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WEB-BASED DECISION SUPPORT SYSTEM FOR SELECTING THE BEST PARIPURNA MOSQUE IN PEKANBARU CITY USING THE SIMPLE ADDITIVE WEIGHTING (SAW) METHOD

Aisyah Rizki Utari[1], Octadino Haryadi[2]*

[1,2]Universitas Islam Riau, Pekanbaru, Indonesia

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Correspondence

E-mail: octadino92@eng.uir.ac.id*

A B S T R A C T

This study aims to develop a web-based decision support system (DSS) used to determine the best full-service mosque in Pekanbaru City. This system uses the Simple Additive Weighting (SAW) method, which is capable of managing assessments from various criteria, such as facilities, worship activities, cleanliness, services, and mosque management. The system was designed using the Rapid Application Development (RAD) approach and tested through the black-box method and manual calculation validation. The implementation results show that the system can provide accurate and objective ranking results based on the highest preference values of 20 sample mosques. In addition, user testing results show a satisfaction level of 83%. This system is considered effective in supporting the transparency and efficiency of the process of selecting the best mosques and can be accessed online by the public and authorities.

1. Introduction

Mosques play a very important role in the lives of Muslims, not only as places of worship, but also as centers for social, educational, economic, and community empowerment activities (Huda & Nasution, 2022). Amidst the complexity of modern society, mosques are required to function beyond merely being places of worship. Mosques have become venues for da'wah activities, religious discussions, social activities, and even economic development programs for the community. This transformation in function has prompted many local governments in Indonesia to develop the Full Mosque program.

In Pekanbaru City, in particular, the Complete Mosque concept has been made a strategic program since the issuance of Local Regulation No. 2 of 2016 concerning Complete Mosques. This program was reinforced by the Pekanbaru Mayor's Decree No. 854 of 2021, which designated 100 mosques as Complete Mosques at the city, sub-district, and village levels. The aim of this program is to optimize the role of mosques in the areas of idarah (management), imarah (prosperity), and ri'ayah (maintenance), as well as to form a religious and productive civil society (Firdaus, et al, 2021).

However, the selection of the best Full Mosques still faces several obstacles, particularly in terms of assessment, which has been carried out manually and tends to be subjective. Various criteria that should form the basis of evaluation, such as cleanliness, infrastructure, intensity of worship activities, congregation participation, and transparency of management, have not been assessed using a systematic and standardized approach. As a result, the selection results may be biased and less

accountable. This poses a challenge for the government and the community in ensuring that the selection of the Best Mosque is truly based on performance and real contributions.

To address this challenge, the use of information technology in the form of a web-based Decision Support System (DSS) is a very promising alternative solution. DSS is designed to assist in complex decision-making processes involving various criteria by providing recommendations based on logical and objective calculations (Limbong, et al, 2020). One of the most widely used methods in DSS is the Simple Additive Weighting (SAW) method, which is known for its simplicity, clarity, and ability to handle many criteria simultaneously (Yohanes & Hajjah, 2019).

According to Wijaya et al. (2019), the SAW method has been proven effective in various fields, such as business location selection, supplier evaluation, determining road construction project priorities, and multi-dimensional criteria-based scholarship selection (Yulaikha & Sari, 2023). The main principle of the SAW method is to calculate the preference value of each alternative based on the weighted sum of each normalized criterion. With this method, the selection process becomes more measurable and transparent, and can be understood by various groups of system users (Haryadi & Bakri, 2022).

Based on these issues, this study proposes the development of a web-based decision support system using the SAW method to assist in the selection process for the best Paripurna Mosque in the city of Pekanbaru. This system will assess mosques based on seven main criteria and sixty-one sub-criteria that have been adjusted to the mosque management standards in the city. In addition, this system is designed to be easily accessible by relevant parties such as the city government, mosque managers, and the general public (Liesnaningsih, et al, 2020).

The main contribution of this research lies in the integration of a web-based information system and an objective decision-making method to support government programs in assessing and improving the quality of mosques. Not only does it offer practical solutions, but this research also enriches the academic literature in the field of decision support systems with specific and contextual case studies. In the future, this approach can be further developed for application in various public service sectors that require data-based selection or evaluation processes.

Thus, this study aims to address the need for an objective, efficient, and transparent assessment system in selecting the best Paripurna Mosques, as well as introducing innovations in the application of the SAW method in web-based religious information systems that can be widely utilized by the community.

