions this technique is used for decision makers in selecting several alternatives, each alternative has criteria and each criterion has a value. Alternatives must be selected by each decision-maker following the objectives set [16]. The steps in applying the SMART method are as follows:

1. Define attributes or criteria
2. Weighting each criterion using an interval of 1-100 with the most important priority
3. Calculate the normalization of each criterion by comparing the weights with the normalization formula equation 1.

$$nw_j = \frac{w_j}{\sum_{j=1}^{k} w_n} \quad (1)$$

4. Determine the utility value of each sub-criteria using equations 2 and 3, the utility value can also be directly determined based on priority. The equation formula for finding the utility value, Criteria that are "smaller is better" or also called Cost Criteria, using equation 2.

$$u_i(a_1) = \frac{(c_{max} - c_{out})}{(c_{max} - c_{min})} \quad (2)$$

Description, $u_i(a_1)$ is the utility value of the i-th criterion for the i-th alternative, C_{max} is the maximum criterion value, C_{min} is the minimum criterion value, C_{out} is the i-th criterion. Moreover, criteria that are "bigger is better" or also called Benefit Criteria, using equation 3.

$$u_i(a_1) = \frac{(c_{out} - c_{max})}{(c_{max} - c_{min})} \quad (3)$$

5. Calculating the final value for each criterion and sub-criteria with equation 4.

$$SMART = \sum_{j=1}^{k} w_j u_i(a_i) \quad (4)$$

The SMART method calculates the final value of each data then ranked or sorted. The results obtained from the calculation of the SMART method are ranking the highest weight value to the lowest weight value, which then the highest weight value is the result needed for decision-makers [18].

2.3 Programming Language

The programming language used in the Bus Company selection decision support system using the SMART method uses several programming languages and the help of several frameworks including:

1. PHP
   Hypertext Preprocessor or PHP is a programming language designed as a media programming language that is designed as a medium for web development. web development. PHP is processed on a computer server or can be called a server-side programming language. server-side programming language. This is not the same as another programming language because other programs can be accessed publicly [19].

2. Codeigniter
   CI (Codeigniter) is a PHP-based framework that organizes files into three groups, namely models which are groups of files that manage database configurations, views which are groups of files that manage views, and controllers which are files that connect model files with view files. The implementation of the Codeigniter Framework can help speed up developers in developing PHP-based web applications compared to writing all program code from scratch [20].

3. Bootstraps
   Bootstrap web technology is a framework for building responsive web designs. This means that the web display created with the Bootstrap framework will adjust the screen size of the browser that will be used either on a desktop, tablet, or mobile device. This feature can be activated or deactivated according to your wishes, so you can create a web for desktop display only, and when rendered by a mobile browser, the appearance of the web created cannot adapt to the screen. With Bootstrap, web developers can save time in designing application displays [21].

4. MySQL
   MySQL is an implementation of a relational database management system (RDBMS) that is distributed free of charge under the GPL (General Public License) license. Any user can freely use MySQL, but with the limitation that the software cannot be made into commercial derivative products [22].

3. Method

The research was conducted at Zyan Residence Housing, Mojosari, Mojokerto East Java. The research time was conducted for 5 months, starting from September 2023 to January 2024. The research stages are contained in the following flowchart, This type of data is collected through observation methods, one-on-one interviews, conducting focus groups, and other methods about similar [23]. where the research process uses several processes such as conducting interviews with sources, as well as observations to direct events. The system development method used is waterfall because this method is suitable for use. After all, it has generally been widely used on a small scale [24]. There are five stages in the waterfall model including Requirements Analysis, System Design, Implementation and Testing, Integration and Approval, Operation and Handling. So that the result will provide the right recommendations according to user needs [25].

3.1 Needs Analysis

Is a stage where the process of collecting data and information that will be used as a means of support and support in making the Bus Company Selection Decision Support System at Nuansa Utama Tour Travel [26]. In analyzing needs based on the formulation of problems in the background that will be carried out. Until later it will provide solutions to solve problems in the case study. In this context, the necessary needs such as place and time of research to the data collection process, before being processed to the next stage. Obtained criteria data where the criteria are used conditionally depending on travel needs according to consumer demand when the criteria are used it will be worth 20% and if not it will be worth 10% in the following Table 1.

