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Application of the SAW Method in a Decision Support System to Determine the Best Public Transportation Mode for UPN "Veteran" Jakarta Students

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ABSTRACT
Purpose: The high use of private vehicles in Jakarta exacerbates traffic congestion, making public transportation a vital alternative, especially for students of the National Development University "Veteran" Jakarta (UPNVJ). However, with numerous options available, many students struggle to select the most suitable mode of transport. This study aims to aid this decision-making process by developing a Decision Support System (DSS) to evaluate and recommend the most optimal public transportation mode.
Methods/Study design/approach: This research implements a DSS using the Simple Additive Weighting (SAW) method. Five transportation modes were analyzed: MRT, KRL, TransJakarta, Jaklingko, and Online Motorcycle Taxi. The evaluation was based on five criteria: cost, speed, comfort, accessibility, and safety. Primary data was collected through questionnaires distributed to students, which were then processed using normalization and weighting based on the perceived importance of each criterion.
Result/Findings: The analysis revealed that Online Motorcycle Taxi is the top choice among students (score: 0.859), followed by MRT (score: 0.853) and TransJakarta (score: 0.837). The results indicate that each mode has distinct advantages; for instance, MRT excels in comfort and safety, while Jaklingko is perceived as the most economical option.
Novelty/Originality/Value: This study demonstrates that flexibility and accessibility are the primary considerations for students when choosing transportation. The findings provide a useful, structured reference for students to select efficient transport that meets their needs, moving beyond anecdotal decision-making. The research effectively applies the SAW method to offer a practical solution to a common student mobility challenge.

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1. INTRODUCTION

The number of private vehicles in Jakarta continues to increase every year. Data shows that the growth rate for cars has reached 7.01%, while motorbikes have grown by 4.9% [1]. This rise has contributed to various issues, particularly traffic congestion. In response, the DKI Jakarta Provincial Government, in collaboration with the Ministry of Transportation, has implemented several initiatives to improve the public transportation system. These include the development of Transjakarta, MRT, KRL, and integrated services such as JakLingko.

According to the Central Statistics Agency (BPS) of DKI Jakarta Province, these efforts have produced positive results, as evidenced by an increase in public transportation usage compared to the previous year [2].

Among the many users of public transportation, the most dominant groups are employees and students. For instance, based on data from the Transjakarta Blok M – Bundaran HI route, 25.0% of users are employees, while 23.5% are students. Similarly, in the MRT system, employees account for 27.5% of users, followed by students at 19.0% [3]. This data highlights the significant role students play as active users of public transportation and shows how dependent they are on the availability and effectiveness of these services. Specifically, students of the National Development University "Veteran" Jakarta, many of whom reside in the Greater Jakarta area (Jabodetabek), regularly use various modes of public transportation in their daily lives. However, the wide range of available options often makes it difficult for students to determine the most suitable mode of transport. This decision is usually based on habit, peer suggestions, or trial and error—an approach that often overlooks important factors such as time efficiency, comfort, cost, and service reliability.

Therefore, there is a need for an approach that enables students to make rational and structured decisions. One potential solution is the application of a Decision Support System (DSS), which can improve decision-making accuracy, enhance efficiency, and reduce the risk of error [4].

Several previous studies have applied DSS to assist in selecting public transportation modes using methods such as AHP, TOPSIS, and ELECTRE. These systems have successfully helped users choose appropriate transportation options. For example, one study recommended PT. NPM Medan buses as the best choice [5], while another identified TransmetroDeli as the most effective mode for students [6].

However, most of these studies are limited to evaluating only a single type of transportation and have rarely utilized the Simple Additive Weighting (SAW) method. Given its simplicity, ease of implementation, and effectiveness in decision-making across multiple criteria, the SAW method remains highly relevant for research aimed at identifying the best public transportation mode for students of the National Development University "Veteran" Jakarta.

