OPEN ACCESS
Indo-JC Indonesia Journal of Computing
ISSN 2460-9056
socj.telkomuniversity.ac.id/indojc

Ind. Journal on Computing
Vol. 9, Issue. 2, August 2024. pp. 96-117
doi:10.34818/indojc.2024.9.2.966

Development of a Decision Support System Website for MSME Funding Using Simple Additive Weighting

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Abstract

This research aims to design and develop an efficient funding website for Micro, Small, and Medium Enterprises (MSMEs) in Mataram City using the Simple Additive Weighting (SAW) method at PT XYZ. The background of this research includes challenges in the MSME selection process, which is still manual, time-consuming, prone to scoring errors, and disorganized document collection. PT XYZ also lacks a website platform to support its funding program. This research uses a qualitative approach, collecting data through literature studies, interviews, and observations. Evaluation was conducted on three main components of the Decision Support System (DSS): database, model, and user interface (UI). The designed database has been proven to support the DSS well, effectively and efficiently storing and managing MSME data. The SAW model used has also been proven effective in generating good decision alternatives, with the same final score of 14.8 obtained both manually and using the program, demonstrating the model's accuracy and speed. The developed user interface (UI) has been proven satisfactory, with a user-friendly design that makes it easy for users to access and operate the website, increasing the efficiency and effectiveness of the selection and data management processes. With adequate evaluation of these three DSS components, the research concludes that the developed funding website can support the implementation of PT XYZ's funding program and address existing problems.

Keywords: *Funding website, MSMEs, Simple Additive Weighting (SAW), Decision Support System (DSS), Database, User Interface (UI), Qualitative Approach, Data Management, Efficiency and Effectiveness*

Abstrak

Penelitian ini bertujuan untuk merancang dan mengembangkan website pendanaan yang efisien bagi Usaha Mikro, Kecil, dan Menengah (UMKM) di Kota Mataram menggunakan metode Simple Additive Weighting (SAW) di PT XYZ. Latar belakang penelitian ini adalah kendala dalam proses penyeleksian UMKM yang masih manual, memakan waktu lama, rentan kesalahan perhitungan skor, dan pengumpulan berkas yang tidak teratur. PT XYZ juga belum memiliki platform website untuk mendukung program pendanaannya. Penelitian ini menggunakan pendekatan kualitatif dengan pengumpulan data melalui studi literatur, wawancara, dan observasi. Evaluasi dilakukan terhadap tiga komponen utama Decision Support System (DSS): basis data, model, dan antarmuka pengguna (UI). Basis data yang dirancang telah terbukti mendukung DSS

Received on April, 2024. Accepted on August, 2024

dengan baik, mampu menyimpan dan mengelola data UMKM secara efektif dan efisien. Model SAW yang digunakan juga terbukti efektif dalam menghasilkan alternatif keputusan yang baik, dengan nilai akhir yang sama, yaitu 14,8, baik secara manual maupun menggunakan program, menunjukkan akurasi dan kecepatan model. Antarmuka pengguna (UI) yang dikembangkan terbukti memuaskan, dengan desain user-friendly yang memudahkan pengguna mengakses dan mengoperasikan website, meningkatkan efisiensi dan efektivitas proses penyeleksian dan pengelolaan data. Dengan evaluasi yang cukup terhadap ketiga komponen DSS ini, penelitian menyimpulkan bahwa website pendanaan yang dikembangkan mampu mendukung pelaksanaan program pendanaan PT XYZ serta mengatasi masalah yang ada.

Kata Kunci: *Website pendanaan, UMKM, Simple Additive Weighting (SAW), Sistem Pendukung Keputusan (DSS), Basis Data, Antarmuka Pengguna (UI), Pendekatan Kualitatif, Manajemen Data, Efisiensi dan Efektivitas*

I. INTRODUCTION

The city of Mataram, located on the island of Lombok, West Nusa Tenggara (NTB), is a significant center of economic activity in the region. The rapid economic growth in Mataram City has been driven by a diverse MSME sector, encompassing various types of businesses, from local crafts to service industries. MSMEs are the backbone of the local economy and play a significant role in creating jobs and increasing community income. However, in facing the pressures of increasing competition and changing consumer trends, MSMEs often encounter funding challenges necessary for their growth and development[1]. One of the main obstacles faced by MSMEs in Mataram City is the limited access to the funding they need. Many MSMEs face challenges in accessing traditional funding sources such as banks and other financial institutions. Complicated procedures, strict requirements, and intense competition in the banking sector often limit MSMEs in obtaining the financial support they need. This obstacle has become a serious barrier to developing their businesses and capitalizing on existing growth opportunities[2].

PT XYZ on the island of Lombok has launched a Funding Program for MSMEs in Mataram City. This program aims to help MSMEs realize their dreams or develop their businesses through various prepared programs. All interested MSMEs can participate in this program with the applicable terms and conditions. Complete information about the requirements, conditions, and available programs will be provided through the website. PT XYZ intends to leverage information technology to enable MSMEs to access funding more easily, efficiently, and gain access to a wider range of funding options.

In this funding program, there is a selection process for registered MSMEs, which is still done manually, causing the selection process to take a considerable amount of time. Not only does the selection process take a long time, but misunderstandings about the criteria values for the registered MSMEs can also occur between both parties. Additionally, the criteria values do not yet have a definite average value for each existing category, which can lead to the loss of registered documents due to disorganized storage, causing the documents to be scattered. Given these issues, the selection of MSMEs requires precise accuracy in the SAW method to ensure fair selection for all registered MSMEs, and system speed is also needed in the website development. To address these problems, a website will be created to serve as an online platform to solve the ongoing issues. This website will provide all the information needed by MSMEs and serve as a registration platform to organize MSME documents more systematically. A decision support system will be implemented on the website to identify the best MSMEs.