Table 1. Criteria Data

No	Namap
1	Bus Types
2	Toilets
3	Smoke Area
4	Chair Styles
5	Capacity
6	Speed
7	Release Year
8	Number of Bus

3.2 System Development

The results of the analysis of the previous stages are the basis for system design. Technically, the system design is carried out in a structured manner by making such as: (1) Use Case Diagram, (2) Activity Diagram, (3) Sequence Diagram, (4) Class Diagram, and (5) UI Design. This design stage is a reference in the coding process carried out at the next stage, namely system implementation [27].

3.3 Implementation & Testing

The system implementation stage is the coding process of the system design that has been done before. The implementation of this system will later build a website-based decision support system using the PHP programming language assisted with the help of the CodeIgniter and bootstrap frameworks and using MySQL as the database. Until later it will proceed to the integration stage [28].

3.4 Integration & Testing

The integration stage is the process of uniting all parts of the system as a whole that has been developed. This will then be carried out through a testing process to ensure that all parts made have worked properly and follow the planned expression. Then next in the last stage [29].

3.5 Operation & Handling

The operation stage is intended for when all systems during the integration stage have been completed, they are submitted to the resource person for use or utilization, and if during the use stage, the user experiences problems, the process of handling the repair of the part that is experiencing problems will be carried out to develop a more perfect system [30]. So that this decision support system can provide the best recommendations according to the needs of the case study (Nuansa Utama Tour Travel) to facilitate the process before choosing a Bus Company.

4. Result and Analyzes

4.1 System Calculation Results

The calculation process of this decision support system plays an important role in providing and processing data to make the best recommendations according to user needs and in calculating this smart method using 5 stages with details of the calculation results as follows.

1. Determine the criteria where the criteria have been predetermined together with the sources in Table 1. Criteria Data
2. Weighting is carried out on the criteria as previously explained if the criteria are used it will get a 20% weight and if not it will get a 10% weight.
3. After that, normalize the weight of the criteria using the formula equation (1), so that the results are obtained in Table 2.

Table 2. Normalization Result

Use			Not in use		
No	**Criteria**	**Weight**	**No**	**Criteria**	**Weight**
1	C1	0,2	1	C1	0,1
2	C2	0,2	2	C2	0,1
3	C3	0,2	3	C3	0,1
4	C4	0,2	4	C4	0,1
5	C5	0,2	5	C5	0,1
6	C6	0,2	6	C6	0,1
7	C7	0,2	7	C7	0,1
8	C8	0,2	8	C8	0,1
9	C9	0,2	9	C9	0,1

In this context, users input 2 different respondent requirements as listed in Tables 3 and 4.

Table 3. Response A

No	Questionnaire	Weight	Response
1	latest version	0,2	Yes
2	toilet	0,2	Yes
3	smoking	0,1	No
4	style	0,2	Yes
5	capacity	0,2	Yes
6	speed	0,1	No
7	year of release	0,1	No
8	amount	0,2	Yes
9	Price	0,1	No

Table 4. Response B

No	Questionnaire	Weight	Response
1	latest version	0,2	Yes
2	toilet	0,2	Yes
3	smoking	0,2	Yes
4	style	0,2	Yes
5	capacity	0,2	Yes
6	speed	0,1	No
7	year of release	0,2	Yes
8	amount	0,2	Yes
9	Price	0,1	No

4. After that, the utility value of alternative data is calculated using formulations (2) and (3) so that the utility value is obtained in Table 5.

Table 5. Utility Value

Namap	C1	C2	C3	C4	C5	C6	C7	C8	C9
27Trans	1	0	1	0,5	0	0	1	1	0,5
27Trans	0	1	1	0,5	0	0	1	1	0,5
Pandawa87	1	1	1	1	0	1	0	1	1
Pandawa87	0	0	1	0,5	0	0	1	1	0,5
Pandawa87	0	0	0	0	1	0	0,5	0	0
Pandawa87	1	0	1	0,5	0	0	1	1	0,5
Pandawa87	0	1	1	0,5	0	0	0,5	1	0,5
Juragan99	1	0	1	0,5	0	0	1	1	0,5
Juragan99	0	1	1	0,5	0	0	1	1	0,5

5. Until the last stage, calculate the final score using equation (4) so that the final score and total are obtained as follows in Tables 6 and 7.