2. METHOD

2.1 Data Collection Techniques and Sources

This study uses a quantitative approach that focuses on the collection and analysis of numerical data to measure the variables studied [7]. The data collection techniques used in this study include:

a. Questionnaire

Primary data were collected through the distribution of questionnaires to active students of Universitas Pembangunan Nasional "Veteran" Jakarta. The questionnaire consists of two main sections:

1. Respondents' assessment of public transportation modes based on predetermined criteria.
2. Respondents' assessments of the importance level of each criterion in selecting a mode of public transportation, which serves as the basis for determining the weight of each criterion.

The questionnaire uses a Likert scale ranging from 1 to 5, with the following categories:

- 1: Very Dissatisfied / Very Unimportant
- 2: Dissatisfied / Unimportant
- 3: Neutral / Moderately Important
- 4: Satisfied / Important
- 5: Very Satisfied / Very Important

b. Literature Review

This technique was used to collect secondary data by reviewing previous research that is relevant to the main topic, namely the application of a Decision Support System (DSS) for selecting public transportation modes for students of Universitas Pembangunan Nasional "Veteran" Jakarta.

2.2 Criteria and Alternative Determination

This stage involved identifying the criteria and available alternatives through literature review and the synthesis of previous studies related to decision support systems in public transportation selection. The purpose of this step is to define measurable factors that influence decision-making and to determine the possible transportation modes (alternatives) that students commonly use.

The methods applied for problem-solving in this study include procedures for measurement and analysis. These methods are explained in sufficient detail to allow the experiment to be reproduced. Established methods referenced from the literature are cited accordingly; only modifications or context-specific adjustments are described in detail.

Table 1. Codes and descriptions of public transportation selection criteria

Criteria Code	Criteria
K1	Price
K2	Speed
K3	Comfort
K4	Accessibility
K5	Safety

The following are explanations of each criterion used in this study:

1. **Price (K1)**
   Represents user satisfaction with the cost incurred when using a transportation mode.
2. **Speed (K2)**
   Refers to the travel time required to reach a destination. The shorter the travel time, the higher the satisfaction level.
3. **Comfort (K3)**
   Includes aspects such as cleanliness, the availability of facilities like air conditioning (AC), seat conditions, and the overall atmosphere during the journey.
4. **Accessibility (K4)**
   Indicates the ease of accessing the transportation mode, including the availability of routes and the convenience of access from the place of residence to the destination.
5. **Safety (K5)**
   Relates to the sense of security experienced by users during the journey, considering factors such as vehicle condition, driver performance, and the risk of crime.

Meanwhile, the alternatives in this study refer to public transportation modes that are commonly used by students of Universitas Pembangunan Nasional "Veteran" Jakarta who reside in the Greater Jakarta area (Jabodetabek). The selection of alternatives is based on the types of public transportation that are frequently encountered and accessed by students in their daily activities. These alternatives include:

Table 2. Public Transportation Alternatives and Their Codes

Alternative Code	Alternative
A1	MRT
A2	KRL
A3	Transjakarta
A4	Jaklingko
A5	Ojek Online

2.3 Research Model Stages: Simple Additive Weighting (SAW)

The research model used in this study is a Decision Support System (DSS) based on the Simple Additive Weighting (SAW) method. The SAW method was chosen due to its advantages in multi-criteria decision-making processes, which fundamentally involve summing the normalized values of each alternative across all predetermined criteria.