Based on the issues previously described, a fishbone diagram will be created to explain the problem more clearly and in detail, as shown in Figure 1. To understand the problems, the author has conducted interviews with the company regarding the issues they are facing. The author proposed a solution to develop a website that utilizes a Decision Support System (DSS) to assist with MSME funding in Mataram City

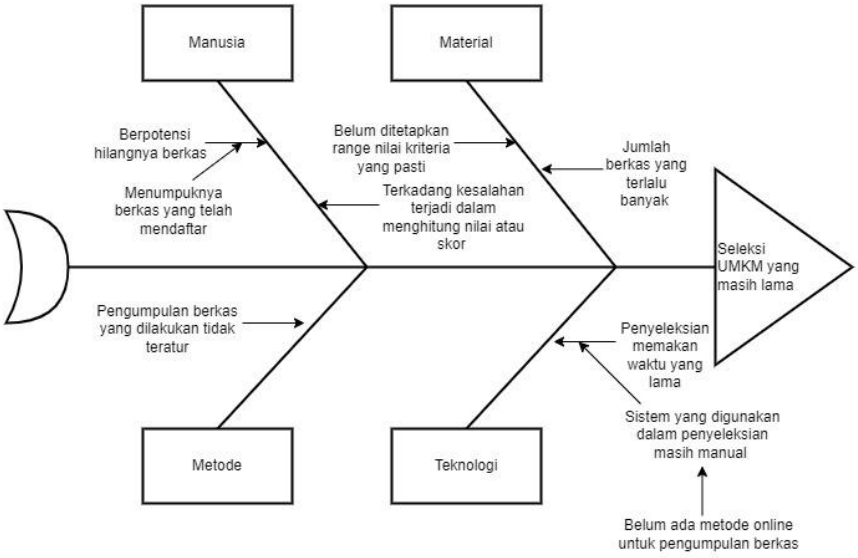

Figure 1 Fishbone Diagram Analisis Penyeleksian UMKM yang masih lama

A Decision Support System (DSS) is built to assist in making choices, in this case, to help the admin in selecting funding for registered MSMEs based on the terms and conditions set by the institution. A Decision Support System is part of a computer-based information system that includes a knowledge system used to support decision-making in an organization, individual, or even a company. A Decision Support System can also be defined as a computer system that processes data into information to make decisions for specific semi-structured problems[3].

The Simple Additive Weighting (SAW) method is one of the methods used to solve problems in multiple attribute decision making (MADM) [4]. The Simple Additive Weighting method is also often known as the weighted sum method. The basic concept of the Simple Additive Weighting method is to find the weighted sum of performance ratings for each alternative across all attributes. The underlying assumption of the Simple Additive Weighting (SAW) method is that each attribute is independent, so they do not influence each other. Scoring in this method is obtained by adding the contributions of each attribute[5].

Research related to the Simple Additive Weighting (SAW) method has been widely conducted. Among the studies that have been done are the one in [6], which examined the use of SAW to select the best online platform priorities. Weighting was applied to variables such as consumer reach segmentation, ease of use of the application, ease of chat platforms, and complete application features. Furthermore, the paper in [7] explored the use of SAW for selecting SME suppliers. Weighting was applied to variables including transport speed, discount rate, service, warranty, authenticity of goods, and payment terms. Lastly, research by Sahat Sonang [8] utilized SAW to determine the provision of SME credit at Bank Mandiri Pematangsiantar. Weighting was applied to variables such as income, collateral, loan limit, installments, length of business, and number of dependents.

Therefore, this research aims to design and develop a Decision Support System (DSS) website for MSME funding programs in Mataram City, focusing on three main components of the DSS: compiling and evaluating the database (data tables) to ensure that the database adequately supports the DSS in terms of effective and efficient MSME data storage and management; implementing and testing the Simple Additive Weighting (SAW) model to ensure that this model is sufficient to produce good, accurate, and fast decision alternatives in supporting MSME funding; and designing and assessing the user interface (UI) to ensure that the developed UI is adequate in processing and displaying decision alternatives and is easily accessible and usable by users. In developing the website, a decision support system will be implemented using the Simple Additive Weighting method, which is often known as weighted summation.

The Simple Additive Weighting (SAW) method was chosen because it has the fastest computation time and very good decision-making accuracy compared to other Multiple Criteria Decision Making (MCDM) methods, allowing administrators to quickly select MSME funding [9]. After the website is designed, it will be tested using black-box testing to determine whether the designed website functions as desired.

II. LITERATURE REVIEW

A. Decision Support System

A Decision Support System (DSS) is a system that can produce solutions to problems or the correlation of problem conditions ranging from partially structured to unstructured conditions. Many people are confused or do not know what decision to make, and this system can help individuals generate decisions[10].

A Decision Support System (DSS) provides information, guidance, predictions, and directions to users to make better decisions. A DSS is an implementation of decision-making theories introduced by disciplines such as management science and operations research. The difference from previous decision-making methods is that problems were solved manually through iterative calculations (usually to find minimum, maximum, and optimum values), whereas now computers have the capability to solve the same issues in a relatively short time[11]. The modules in a Decision Support System (DSS) can be seen in Figure 2.1[12].

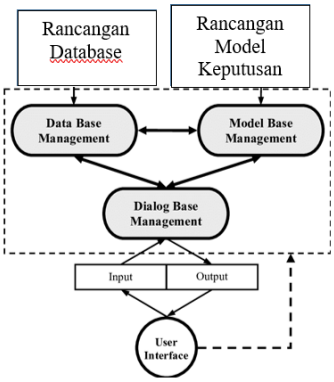

Figure 2. 1 Decision Suport System (DSS)[12]

B. Website

Muhyidin explained that a website is a service that provides information using the concept of hyperlinks. This concept makes it easier for computer users, often referred to as surfers, to browse information on the internet [13].