Table 6. Final Score A response

Namap	C1	C2	C3	C4	C5	C6	C7	C8	C9
27Trans	0,1	0,2	0	0,2	0,2	0	0,2	0,5	1,4
27Trans	0,1	0	0,1	0,2	0,2	0	0,2	0,5	1,3
Pandawa87	0,2	0,2	0,1	0,2	0,2	0,1	0	1	2
Pandawa87	0,1	0	0	0,2	0,2	0	0,2	0,5	1,2
Pandawa87	0	0	0	0	0	0	0,1	0	0,1
Pandawa87	0,1	0,2	0	0,2	0,2	0	0,2	0,5	1,4
Pandawa87	0,1	0	0,1	0,2	0,2	0	0,1	0,5	1,2
Juragan99	0,1	0,2	0	0,2	0,2	0	0,2	0,5	1,4
Juragan99	0,1	0	0,1	0,2	0,2	0	0,2	0,5	1,3

Table 7. Final Score B response

Namap	C1	C2	C3	C4	C5	C6	C7	C8	C9
27Trans	0,1	0,2	0	0,2	0,2	0	0,2	0,05	0,95
27Trans	0,1	0	0,2	0,2	0,2	0	0,2	0,05	0,95
Pandawa87	0,2	0,2	0,2	0,2	0,2	0,2	0	0,1	1,3
Pandawa87	0,1	0	0	0,2	0,2	0	0,2	0,05	0,75
Pandawa87	0	0	0	0	0	0	0,1	0	0,1
Pandawa87	0,1	0,2	0	0,2	0,2	0	0,2	0,05	0,95
Pandawa87	0,1	0	0,2	0,2	0,2	0	0,1	0,05	0,85
Juragan99	0,1	0,2	0	0,2	0,2	0	0,2	0,05	0,95
Juragan99	0,1	0	0,2	0,2	0,2	0	0,2	0,05	0,95

Finally, only then can ranking data be generated, namely with the information that the highest value is the best in the calculation process according to the needs inputted by users in the system. And generated in the following Table 8.

Table 8. Final Ranking of Responses A and B

Respon A			Respon B		
Namap	**Total**	**Rank**	**Namap**	**Total**	**Rank**
27Trans	1,4	2	27Trans	0,95	2
27Trans	1,3	5	27Trans	0,95	2
Pandawa87	2	1	Pandawa87	1,3	1
Pandawa87	1,2	8	Pandawa87	0,75	8
Pandawa87	0,1	10	Pandawa87	0,1	10
Pandawa87	1,4	2	Pandawa87	0,95	2
Pandawa87	1,2	7	Pandawa87	0,85	7
Juragan99	1,4	2	Juragan99	0,95	2
Juragan99	1,3	5	Juragan99	0,95	2
MawarJaya	0,5	9	MawarJaya	0,5	9

The results of the calculation process in questionnaire A, the third alternative data from the Pandawa87 bus company is the most suitable for use as needed, and in questionnaire B, the third alternative data from the Pandawa87 bus company is the most suitable for use as needed, where in the Pandawa 87 bus company has bus specifications that match the needs of the main nuances of tour travel.

4.2 Discussion

The following is a design of a decision support system for selecting Bus Company buses using the SMART method at Nuansa Utama Tour Travel. Figure 2 is a use case diagram using the website-based Bus Company selection decision support system application. 2 actors can interact with the application, namely the user as registering, logging in, seeing a list of companies, searching for recommendations by comparing or questioning, viewing history, and logging out. The admin can log in, view alternative data (add, edit, delete, preview), view criteria data (add, edit, delete), view question data (edit, add, delete), view user data (edit, add, delete) and log-out, as shown in Figure 2 use case diagram.