2. Research Method

This study uses a software engineering approach based on information system development to design and build a Decision Support System (DSS) for selecting the best Paripurna Mosque in Pekanbaru City. The DSS developed is web-based and uses the Simple Additive Weighting (SAW) method as a multi-criteria decision-making method. The system development was carried out using the Rapid Application Development (RAD) approach, which allows for rapid and flexible iteration of system design and testing according to user needs.

2.1. Research Location and Object

The research was conducted in the Pekanbaru City Government, focusing on the evaluation process of Paripurna Mosques at the sub-district level, which was established through Pekanbaru Mayor Decree No. 854 of 2021. A total of 83 mosques were designated as Paripurna Mosques at the sub-district level, but 20 mosques were used as a sample for testing the system.

2.2. Data Collection Methods

In the process of developing a decision support system to determine the best Paripurna Mosque, the author requires accurate supporting data. Therefore, the author applied several data collection methods as follows.

a. Interviews

The author conducted interviews with competent parties to obtain more in-depth and specific information about the Paripurna Mosque. Sources included mosque administrators and congregations.

b. Observation

Data was also collected based on field surveys and observations. Observations were conducted to gather data on the physical condition and facilities of grand mosques in Pekanbaru City. During these observations, the author's activities included:

1. Direct visits to grand mosques to observe the facilities, cleanliness, religious activities, and congregation participation.
2. Recording of the mosque environment conditions that could affect the assessment.

2.3. System Development Method

The system was developed using the Rapid Application Development (RAD) method, which consists of five stages, namely:

1. Requirement Planning

Identify system requirements based on literature studies, observations, and consultations with relevant parties such as the Social Welfare Bureau staff, mosque administrators, and experts in mosque management. Some of the identified requirements are:

a. The system must be able to process mosque data based on predetermined criteria, such as facilities, comfort and safety, worship and religious activities, services, etc.

b. The system must use the Simple Additive Weighting (SAW) method to determine the mosque assessment results based on the weight and value of the criteria.

c. A web-based system that is easily accessible by administrators (authorities) to manage mosque data, criteria, sub-criteria, and assessment results.

d. The system provides transparent assessment reports that are accessible to the public.

e. The system design must be simple, responsive, and easy to use.

2. Design System

Once the system requirements have been clearly defined, the next stage is Design System (User Design), where technical system design is carried out to ensure that the web-based decision support system can function as required. At this stage, the design is carried out using flowcharts, use case diagrams, and UML diagrams (class diagrams and activity diagrams) to illustrate the system structure, workflow, and user interactions.

3. Construction

At this stage, the system begins to be built based on the design that was previously created in the Design System stage. The implementation of this stage includes database design, backend and frontend system development, and implementation of the SAW method in decision calculations. System development is carried out using the PHP programming language and MySQL database.

4. **Implementation and Testing**
   This stage tests and implements the system before it is used. It begins with System Implementation, where initial testing is conducted in a local environment (XAMPP) to ensure frontend, backend, and database connections, as well as data input validation, SAW calculations, and assessment output. Next, Functional Testing (Black Box Testing) ensures that every feature is functioning properly. Testing scenarios include mosque data input, SAW calculations, and ranking results display. Then, Data Validation testing verifies the accuracy of SAW calculations in the system by comparing them manually. Finally, User Acceptance Testing (UAT) involves stakeholders (the community, mosque administrators, or the government) to try out the system and provide feedback as a basis for improvement before the system is published.
5. **Maintenance**
   After the system has been successfully implemented, maintenance is carried out to ensure that the system continues to run smoothly in the long term. Activities carried out at this stage include bug fixes, system updates in accordance with new policies, database backups, and UI/UX improvements.

2.4 Support

Development of a web-based Decision Support System (DSS) for selecting the best mosque in Pekanbaru City using the SAW method is supported by a combination of specific hardware and software specifications. In terms of hardware, this system was developed using an HP ProBook 430 G5 laptop powered by an Intel(R) Core(TM) i7-8550U CPU with a speed of 1.80GHz. For data storage, this device is equipped with a 1 Terabyte hard drive and supported by 16 GB of RAM. The operating system runs on a 64-bit architecture. Meanwhile, for software, this system is built on Microsoft Windows 10 Pro 64-bit. The programming languages used include PHP, HTML, CSS, JavaScript, and SQL. Database management utilizes MySQL integrated with XAMPP. To speed up development and ensure efficient code structure, the Laravel and Bootstrap frameworks are used. Finally, for program logic and user interface design, tools such as Draw.io, Figma, and Canva are utilized.