Furthermore, Doni & Rahman stated that a website is a collection of documents stored on a server and accessible by users through a computer browser. These documents can consist of many pages that present various information and interactions, such as text, images, videos, animations, sounds, and so on [14]

C. Simple Additive Weighting (SAW)

One of the methods to solve Multiple Attribute Decision Making (MADM) problems is the Simple Additive Weighting (SAW) method[15]. This method is also known as the weighted summation method. The basic concept of the Simple Additive Weighting (SAW) method is to calculate the weighted sum of each performance rating for all attributes [16].

In the Simple Additive Weighting (SAW) method, it is necessary to normalize the decision matrix (X) into a scale so that all ratings can be compared. The SAW method is known for using weights for each established criterion[16]. By applying the Simple Additive Weighting (SAW) method in a decision support system, ranking results can be obtained effectively, and the results can be used for decision-making. The final result of this system is an evaluation of those who receive the highest score among all [17].

In the Simple Additive Weighting (SAW) method, there are two attributes called benefit criteria and cost criteria. The difference between them lies in how they are used in problem conditions. These two attributes will be used in the calculation process of the Simple Additive Weighting (SAW) method [16].

Equation (1):

$$R_{ij} = \begin{cases} \dfrac{X_{ij}}{Max_i\ X_{ij}} & If\ J\ it\ is\ a\ benefit\ attribute \\ \dfrac{Min_i\ X_{ij}}{X_{ij}} & If\ J\ is\ a\ cost\ attribute \end{cases} \quad (1)$$

Explantion :

R_{ij} = Normalized Performance Rating

Max_i = Maximum Value of Each Criterion

Min_i = Minimum Value of Each Criterion

X_{ij} = Attribute Value of Each Criterion

Benefit = If the highest value is the best value

Cost = If the lowest value is the best value

Where R_{ij} is the normalized performance of alternative Ai on attribute C_j; i=1,2,…,m and j=1,2,…,n. The Preferences values for each alternative (V_i) is given by equation (2):

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

Expalanation :

V_i = Preferences Value

W_j = Ranking Weight

R_{ij} = Normalized Performance Rate

A larger V_i value indicates that A_i is more preferred[4]. The Following is the process carried out in the Simple Additive Weighting (SAW)[16]:

1. Determine the criteria to be used as the basis for decision making, denoted as C.
2. Determine the level of suitability for each criterion.
3. Create decision matrix for each criterion (C), then normalize it based on the appropriate equations for each type of attribute(both benefit and cost attribute)
4. The final ranking result is obtained by multiplying the normalized matrix R with the weight vector, so the best alternative (A) is selected as the solution with the highest value.

The advantage of the Simple Additive Weighting (SAW) method compared to other problem-solving methods lies in its ability to perform more accurate evaluations based on the established criteria values and preference weights. Additionally, the SAW method has the advantage of selecting the best alternative from a set of available options due to the ranking process after determining the weights for each attribute [16][18].

D. Blackbox Testing

Blackbox Testing is a testing method that focuses on the functional specifications of the software. The results of blackbox testing can determine the set of input conditions and test the functional specifications of the program using the established requirements. The blackbox testing process involves testing the program by entering data into each of its forms. This step aims to verify whether the program meets the company's needs. Blackbox testing is not a replacement for whitebox testing but is an additional approach to finding issues that may not be detected using whitebox testing [19].

Blackbox testing aims to detect errors in several aspects, as described in [19]:

1. Function that do not work correctly or are missing.
2. Issues with the user interfaces.
3. Errors in data structures or when accessing external databases.
4. Performance issues.
5. Problems with initialization and termination processes.

III. RESEARCH METHOD

A. Research Method

Research methodology is a sequence of processes carried out in a study, typically represented in the form of a flowchart.

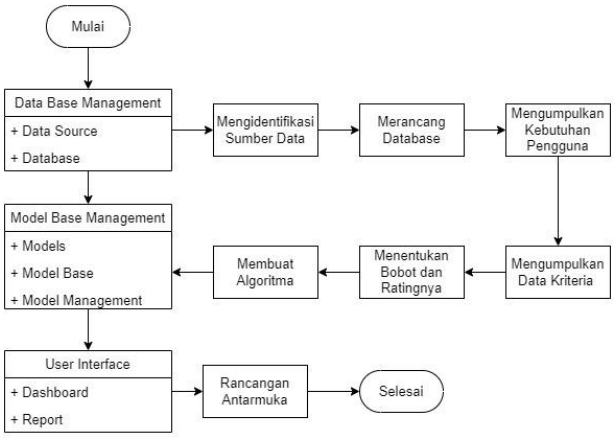

Figure 3.1 Research Method

The flowchart in Figure 3.1 illustrates the process of developing a decision support system website for MSME selection. The decision support system consists of three main components: database management, model base management, and user interface. The process starts with gathering user requirements to identify the needs for developing the website, identifying data sources to determine the relevant data sources to be used, designing the database to create a structure for storing and managing data, collecting criteria and alternative data to establish the criteria data obtained from the company, determining weights and ratings for each criterion through interviews and discussions with the company, followed by creating algorithms to manage the data, and finally designing the website interface.

B. Identifying Problems

The data for creating the website was obtained from the Performance, Risk, & QoS unit of PT XYZ. The data was gathered through an interview with one of the managers at PT XYZ. During the interview, it was revealed that PT XYZ plans to create a program called the Funding Program. This program is designed to help MSMEs develop their ongoing businesses. The goal of the Funding Program is to provide financial assistance to MSMEs in need. In addition, the program includes supporting activities such as seminars, training, and more. The program will involve a selection process for MSMEs to receive the requested funding. This selection process is based on the criteria and conditions set by PT XYZ. If conducted manually, there could be opportunities for errors such as scattered or lost documents and lengthy processing times if there are many applicants. To streamline the program, PT XYZ needs a website that can facilitate quick selection and minimize potential issues. Therefore, the author is developing a Decision Support System (DSS) website to provide a solution to PT XYZ's challenges.