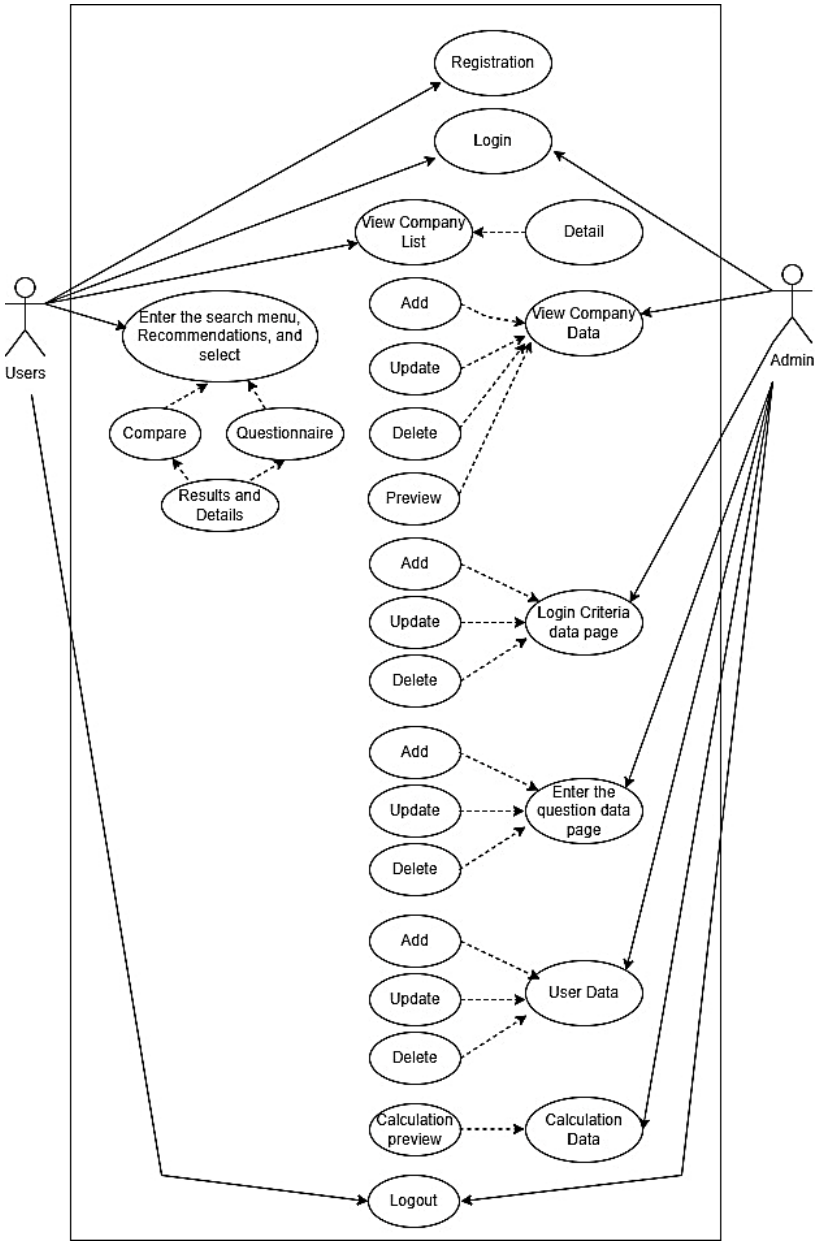

Figure 2. Use Case Diagram

At this stage will display a summary of the results of the views that exist in the decision support system for selecting bus companies for users and admins.