The main steps in the SAW method include:

1. Determining the criteria to be used as the evaluation basis and establishing the alternatives to be assessed.
2. Assigning weights to each criterion according to their level of importance.
3. Constructing a decision matrix containing the ratings of each alternative against every criterion.
4. Normalizing the matrix so that the values across all criteria are scaled uniformly, using the formula shown in Figure 1.

$$r_{ij} = \begin{cases} \frac{x_{ij}}{Max_i x_{ij}} \; jika\ j\ adalah\ atribut\ keuntungan\ (benefit) \\ \frac{Min_i x_{ij}}{x_{ij}} \; jika\ j\ adalah\ atribut\ biaya\ (cost) \end{cases}$$

Figure 1. SAW Normalization Formula

5. Multiplying the normalized values by the criteria weights to obtain the preference scores for each alternative, as described in Figure 2.

$$V_i = \sum_{j=1}^{n} W_j \, r_{ij}$$

Figure 2. SAW Final Scoring Formula

6. Selecting the best alternative based on the highest total preference score.

3. RESULTS AND DISCUSSIONS

After the data collection was completed, the next step was to implement the data into the Simple Additive Weighting (SAW) method. The following are several calculation stages performed according to the method:

3.1 Results of Questionnaire for Weight Determination

The weights were established based on the results of questionnaires distributed to the students. The questionnaire aimed to determine the importance level of each criterion according to the respondents' perceptions.

Table 3. Criteria and their Weights

Criteria Code	Weight
K1	0,197
K2	0,193
K3	0,193
K4	0,215
K5	0,202

Based on these results, Accessibility (K4) has the highest weight, indicating that this factor is considered the most important by the respondents. Meanwhile, Comfort (K3) and Speed (K2) have the lowest weights, with relatively small differences.

3.2 Alternative Evaluation Based on Criteria

The evaluation of each transportation mode (alternative) was determined based on the questionnaire results distributed to the students. Each respondent was asked to provide scores for each transportation mode based on the five established criteria. The obtained scores were then averaged to represent the general perception of respondents towards each transportation mode.

Table 4. Alternative Scores Based on Criteria

Alternative	K1	K2	K3	K4	K5
A1	3,35	4,12	4,85	2,97	4,71
A2	4,24	3,32	3,65	2,94	3,56
A3	4,29	2,91	4,24	3,97	4,09
A4	4,44	2,97	3,38	3,53	3,26
A5	2,88	4,5	3,85	4,79	3,97

Dari hasil Tabel 4 dapat diambil beberapa poin penting, yaitu:

- MRT (A1) achieved the highest scores in K3 (Comfort) and K5 (Safety), indicating that this mode is perceived as very comfortable and safe by the respondents.
- KRL (A2) holds the highest value in K1 (Price), showing that KRL is considered one of the most economical transportation modes.
- TransJakarta (A3) stands out in K1 (Price) and K3 (Comfort), representing a mode that is both economical and comfortable.
- JakLingko (A4) recorded the highest score in K1 (Price) but the lowest in K5 (Safety). This indicates that although it is economical, this mode is perceived as lacking in safety aspects.

- Online Motorcycle Taxi (A5) received the highest scores in K2 (Speed) and K4 (Accessibility), demonstrating advantages in flexibility and ease of reaching destinations.

These findings show that each transportation mode has different characteristics in meeting user needs based on the established criteria.

3.3 Decision Matrix Normalization

This stage is carried out to standardize the scoring scale among the criteria, so that the evaluation of alternatives becomes fairer and more objective. All criteria are considered as benefits because the questionnaire uses a Likert scale from 1 to 5, where a score of 1 indicates dissatisfaction and 5 indicates satisfaction. Therefore, even criteria such as price, which generally is considered a cost criterion, is treated as a benefit in this context because higher values reflect higher user satisfaction.

Table 5. Normalized Decision Matrix

Alternative	K1	K2	K3	K4	K5
A1	0,7545045045	0,9155555556	1	0,6200417537	1
A2	0,954954955	0,7377777778	0,7525773196	0,6137787056	0,7558386412
A3	0,9662162162	0,6466666667	0,8742268041	0,8288100209	0,8683651805
A4	1	0,66	0,6969072165	0,7369519833	0,6921443737
A5	0,6486486486	1	0,793814433	1	0,8428874735

3.4

Final Score Calculation

This stage is performed by multiplying the normalized values of each alternative in each criterion by the respective criterion weights determined previously. The products are then summed to obtain the final score for each alternative.

