



Comparison Analysis of Saw and Smart Methods Decision Support Systems in Selections Online Transportation in City Communities Bandung

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Abstract

Online transportation is transportation based on a particular application, where consumers order a means of transportation through an application system on a smartphone. This change in lifestyle is used by business actors to start business competition in the online transportation business. In the competition regarding price, convenience, driver courtesy, and satisfaction, there are various kinds of online transportation including Gojek, Grab, Maxim, and InDriver. In the end, this becomes a consideration for the selection of online transportation for the people of Bandung City. To overcome these problems, a Decision Support System was developed using 5 criteria including: Ease, Service Quality, Product Quality, Price and Emotional. Comparative analysis between the Simple Additive Weighting (SAW) and Simple Multi Attribute Technique (SMART) methods was conducted to find out how well the level of relevance of each method was to real conditions. Based on the ranking results from the questionnaire of 100 respondents from the Bandung City community, it is known that the distance difference between the rankings in the SAW method is 0.994 and the SMART method is 0.92. Thus, it can be concluded that the SAW method is considered relatively more relevant to be recommended in this type of case than the SMART method.

Keywords: Decision support system, SAW, SMART, online transportation.

1. Introduction

People in big cities now use a lot of online transportation with applications on smartphones (Suprianto, 2021). Besides being able to save time, online transportation can also save money because of the many promos offered (Morganosky, 2000). Simply by downloading the application on the smartphone, then registering on the application, then including the pick-up and drop-off location, then in a matter of minutes the transportation service agent is ready to take passengers to their destination. This lifestyle change is used by business actors to start business competition in the online transportation business. In the presence of competition related to price, comfort, courtesy of drivers, and satisfaction, there are various types of online transportation including GO JEK, GRAB and MAXIM and In Driver. The implementation of decision support systems can be carried out in almost all business functions in an organization, starting from production and financial planning functions, customer service functions, sales, and human resource management (Beckers, 2002). In the human resource processing function, Decision Support Systems can be utilized to assist the human resource management (HR) process to be more effective. One of them is by using the SAW and SMART methods (Tansley, 2001). Good public transportation must meet three basic criteria, namely: comfort, safety, and speed. The first criterion, convenience. Aspects of comfort can be felt by passengers if there are facilities such as air conditioning, and are closed from motor vehicle pollution fumes (Purba, 2021). The second criterion, security. The security system for getting on and off passengers must be at a predetermined terminal or bus stop. The third criterion, speed. Fulfillment of time quickly and precisely to arrive at the destination. Meanwhile, to determine the level of customer satisfaction there are five factors, namely: product quality, price, service quality, emotionality and convenience. This research will describe what facilities and services determine consumer interest in choosing online transportation and compare two decision support system methods. Research with a comparison of the two methods, can produce the best service and facility conclusions and according to community needs.

2. Literature Review

2.1 Decision Support systems

The decision support system put forward by McLeod (1998) is quoted in stating that a decision support system is an information-producing system that is aimed at a problem that must be made by managers, a decision support system is an information system that is intended to assist management in solving the problems it faces.

The concept of a Decision Support System was first introduced in the early 1970s by Michael S. Scott Morton with the term Management Decision System (Sprague Jr & Carlson, 1982). The concept of decision support is characterized by interactive computer-based systems that help decision makers utilize data and models to solve unstructured problems. Basically DSS is designed to support all stages of decision making starting from identifying problems, selecting relevant data, determining the approach used in the decision making process, to evaluating alternative choices. Decision support systems are interactive computer-based systems that help decision makers utilize data and models to solve unstructured and semi-structured problems (Epstein, 2002). Actually, the initial definition, a decision support system is a model-based system consisting of procedures for processing data and considerations to assist managers in making decisions. In order to achieve its goals, the system must be simple, easy to control, adaptable, complete.

2.2 SAW (Simple Additive Weighting)

Method *Simple Additive Weighting* is a method of adding up the weights of the performance of each different object and having equal opportunity on all the criteria it has. The SAW method requires a process of normalizing the decision matrix (x) to a scale that can be compared with all existing alternative ratings (Epstein, 2002).

The SAW method can assist in making a decision on a case, but calculations using the SAW method only produce the largest value which will be selected as the best alternative. Calculations will be in accordance with this method if the selected alternative meets predetermined criteria (Devi, 2019). This SAW method is more efficient because the time needed in the calculation is shorter.

$$r_{ij} = \begin{cases} \frac{x_{ij}}{\max_i x_{ij}} & \text{if } J \text{ is gain attribute (benefit)} \\ \frac{\min_i x_{ij}}{x_{ij}} & \text{if } J \text{ is the cost attribute (cost)} \end{cases} \quad (1)$$

Description:

r_{ij} : normalized performance rating value
 x_{ij} : attribute value owned by each criterion
 $\max_i x_{ij}$: the largest value of each criterion
 $\min_i x_{ij}$: the smallest value of each criterion
Benefit : if the largest value is the best
Cost : if the smallest value is the best