C. Design Database

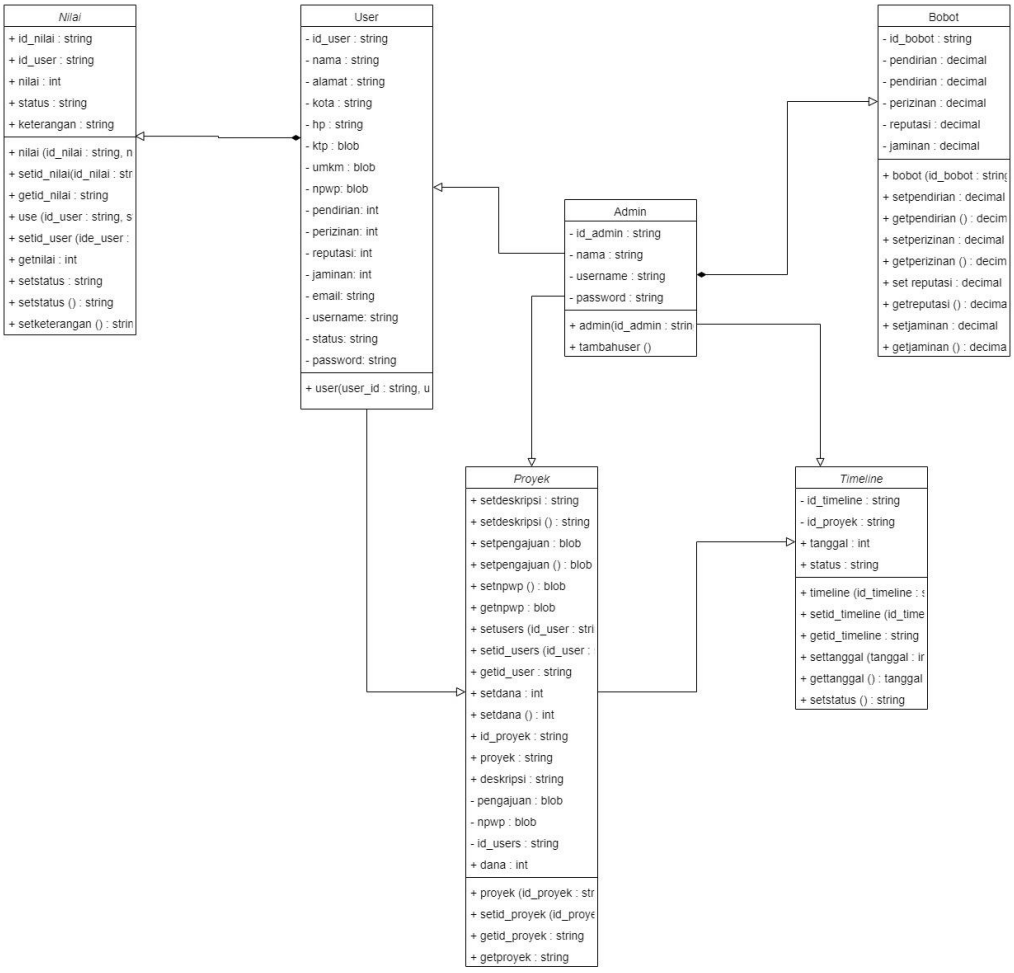

Figure 3.2 Design Database

The MSME database consists of 5 classes: admin, user, weight, value, project, and timeline. In the system, the admin is the primary actor responsible for managing the operations of all classes. The admin class is responsible for handling the user, weight, project, and timeline classes. In the user class, the admin's tasks include adding, editing, deleting, and searching for users. In the weight class, the admin's role is to assign weight values to each criterion. In the project and timeline classes, the admin manages the attributes by adding, editing, deleting, and searching within those classes. The user class has a strong relationship with the value class because the value class contains the names of users with the highest scores or those who have been selected and can receive funding assistance. The user class also has a relationship with the project class, where each user who registers can view the projects they have submitted in the project class, and users can also view the timeline of their submitted projects in the timeline class, which is linked to the project class. Users can view their projects and timelines on their dashboard page.

D. Gathering User Requirements

Data collection related to the research and development of the system is conducted through literature review, interviews, and using information provided by PT XYZ. The section on gathering user requirements includes subsections such as: problem analysis, problem solving, activity diagram, functional requirements, system functions, hardware requirements, software requirements, and decision support system criteria.

E. Collecting Criteria Data

In the Simple Additive Weighting (SAW) method, there are two types: benefit and cost. Benefit is a type of criterion that is advantageous for making a decision, while cost is the opposite of benefit. In this research, the funding criterion is taken as a cost type. The cost type selected is funding because if the amount requested by MSME applicants is larger, the company's risk of loss increases, and vice versa. Therefore, if an MSME applicant requests a large amount of funding, the points awarded will be lower, and vice versa. The benefit and cost criteria data can be adjusted according to the required criteria to develop an effective decision support system.

The criteria data used in this research for the MSME funding program in Mataram City are as follows:

Tabel 1 Criteria Data

Criteria Code	Name of Criteria	Type
C1	Pendirian	Benefit
C2	Dana	Cost
C3	Reputasi	Benefit
C4	Jaminan	Benefit

F. Determining the Citeria Weights and Ratings

The values that have been determined for calculating the weights can be seen in Table 2.