2.5. System Analysis

The process of selecting the best mosque in Pekanbaru City currently lacks a clear formal system, whether manual or automated. Assessments tend to be subjective, based on the experiences of individuals or groups such as the People's Welfare Bureau (Kesra) or mosque administrators, without objective or transparent criteria. To address this issue, a web-based decision support system is proposed. This system will have an administrator as the main user who manages the process. The administrator must log in to ensure secure access, then can input mosque data and assessment criteria along with their weights. After that, the system will automatically normalize the data to standardize the assessment scale and continue with the calculation of preference values using the Simple Additive Weighting (SAW) method.

These preference scores will determine the ranking of mosques, with the highest score indicating the best mosque. The ranking results will then be displayed to the administrator for evaluation and reporting, as well as to the public for information. The public only has access to view the results and cannot change the data. Once completed, the administrator can log out to secure the system. The application of the SAW method in this system will consider seven main component categories: Facilities, Worship and Religious Activities, Comfort and Safety, Social & Educational Activities, Services, Cleanliness, and Management and Governance. The process involves determining mosque alternatives, criteria, weights, and suitability ratings for each alternative.

2.6. Implementation of the SAW Method

The Decision Support System (DSS) for selecting the best grand mosque in Pekanbaru implements the Simple Additive Weighting (SAW) method. The process begins with identifying 20 grand mosques as alternatives. The assessment is based on seven main criteria: Facilities, Worship and Religious Activities, Comfort and Safety, Social & Educational Activities, Services, Cleanliness, and Management and Governance. Each criterion has sub-criteria with a specific value range and predetermined preference weights (e.g., Facilities 15%, Worship Activities 20%, Cleanliness 10%). Criteria are also classified as Benefit (the higher the value, the better) or Cost (the lower the value, the better).

Perform normalization of the decision matrix X to calculate the normalized performance rating value (rij) of the alternative or candidate for the best complete mosque (Ai) on the criteria (Ci). For all criteria given as benefit and cost criteria, use the equation:

If rij is the attribute of benefit $$r_{ij} = \frac{X_{ij}}{X_{ij\_max}}$$ (2.1)

If rij is a cost attribute $$r_{ij} = \frac{X_{ij\_min}}{X_{ij}}$$ (2.2)

Next, the preference value (Vi) of each mosque is calculated by summing the results of multiplying the normalized matrix by the predetermined weight vector (W=[0.15;0.20;0.10;0.15;0.15;0.10;0.15]).

3. Results and Discussion

Based on the analysis and design carried out in the previous chapter, the next step is testing. Testing is conducted to ensure that the system is running as expected. There are three types of testing, namely SAW method testing, black box testing, and system accuracy testing.

3.1. Testing the Simple Additive Weighting (SAW) Method

In testing the SAW method, several calculations are used, namely normalization, calculation of the results of normalization, then multiplied by the criterion weight value and ended with the sum of the rankings. Based on the results of the data analysis obtained from the operation of full-fledged mosques in Pekanbaru City, where 20 full-fledged mosques at the village level were taken as samples in this study, it can be solved manually by applying the Simple Additive Weighting (SAW) method, as follows.

Table 1. Rating Values for Each Alternative

A1	4	5	4	4	4	4	5
A2	5	5	4	3	3	5	4
A3	4	5	4	4	2	5	4
A4	5	5	4	4	3	5	4
A5	4	5	3	4	3	5	4
A6	5	5	3	3	3	5	5
A7	5	5	3	4	2	5	3
A8	5	5	4	3	3	5	4
A9	4	5	3	3	2	5	2
A10	4	5	4	3	5	5	4
A11	5	5	4	4	3	5	5
A12	4	5	4	4	2	5	4
A13	4	5	4	5	4	5	4

A14	5	5	4	4	3	4	3
A15	4	4	3	3	3	4	3
A16	5	5	4	4	4	5	3
A17	5	5	5	4	5	5	5
A18	5	4	3	5	5	3	5
A19	4	3	3	3	1	3	2
A20	4	4	3	5	5	4	5

The values obtained from the field survey and interviews with mosque administrators regarding the researcher's analysis process are as follows.