Where is r_{ij} the normalized performance rating of the alternative (A_i) on attribute (C_j); $i = 1, 2, \dots, m$ and $j = 1, 2, \dots, n$. the preference value for each alternative (V_i) is given as:

$$V_i = \sum_{j=1}^n w_j r_{ij} \quad (2)$$

Description:

V_i : ranking for each alternative
 w_j : weight value of each criterion
 r_{ij} : normalized performance rating value

A V_i larger value indicates that alternative (A_i) is more selected. Completion steps *Simple Additive Weighting* (SAW) are as follows:

1. Determine the criteria that will be used as a reference in decision making, namely C_i .
2. Determine the suitability rating of each alternative on each criterion
3. Decide matrix based on criteria (C_i), then normalize the matrix based on the equation adjusted for the type of attribute (profit attribute or cost attribute) so that a normalized matrix R is obtained.

The result is obtained from the ranking process, namely the sum of the multiplication of the normalized matrix R with the weight vector so that the largest value is selected as the best alternative (A_i) as a solution.

2.3 SMART (Simple Multi Attribute Rating Technique)

The Simple Multi Attribute Rating Technique (SMART) is a technique or method that has *multiple attributes* in a decision-making system. This method was developed in 1977 by Edward. The decision maker must choose different objects and have the same opportunity, according to the goals that have been formulated. Each of these objects has a character, component, or criteria in the decision. However, in a condition, it is possible that there are sub-criteria that are related to the existing criteria (Epstein, 2002).

This multi-criterion decision-making technique 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. This weighting is used to assess each alternative in order to obtain the best alternative. Process Modeling SMART Method Process Modeling. The sequence in using the SMART method (Goodwin and Wright, 2009) is as follows:

1. Determines the number of criteria used.
2. Determine the weight of the criteria for each criterion by using an interval of 0-100 for each criterion with the most important priority.
3. Calculate the normalization of each criterion by comparing the criterion weight value with the total criterion weight.
4. Provides criterion parameter values for each criterion for each alternative.
5. Determine the utility value by converting the criterion value on each criterion to the standard data criterion value.

If the value of the benefit criteria:

$$u_i(ai) = \left(\frac{c_{out} - c_{min}}{c_{max} - c_{min}} \right) \times 100\% \quad (3)$$

If the value of the cost criteria:

$$u_i(ai) = \left(\frac{c_{max} - c_{out}}{c_{max} - c_{min}} \right) \times 100\% \quad (4)$$

Description:

$u_i(ai)$: value of the utility criteria to i

c_{max} : maximum criterion value

c_{min} : minimum criterion value

c_{out} : the i criterion value

Determines the final value of each criterion by multiplying the value obtained from the standard data criterion value normalization with the criterion weight normalization value.

3. Materials and Methods

3.1. Materials

The object of this research was carried out by researchers, namely related to online transportation which is currently widely used by the people of the city of Bandung. The choice of online transportation for the people of the city of Bandung is carried out by looking at prices and the number of promos. Through a questionnaire distributed by conducting an analysis using a decision support system, online transportation is the most widely used in the people of Bandung City. SPK is used as a recommendation to the people of Bandung City who have never used online transportation.

3.2. Methods

The method used is the SAW method and the SMART method. Research flow carried out Comparative Analysis of the SAW Method and SMART Decision Support Systems in the Selection of Online Transportation in Bandung City Communities, Problem Formulation, Research Objectives, Questionnaire Data Collection, Questionnaire Data Processing and Conclusions.

4. Results and Discussion

The choice of online transportation for the people of Bandung City is done by looking at the price and the number of promos. Through a questionnaire distributed by conducting an analysis using a decision support system, online transportation is the most widely used in the people of Bandung City. SPK is used as a recommendation to the people of Bandung City who have never used online transportation. One of the questionnaires was declared fit for use in research, namely the research instrument had to be tested as Table 1.

Table 1: Reliability Test

| Variable | Cronbach Alpha Value | Description |
|---------------------------|----------------------|-------------|
| Convenience (C_1) | 0.979 | Reliable |
| Service Quality (C_2) | 0.963 | Reliable |
| Product Quality (C_3) | 0.951 | Reliable |
| Price (C_4) | 0.862 | Reliable |
| Emotional (C_5) | 0.968 | Reliable |

In table 1, it can be concluded that all variables in this study are reliable as evidenced by the *Cronbach Alpha* > 0.60 for each variable. Then all variables pass and are feasible to continue and can be trusted.