Tabel 2 Weights Table

No	Value	Explanation
1	1	Very Low
2	2	Low
3	3	Middle
4	4	High
5	5	Very High

The system has established the weights as shown in Table 2. These weights are used in calculations to determine the results. Values from 1 to 5 are used in the calculations to simplify the division, thus avoiding decimal numbers in the initial computations and speeding up the calculation process.

From these weight values, there are several conditions that must be met to achieve the highest score. The assignment of weights depends on the requirements provided by the MSME applicants. If the documents submitted by the applicants meet the company's requirements and conditions, a high criterion score will be awarded. The following are the requirements for each criterion category:

- Requirement of Establishment Criteria (C1)
  - Some required permits include :
    a. Possessing a NIB (Business Identification Number)
    b. Possessing an IUMK (Micro and Small Business License)
    c. Possessing a Distribution Permit
    d. Possessing a Personal Tax Identification Number (NPWP)
    e. Possessing a SITU (Business Place Permit)
    f. Possessing a SKDU (Certificate of Domicile for Business)
    g. Possessing a Legal Entity Approval Decree
       - If an MSME (Micro, Small, and Medium Enterprise) that registers has been operating for at least 1 year and not yet 2 years but does not have the required permits, it will not receive any points.
       - If an MSME that registers has been operating for at least 1 year and not yet 2 years and has 1 required permit, it will not receive any points.
       - If an MSME that registers has been operating for at least 1 year and not yet 2 years and has 2 required permits, it will be given 3 points.
       - If an MSME that registers has been operating for 2-5 years and has 2 or 3 required permits, it will be given 3 points.
       - If an MSME that registers has been operating for 2-5 years and has 4 required permits, it will be given 4 points.
       - If an MSME that registers has been operating for more than 5 years and has 5 required permits, it will be given 5 points.
       - If an MSME has been operating for less than 1 year, it will not qualify.
- Rewuirements for Fund Criteria (C2)
  - Some fund regulations include :
    a. Fund I : 5.0000.000-10.000.000
    b. Fund II : 15.000.000-20.000.000
    c. Fund III : 20.000.000-35.000.000
    d. Fund IV : 35.000.000-50.000.000
    e. Fund V : Lebih dari 50.000.000
       - If an MSME that registers applies for Fund I, it will be given 5 points.
       - If an MSME that registers applies for Fund II, it will be given 5 points.
       - If an MSME that registers applies for Fund III, it will be given 4 points.
       - If an MSME that registers applies for Fund IV, it will be given 4 points.
       - If an MSME that registers applies for Fund V, it will be given 3 points.
- Requirements for Reputation Criteria (C3)
  - Some reputation requirements and conditions include:
    a. Testimonials (user experiences) or honest reviews regarding the product or brand, as well as honesty and ethics.
    b. The MSME has no bad credit.
    c. The financial state of the MSME, such as: the brand's finances are stable and it sells its products consistently, or the brand's finances are less stable but it sells its products beyond the target.

d. No history of legal issues.
   - To determine reputation, the company will observe or survey the registered MSMEs and then discuss the findings among the team members.
   - If an MSME that registers meets 1 or 2 reputation requirements, it will not receive any points.
   - If an MSME that registers meets 3 reputation requirements, it will be given 3 points.
   - If an MSME that registers meets 4 reputation requirements, it will be given 4 points.
   - If an MSME that registers meets 5 or more reputation requirements, it will be given 5 points.

- Requirement for Guarantee Criteria (C4)

  ➢ Some guarantee requirements include :
  a. The guarantee provided must be in the applicant's own name.
  b. The value of the guarantee provided must be at least equal to or greater than the amount being applied for.
     - If an MSME that registers provides a guarantee in their own name and the value of the guarantee is equal to the amount being applied for, it will be given 3 points.
     - If an MSME that registers provides a guarantee in their own name and the value of the guarantee exceeds the amount being applied for, it will be given 4 points.
     - If the guarantee is not in the applicant's own name, the application will be automatically rejected.

To determine the weight for each criterion, the weight values to be used are adjusted according to the preferences of PT XYZ. These weight values have been validated through discussions among the internal parties of the company. The criteria weight table can be seen in Table 3 below:

Tabel 3 Weight Criteria Table

Criteria Code	Name of Criteria	Criteria Weight
C1	Establishment	5
C2	Funding	3
C3	Reputation	4
C4	Guarantee	4

G. Create Algotirthm

```php
<?php
//echo "<h1>Metode Simple Additive Weighting (SAW)</h1>";
class SAW{
    public  $cn;public  $alternatif=array();public $table;public  $kriteria=array();private  $bobot=array();
    public  $varminmax=array();public   $minval=array();public  $maxval=array();public  $norm=array();public
    $norm_bobot=array();public  $sum_norm_bobot=array();private $panel_open;private $panel_close;
    public function __construct(){$this->cn=$cn=mysqli_connect("localhost","root","","umkm");}
    public function panel_open($name_panel){echo "<div class='panel panel-primary' style='width:100%;overflow:auto;'>
    <div class='panel-heading'><h3>$name_panel</h3></div><div class='panel-body'>";}
    public function panel_close(){echo "</div></div>";}
    public function set_table($table,$kriteria){
        //SET kriteria, Bobot, Variabel Minimum dan Maximum
        foreach ($kriteria as $key => $val) {
            $this->kriteria[]=$key;
            $this->bobot[]=$val[0];
            $this->varminmax[]=$val[1];
        }
        $fd=array();
        for($i=0;$i<count($this->kriteria);$i++){
            //if($this->kriteria[$i]=='pendirian'){

                //$fd[]="max(if(2024-".$this->kriteria[$i].">5,5,2024-".$this->kriteria[$i].")) as max_".$this->kriteria[$i].",min(if(2024-".$this->kriteria[$i].">5,5,2024-".$this->k

            //}
            //else{
                $fd[]="max(".$this->kriteria[$i].") as max_".$this->kriteria[$i].",min(".$this->kriteria[$i].") as min_".$this->kriteria[$i];
            //}
        }
        //SET Nilai Minimum dan Maximum
        $this->table=$table;
        $rs=mysqli_query($this->cn,"select ".implode(",",$fd)." from ".$this->table);
```

Figure 3.3 Source code Simple Additive Weighting (SAW)

In developing the website for this research, the PHP programming language was used. Figure 3.4 shows a snippet of the Simple Additive Weighting (SAW) program code created in this research. The above programming language explains the code to set the weight criteria and minimum-maximum variables, and declares arrays for the criteria that will be used. In the calculation process of the Simple Additive Weighting (SAW) method, the predetermined criteria will be used, and these criteria will have values that will be processed in the calculations. The final result of this method is called ranking.