1) 5 = Very Good

2) 4 = Good

3) 3 = Fair

4) 2 = Poor

5) 1 = Very Poor

The variables for each criterion and alternative are in accordance with the conditions of the field survey, interviews, and the researcher's analysis with the administrators and congregations of mosques in several sub-districts in the city of Pekanbaru, as follows.

C1 = Facility criteria with a weight value of (9)

C2 = Worship and religious activities criteria with a weight value of (6)

C3 = Comfort and safety criteria with a weight value of (9)

C4 = Social and educational activities criteria with a weight value of (8)

C5 = Service criteria with a weight value of (8)

C6 = Cleanliness criteria with a weight value of (12)

C7 = Management and governance criteria with a weight value of (9)

From the above results, the following sequence can be created, starting from C1-C7.

W = (9, 6, 9, 8, 8, 12, 9).

3.2. Normalization Results of the Simple Additive Weighting (SAW) Method

The following table shows the results of the normalization calculation for all alternatives, namely the best mosque candidates.

Table 2. Normalization Calculation Results Table

Alternative	C1	C2	C3	C4	C5	C6	C7
A1	0.80	1.00	0.75	0.80	0.80	0.75	1.00
A2	1.00	1.00	0.75	0.60	0.60	0.60	0.80
A3	0.80	1.00	0.75	0.80	0.40	0.60	0.80
A4	1.00	1.00	0.75	0.80	0.60	0.60	0.80
A5	0.80	1.00	1.00	0.80	0.60	0.60	0.80
A6	1.00	1.00	1.00	0.60	0.60	0.60	1.00
A7	1.00	1.00	1.00	0.80	0.40	0.60	0.60
A8	1.00	1.00	0.75	0.60	0.60	0.60	0.80
A9	0.80	1.00	1.00	0.60	0.40	0.60	0.40
A10	0.80	1.00	0.75	0.60	1.00	0.60	0.80
A11	1.00	1.00	0.75	0.80	0.60	0.60	1.00
A12	0.80	1.00	0.75	0.80	0.40	0.60	0.80
A13	0.80	1.00	0.75	1.00	0.80	0.60	0.80

A14	1.00	1.00	0.75	0.80	0.60	0.75	0.60
A15	0.80	0.80	1.00	0.60	0.60	0.75	0.60
A16	1.00	1.00	0.75	0.60	0.80	0.60	0.60
A17	1.00	1.00	0.60	0.80	1.00	0.60	1.00
A18	1.00	0.80	1.00	1.00	1.00	1.00	1.00
A19	0.80	0.60	1.00	0.60	0.20	1.00	0.40
A20	0.80	0.80	1.00	1.00	1.00	0.75	1.00

Table 2 above shows the results of the normalization calculations of the alternative ratings and criteria for selecting the best mosque in Pekanbaru City. These normalization calculations are based on the benefits and costs in the Simple Additive Weighting (SAW) algorithm.

3.3. Calculation of Preference Values for Each Alternative

After normalization, the Simple Additive Weighting (SAW) algorithm calculates the preference values obtained from the ranking process, which is the sum of the normalized matrix multiplied by the weight vector determined by the decision maker. The following table shows the preference values for each alternative. Table 3. Preference values for each alternative.

Table 3. Table of Preference Values for Each Alternative

Alternative	C1	C2	C3	C4	C5	C6	C7
A1	0.80	1.00	0.75	0.80	0.80	0.75	1.00
A2	1.00	1.00	0.75	0.60	0.60	0.60	0.80
A3	0.80	1.00	0.75	0.80	0.40	0.60	0.80
A4	1.00	1.00	0.75	0.80	0.60	0.60	0.80
A5	0.80	1.00	1.00	0.80	0.60	0.60	0.80
A6	1.00	1.00	1.00	0.60	0.60	0.60	1.00
A7	1.00	1.00	1.00	0.80	0.40	0.60	0.60
A8	1.00	1.00	0.75	0.60	0.60	0.60	0.80
A9	0.80	1.00	1.00	0.60	0.40	0.60	0.40
A10	0.80	1.00	0.75	0.60	1.00	0.60	0.80
A11	1.00	1.00	0.75	0.80	0.60	0.60	1.00
A12	0.80	1.00	0.75	0.80	0.40	0.60	0.80
A13	0.80	1.00	0.75	1.00	0.80	0.60	0.80
A14	1.00	1.00	0.75	0.80	0.60	0.75	0.60
A15	0.80	0.80	1.00	0.60	0.60	0.75	0.60
A16	1.00	1.00	0.75	0.60	0.80	0.60	0.60
A17	1.00	1.00	0.60	0.80	1.00	0.60	1.00
A18	1.00	0.80	1.00	1.00	1.00	1.00	1.00
A19	0.80	0.60	1.00	0.60	0.20	1.00	0.40
A20	0.80	0.80	1.00	1.00	1.00	0.75	1.00

Table 3 shows the results of the criteria weighting calculations using normalization to select the best mosque in Pekanbaru City. These calculations are based on the SAW (Simple Additive Weighting) algorithm.