Process decision support system election transportation on line use method SAW and SMART this covers criteria in to do calculation for get alternative best, weight interest every criterion, and weight every criterion. There are 4 criteria and 1 cost criteria used for study is as following.:

1. C_1 = Convenience
Convenience criteria are needed for consumers to be able to choose online transportation that is easy to use
 2. C_2 = Quality of Service
Service quality criteria are needed for consumers to see the quality of service in online transportation.
 3. C_3 = Product Quality
Product quality criteria are needed for consumers to see which product quality on online transportation is the best.
 4. C_4 = Price
Price criteria is needed for consumers to choose related to lower prices and related promotions on online transportation.
 5. C_5 = Emotional
Emotional criteria are needed for consumer satisfaction with the online transportation used.
- The table of criteria is as Table 2:

Table 2: Criteria

| No | Criteria | Description | Type |
|----|----------|--------------------|---------|
| 1 | C_1 | Convenience | Benefit |
| 2 | C_2 | Quality of Service | Benefit |
| 3 | C_3 | Product Quality | Benefit |
| 4 | C_4 | Price | Cost |
| 5 | C_5 | Emotional | Benefit |

In the decision support process for choosing online transportation using the SAW and SMART methods, an alternative is needed which is an online transportation option. There are 4 alternatives in conducting research, namely as Table 3:

Table 3: Alternative

| Code | alternatives |
|-------|--------------|
| A_1 | Gojek |
| A_2 | Grab |
| A_3 | Maxim |
| A_4 | In Driver |

The process of ranking the SAW method using the weights that have been given:

$$w = [0,45 \ 0,26 \ 0,16 \ 0,09 \ 0,04]$$

The results obtained are as follows:

$$V_1 = (0,45)(1) + (0,26)(1) + (0,16)(1) + (0,09)(0,94) + (0,04)(1) = 0,994$$

$$V_2 = (0,45)(0,97) + (0,26)(0,99) + (0,16)(0,98) + (0,09)(0,94) + (0,04)(0,98) = 0,974$$

$$V_3 = (0,45)(0,8) + (0,26)(0,85) + (0,16)(0,87) + (0,09)(0,98) + (0,04)(0,86) = 0,842$$

$$V_4 = (0,45)(0,81) + (0,26)(0,86) + (0,16)(0,88) + (0,09)(1) + (0,04)(0,86) = 0,853$$

The largest value is at 0.994 and 0.974 so that Gojek and Grab are the best alternatives selected as the best alternative as given in the Table 4.

Table 4: Final Score SMART method

| Alternatives | C_1 | C_2 | C_3 | C_4 | C_5 | Total | Rank |
|--------------|-------|-------|-------|-------|-------|-------|------|
| A_1 | 0.45 | 0.26 | 0.16 | 0.01 | 0.04 | 0.92 | 1 |
| A_2 | 0.40 | 0.24 | 0.14 | 0 | 0.03 | 0.81 | 2 |
| A_3 | 0 | 0 | 0 | 0.06 | 0 | 0.06 | 4 |
| A_4 | 0.01 | 0.01 | 0.006 | 0.09 | 0 | 0.11 | 3 |

Table 4, is the preference weight value, it can be seen in the table rank one, namely the 1st alternative, second rank, the 2nd alternative, rank three, namely the 4th alternative, and rank four, namely the 3rd alternative. Based on the SAW and SMART methods, the results of the ranking comparison of the two methods are obtained in the Table 5 below:

Table 5: Comparison Results of the SAW and SMART

| SAW Method | | | SMART Method | | |
|-------------------|--------------------------|------|-------------------|--------------------------|------|
| Alternative Names | Weight values Preference | Rank | Alternative Names | Weight values Preference | Rank |
| A_1 | 0.994 | 1 | A_1 | 0.92 | 1 |
| A_2 | 0.974 | 2 | A_2 | 0.81 | 2 |
| A_4 | 0.853 | 3 | A_4 | 0.11 | 3 |
| A_3 | 0.842 | 4 | A_3 | 0.06 | 4 |
| Max | 0.994 | | Max | 0.92 | |

Based on table 5 of the calculation results above, it can be concluded that the SAW method process has the greatest value, namely alternative A1 with a preference value of 0.994, namely Gojek online transportation. Meanwhile, in the process of the SMART method, it can be concluded that the one with the greatest value is the A1 alternative with a preference value of 0.93, namely Gojek online transportation. The results of the two methods can be concluded that alternative A1 gets the greatest value of the two methods, namely Gojek online transportation.

5. Conclusion

Based on the results of the research conducted by the author, the following conclusions can be drawn:

1. The results of the analysis of the SAW method and the SMART method produced alternative recommendations for choosing online transportation for the people of Bandung City. In the results of the SAW method, one alternative was chosen, A1, namely Gojek with a value of 0.994 and the SMART method, one alternative that was selected, namely A1, was Gojek with a value of 0.92.
2. The results of the comparison of the SAW method and the SMART method of decision support systems were carried out by a sensitivity test where the SAW method was more relevant than the SMART method, the SAW method had a change of 6.91 and the SMART method had a change value of 6.26.

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