Table 6. Final Score Calculation

Alternative	Final Score
A1	0,8536485866
A2	0,7604064871
A3	0,8374809554
A4	0,7571409327
A5	0,859253239

Based on the table above, it can be seen that Online Motorcycle Taxi (A5) obtained the highest final score of 0.859, followed closely by MRT (A1) with a score of 0.854, and TransJakarta (A3) with 0.837. These scores reflect the best overall combination of all weighted criteria evaluated.

3.5 Decision Recommendation

Based on the final score calculation, Online Motorcycle Taxi (A5) is recommended as the most optimal public transportation mode according to the perceptions of the students of Universitas Pembangunan Nasional "Veteran" Jakarta. This indicates that Online Motorcycle Taxi is the best choice for these students considering the combination of all specified criteria. However, other modes such as MRT (A1) and TransJakarta (A3) also perform well and can be viable alternatives depending on user preferences or needs.

Furthermore, if the transportation mode selection is based solely on a single main criterion, the preferred choice may differ. For example:

- Considering only Price (K1), JakLingko (A4) scores the highest and is the most economical choice.
- For Speed (K2), Online Motorcycle Taxi (A5) becomes the primary choice, being rated the fastest by respondents.
- Regarding Comfort (K3), MRT (A1) is the leading mode.
- In terms of Accessibility (K4), Online Motorcycle Taxi (A5) also ranks highest.
- For Safety (K5), MRT (A1) is perceived as the safest option.

Thus, the decision results can be adjusted according to the specific priorities or needs of users regarding particular criteria.

4. CONCLUSION

The results of this study show that the Simple Additive Weighting (SAW) method can be an effective approach to assist students of Universitas Pembangunan Nasional "Veteran" Jakarta in selecting the most suitable public transportation mode according to their needs. Through evaluation based on specific criteria such as cost, comfort, speed, accessibility, and safety, it was found that Online Motorcycle Taxi achieved the highest score. This finding indicates that when choosing transportation modes, students prioritize time flexibility and ease of location access over factors like low cost or short travel time.

Based on the preference scores, online motorcycle taxis (Ojek Online) are the most preferred mode of transportation with a score of 0.859, followed closely by the MRT at 0.853. Transjakarta ranks third with a score of 0.837, while KRL and Jaklingko are less preferred, with scores of 0.760 and 0.757 respectively, placing them fourth and fifth in the ranking.

These data show that although modes such as Transjakarta and KRL excel in terms of price and capacity, students tend to prefer transportation modes that offer practical and efficient user experiences, especially in meeting the demands of dynamic daily mobility.

Based on these findings, it is recommended that public transportation providers reconsider their service strategies, particularly regarding mode integration, enhancement of user comfort, and punctuality of services. Improvements in information systems and technology, such as ease of vehicle tracking and digital payment facilities, are also considered to add value for users. On the other hand, students are encouraged to apply analytical approaches like the SAW method as decision-making tools to take more objective and rational decisions in their daily activities, thereby improving the efficiency and effectiveness of their urban mobility.

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

First author: Designed and structured the entire research; wrote the Introduction, Research Methodology, and Results and Discussion sections; designed the questionnaire; assisted with data processing; supported the respondent recruitment process; and coordinated the entire manuscript preparation process. **Second author:** Provided the initial research idea; designed and distributed the questionnaire; recruited respondents; wrote the research methodology section; and assisted with data processing and calculations. **Third author:** Conducted data processing using the SAW method and supported the calculation process.

DECLARATION OF COMPETING INTERESTS

The authors declare that there are no personal or financial interests that could have influenced the objectivity of the research results presented in this article.

DATA AVAILABILITY

The data for this study were collected through a survey conducted via Google Form, distributed to active students of UPN "Veteran" Jakarta. The data are not publicly available but can be accessed upon reasonable request to the authors via the contact details provided.

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