H. User Interface

The interface design is created to facilitate the input or output of data in accordance with all functional requirements. Here is an example of the interface design for the functional requirements FRP01 and FRP04.

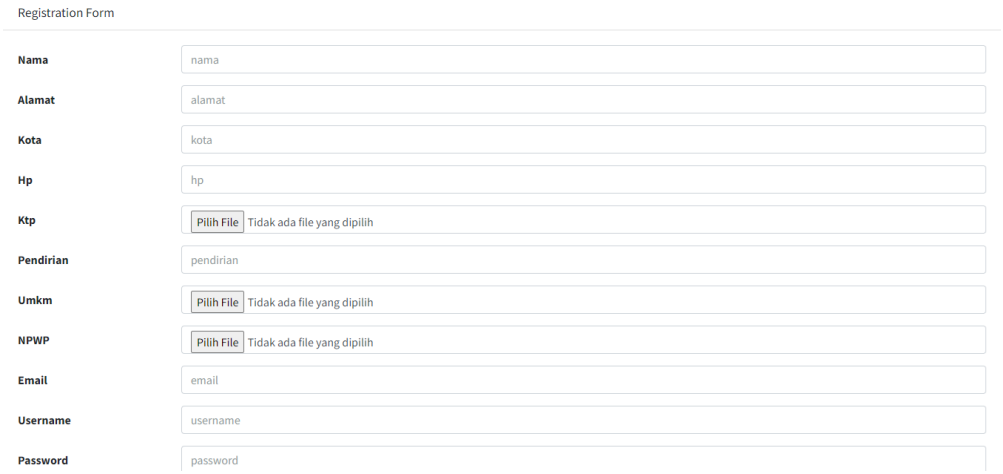

Figure 3.4 Functional Requirement of User interface FRP01

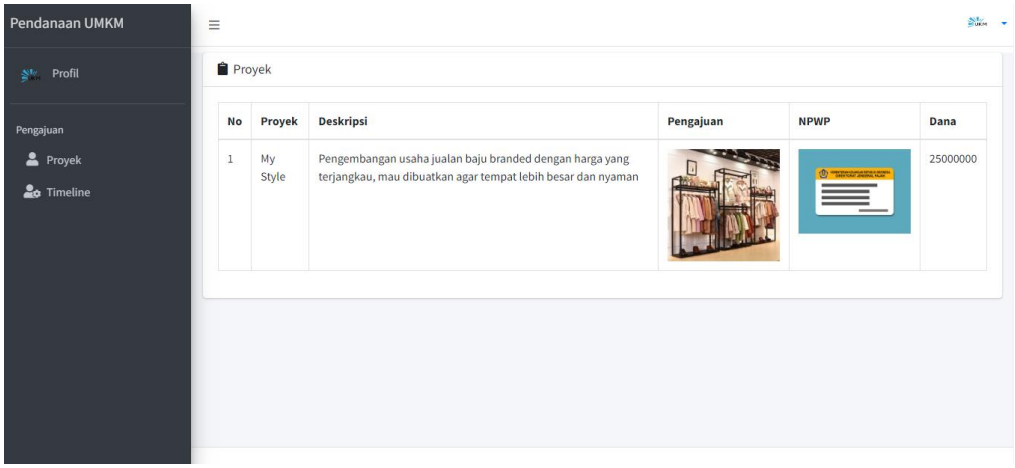

Figure 3.5 Functional Requirement of User interface FRP04

Figure 3.4 shows the registration form for MSME applicants. This registration form is filled out by MSME applicants who want funding for their current business operations. MSME applicants must first fill out the registration form or complete the registration process before they can log in to their accounts. Once MSME applicants have registered, they can log in to their respective accounts. On the MSME applicants' page, they can only edit their profiles and view the projects that have been entered by the admin in accordance with the physical documents submitted by the MSME applicants to the company. In addition to viewing projects, MSME applicants can also see the timeline of the projects they have submitted. Those who achieve the highest scores will receive funding from the company. MSME applicants can check the success of their project proposals in the timeline menu and will also receive an email from the company if they reach the top rank or highest score.

IV. RESULTS AND DISCUSSION

A. User Interface of Website

The following is the display of the interface design for MSMEs that has been developed.

Firstly, MSMEs that wish to participate in the funding program must first register by filling out the provided form, as shown in Figure 3.4. After completing the registration, MSMEs can then log in, as illustrated in Figure 4.1 below.