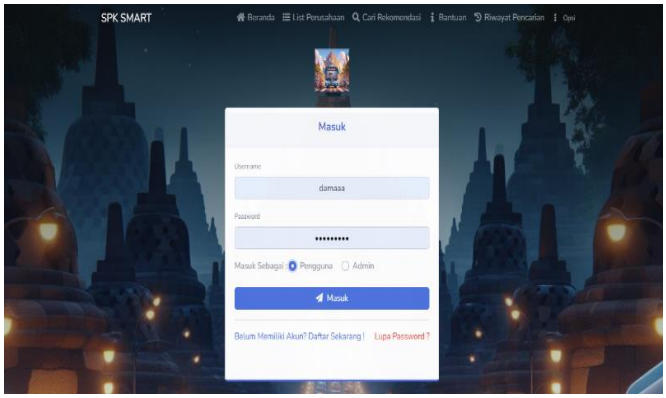

Figure 3. Login View

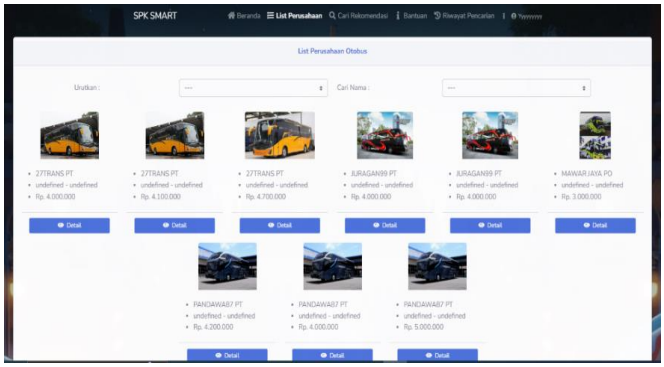

Figure 4. List View

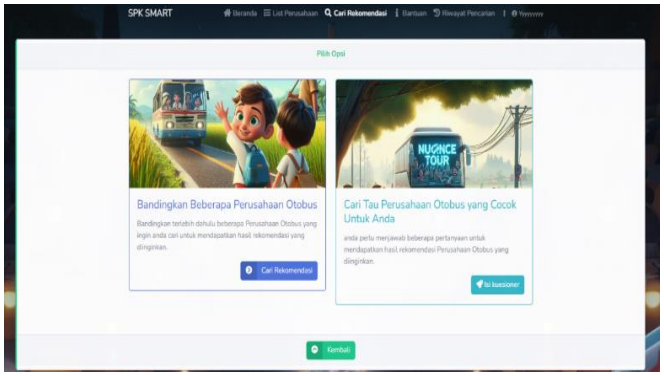

Figure 5. Recommendation View

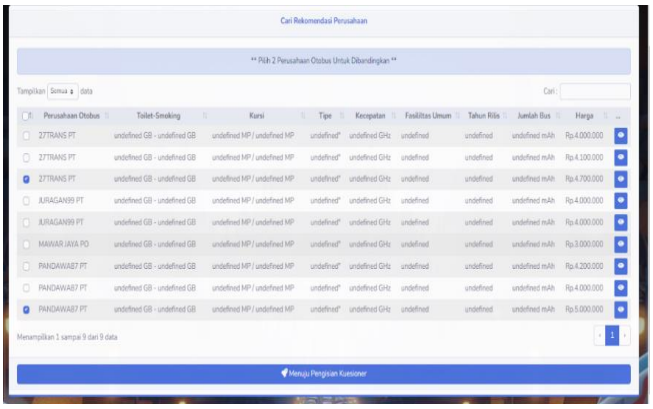

Figure 6. Full data list

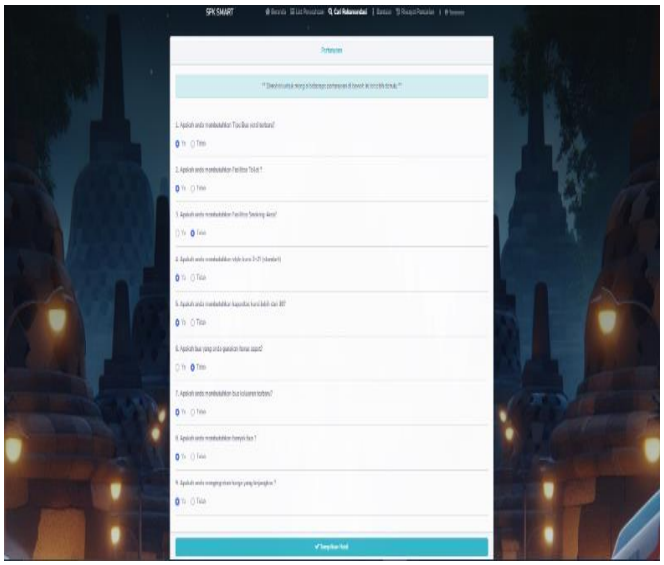

Figure 7. Questionnaire Display

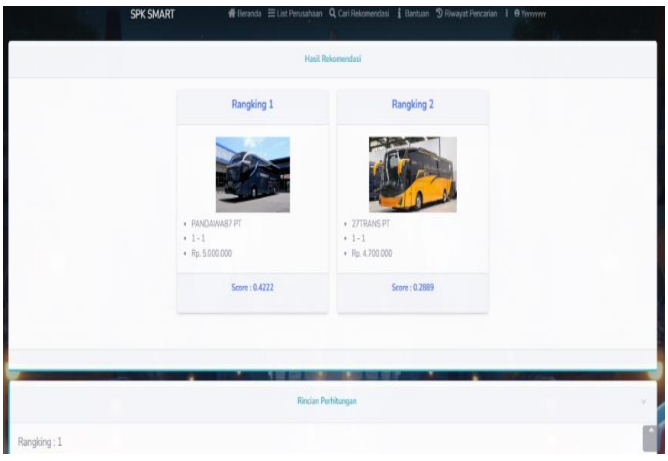

Figure 8. Recommendation View

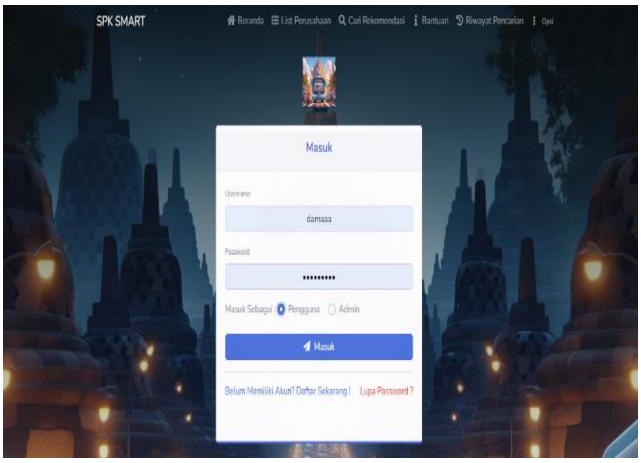

Figure 9. Login View

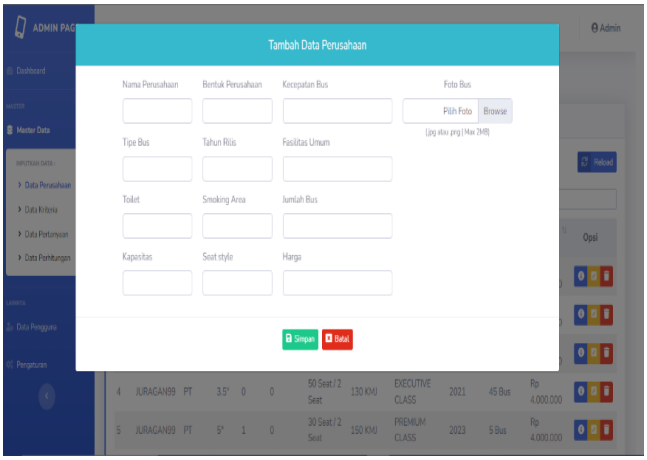

Figure 10. Add Data Display

On the user page, users can register or login (Figure 3) and use the main feature, namely search for recommendations (Figure 5) where users can use 2 options, namely compare (Figure 6) or questionnaire (Figure 7) in determining options to be executed before being selected. After that, the system will work to perform calculations to produce recommendations that best suit the needs that will be used in inputting the previous questionnaire on the system as shown in Figure (8) according to the best calculation score. Where pandawa87 is the highest according to the needs of the travel party.