3.4. Calculation and Ranking of the Best Mosques

The details of the calculation results are presented as follows

. 1. Mosque Paripurna Al-Muhajirin (A18) with a final score of = 0.960

2. Mosque Paripurna Al-Ikhwan (A20) with a final score of = 0.905

3. Mosque Paripurna Lillah (A17) with a final score of = 0.890

4. Mosque Paripurna Al-Mukminin (A1) with a final score of = 0.860

5. Mosque Paripurna Ash-Shobirin (A13) with a final score of = 0.845

6. Mosque Paripurna Al-Iman (A11) with a final score of = 0.845

7. Mosque Paripurna Al-Fajariyah (A6) with a final score of = 0.840
8. Mosque Paripurna Tsamaratul Iman (A10) with a final score of = 0.815
9. Mosque Paripurna Al-Ibadah (A16) with a final score of = 0.815
10. Mosque Paripurna Taqwa (A4) with a final score of = 0.815
11. Mosque Paripurna Al-Muttaqin (A5) with a final score of = 0.810
12. Mosque Paripurna Al-Ukhuwah (A14) with a final score of = 0.800
13. Mosque Paripurna Al-Muhsinin (A8) with a final score of = 0.785
14. Mosque Paripurna Amal Jariyah (A2) with a final score of = 0.785
15. Mosque Paripurna Nurul Huda (A7) with a final score of = 0.780
16. Mosque Paripurna Al-Furqan (A12) with a final score of = 0.755
17. Mosque Paripurna Al-Hikmah (A3) with a final score of = 0.755
18. Mosque Paripurna Al-Ma'ruf (A15) with a final score of = 0.725
19. Mosque Paripurna Darul Ihsan (A9) with a final score of = 0.690
20. Mosque Paripurna Nurul Ikhsan (A19) with a final score of = 0.620

Based on the above ranking results, researchers can recommend the selection of the best full mosque using the Simple Additive Weighting (SAW) algorithm.

3.5. Software Display

Here are some images 1-7 showing the software features used in creating a "web-based decision support system for selecting the best mosque in Pekanbaru City using the SAW method."

Figure 1. Main Menu of the Application

Figure 2. List of Mosques

Figure 3. Criteria and Sub-criteria Menu

Figure 4. Assessment Rules

Figure 5. Assessment Results

Based on Figures 1-5, it is evident that the Mosque assessment information system has various key features that have been tested and are functioning properly. The main menu (dashboard) displays important statistics and provides navigation to all pages of the system. The Mosque data management module supports adding, changing, deleting, and searching data with input validation that prevents empty data. The criteria and subcriteria features enable flexible data management with warnings if the form is incomplete. The assessment rules page allows assessors to assign scores and export data to PDF. Assessment results are displayed in normalized and preference forms, complete with sort and PDF export features. The final results menu presents searchable and exportable Mosque rankings, while the home page displays general information and a list of the best Mosques with search and score sorting features that also run optimally.

4. Conclusions

Based on the results of the analysis and testing of the Decision Support System (DSS) for selecting the best mosque with the application of the Simple Additive Weighting (SAW) algorithm, it can be concluded that this web-based DSS system has successfully designed and implemented a mechanism for selecting the best mosque in the city of Pekanbaru. Using the SAW method, this system can assess mosques based on relevant criteria such as location, facilities, and accessibility in an objective and transparent manner. The results of the User Acceptance Testing (UAT) showed a satisfaction rate of 83%, which indicates that the system is well received by the community and effective in assisting decision makers. In addition, this system meets the expectations of users who want easy and

responsive access to information about mosques. Evaluations from 49 respondents also show that this system works well, meets information needs, and can be implemented effectively to support the selection of the best mosque. In the future, this system has the potential to be expanded to various other fields that require criteria-based decision making.

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