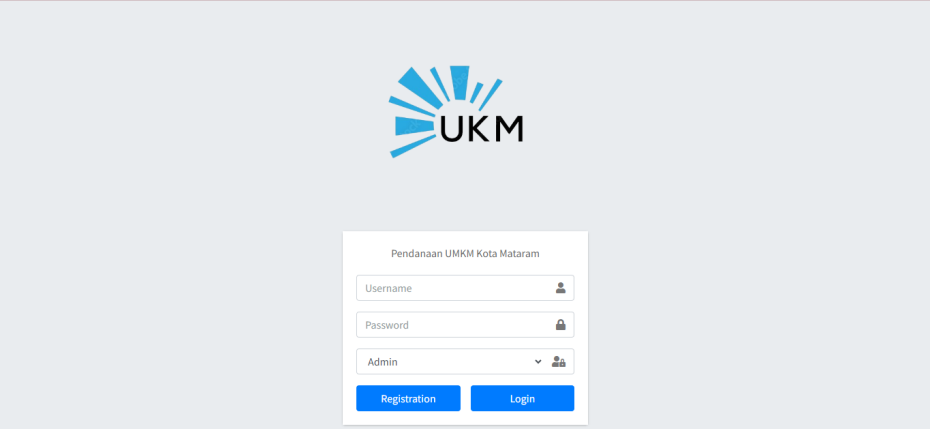

Figure 4.1 User Interface of login

Before logging into the website, MSMEs must first complete the registration process by accurately filling out all required data. This data will be entered into the system, allowing applicants to then log in to the website. The registration interface for applicants meets Functional Requirement 01 (FRP01).

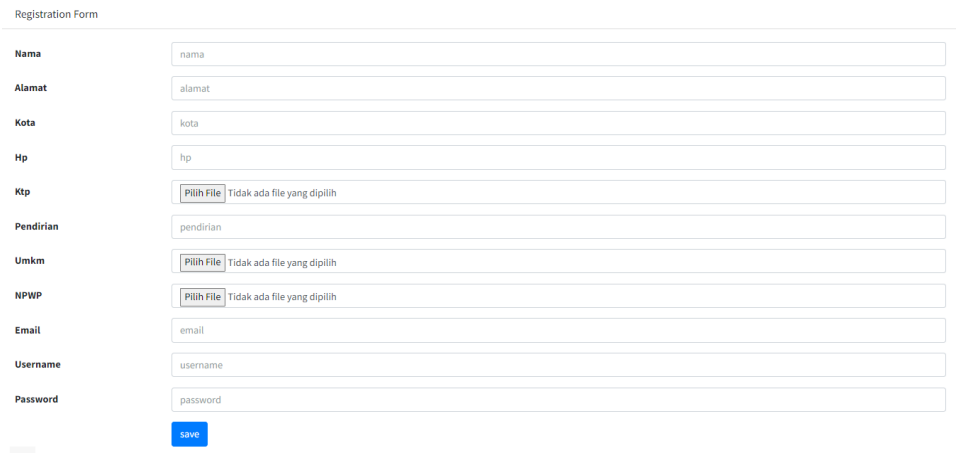

Figure 4.2 User Interface of Registration

Next, Figure 4.3 shows the admin system page. This page can only be accessed by the admin. The admin processes all the data of the applicants and inputs the project data to be submitted by the applicants. Functional Requirement 02 (FRP02) corresponds to the display of the admin system interface.

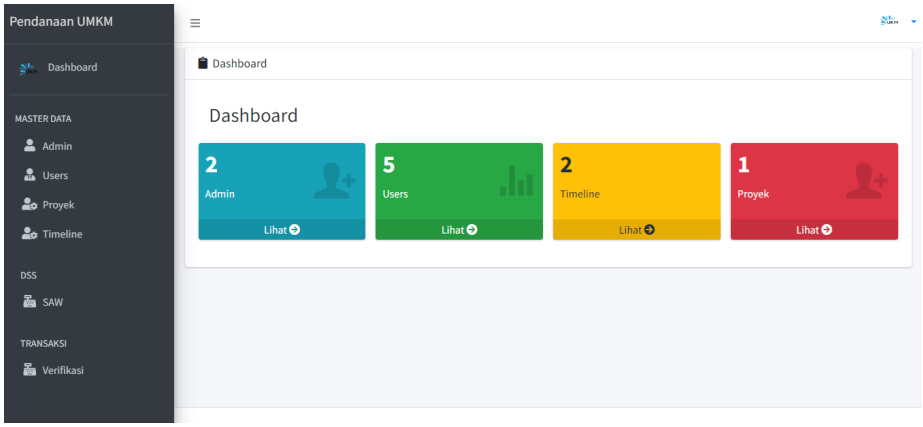

Figure 4.3 User Interface of Admin

On the applicant menu page, you will find the data entered by the applicants through registration, along with additional notes and status information in the user menu. The system will handle filling out the status and notes to determine who has been successful or qualified for funding. This user menu display meets Functional Requirements Admin 03-06 (FRA03-06).

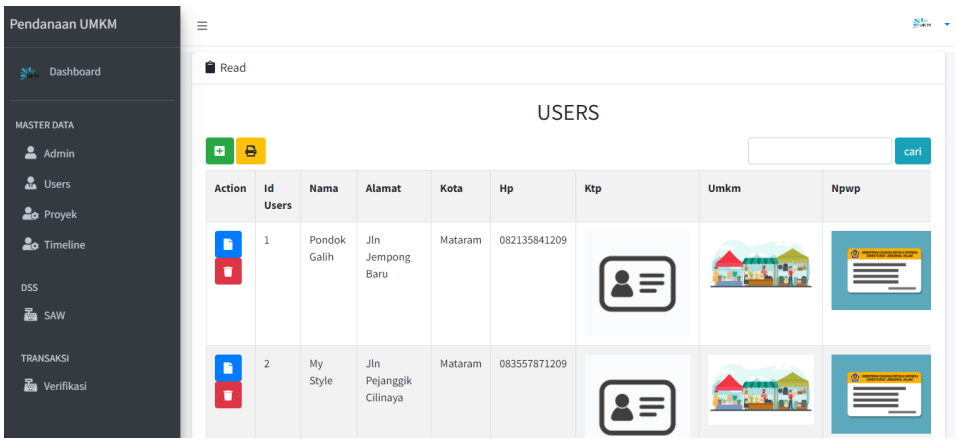

Figure 4.4 User Interface of User

On the project page, manual data entry by the admin will be conducted based on the forms submitted by the applicants to the company. This page is still handled manually by the admin for entering applicant data. On this page, it is possible to input, edit, and delete data. Functional Requirements Admin 07-10 (FRA07-10) correspond to the display of the project menu.