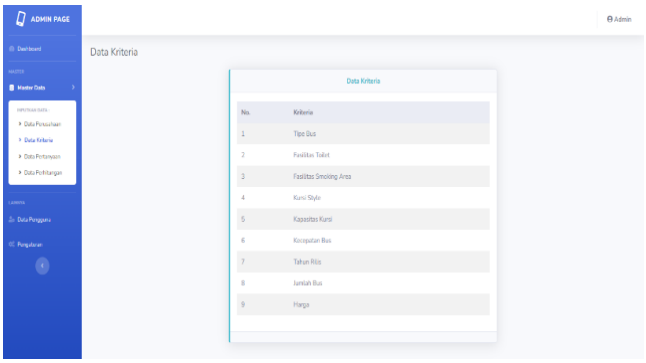

Figure 11. Criteria Data

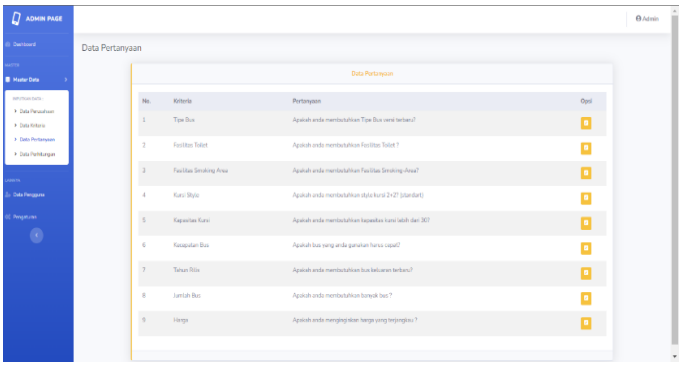

Figure 12. Question Data

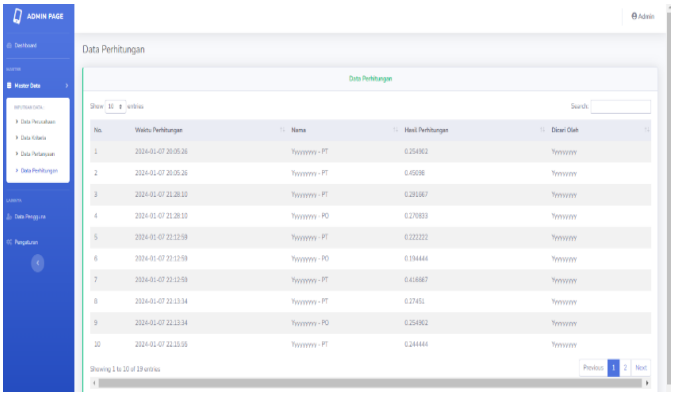

Figure 13. Usage History Data

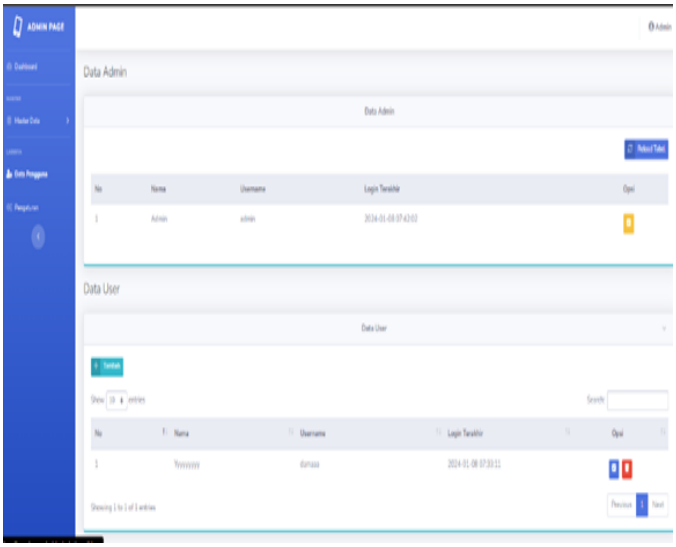

Figure 14. Manage Admin & User Data

On the admin page, the admin can control all data in the system starting from adding alternative data, deleting, editing, and previewing (Figure 10), then adding criteria, editing and deleting (Figure 11), then adding question data, editing, deleting (Figure 12) and can see the results of calculations by users (Figure 13) as well as controlling user data to add new data or delete or edit (Figure 14). So that the admin has full control of the collection and latest changes in the system for development and real-time alignment of the data needed by users.

5. Conclusions

Based on the results of research and discussion, it is concluded that this system provides an effective and efficient solution for the user process in making Bus Company selection decisions. With the decision support system for Bus Company selection using this smart method, it is concluded that the existence of this Bus Company selection decision support system in the main nuances of the tour has the effect of helping and facilitating the travel party in making decisions to determine the best Bus Company by producing information precisely and quickly as from the decision support system application that has been built based on the website using the SMART method with criteria consisting of bus type, toilet, and smoking room facilities, seat placement style, bus capacity, bus speed, year of release of the number of buses and bus prices get the results that Bus Company Pandawa87 Bus is ranked 1 because it best matches the needs inputted by users in the system so that it gets the number 1 ranking recommendation, followed by Bus Company 27Trans in order number 2, and Juragan99 in order number 3. So that the bus selection process is obtained more quickly and actually according to the needs required by the main nuances of the tour without carrying out a prolonged process as before.

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Author contributions: All authors are responsible for building Conceptualization, Methodology, analysis, investigation, data curation, writing—original draft preparation, writing—review and editing, visualization, supervision of project administration, funding acquisition, and have read and agreed to the published version of the manuscript.

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