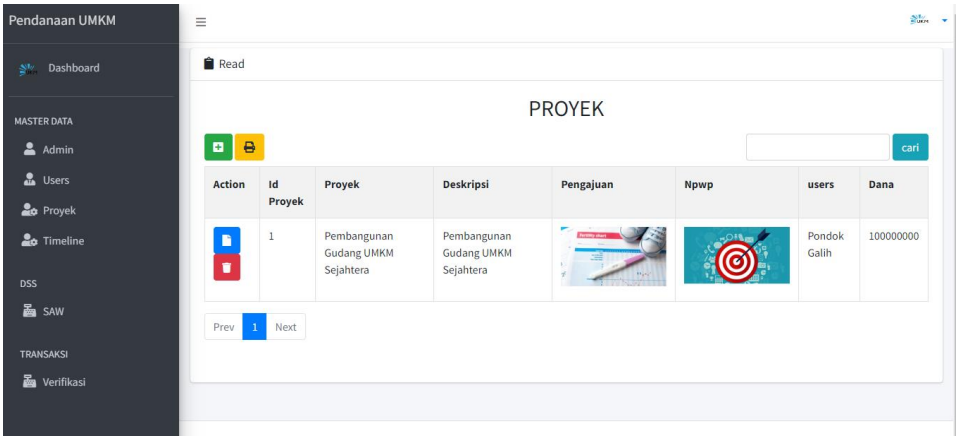

Figure 4.5 User Interface of Project

On the timeline page, manual data entry by the admin will be conducted. This timeline is used to track the duration of data filtering for applicants and to verify whether all submitted documents comply with the requirements and conditions set by the company. Functional Requirements Admin 11-14 (FRA11-14) correspond to the display of the timeline menu.

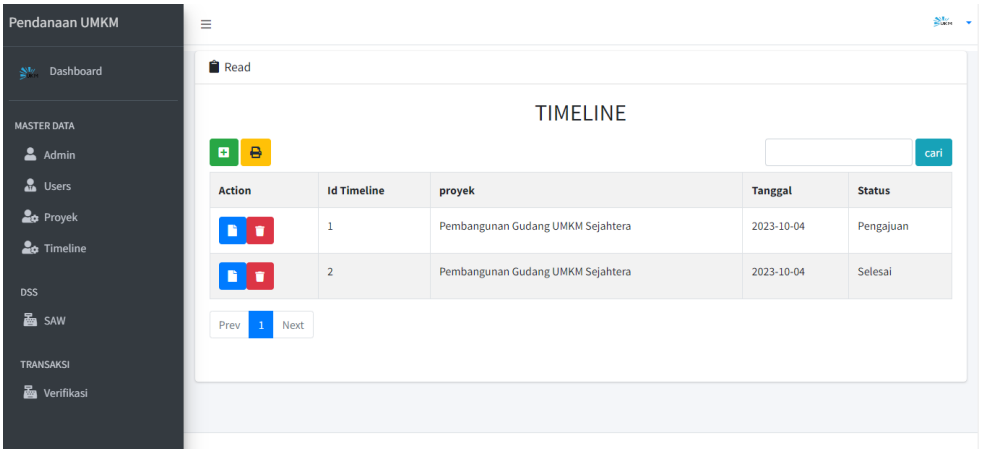

Figure 4.6 User Interface of Timeline

On the SAW menu page, calculations will be performed according to the steps of the SAW method. Before performing the calculations, there must be values assigned to the criteria that have been established. As shown in Figure 4.7, values for each of the criteria are displayed. Functional Requirement Admin 15 (FRA15) corresponds to the display of the Simple Additive Weighting (SAW) menu.

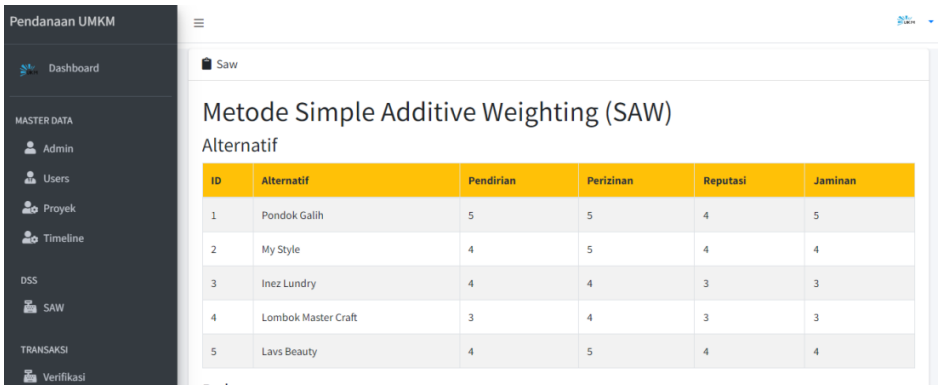

Figure 4.7 User Interface of Menu Simple Additive Weighting (SAW)

After assigning values to the criteria, the next step is to set or determine the weights to be used in the calculations. The display below shows the weights menu for the Simple Additive Weighting (SAW) method.Subsequently, calculations will be performed by computing the minimum values for cost criteria (Establishment) and maximum values for criteria (Funds, Reputation, Guarantee). Once the results for each calculation are obtained, normalization will be applied to the results. This process can be seen in Figure 4.8. The normalization calculations for the Simple Additive Weighting method correspond to Functional Requirement 16 (FRA16).

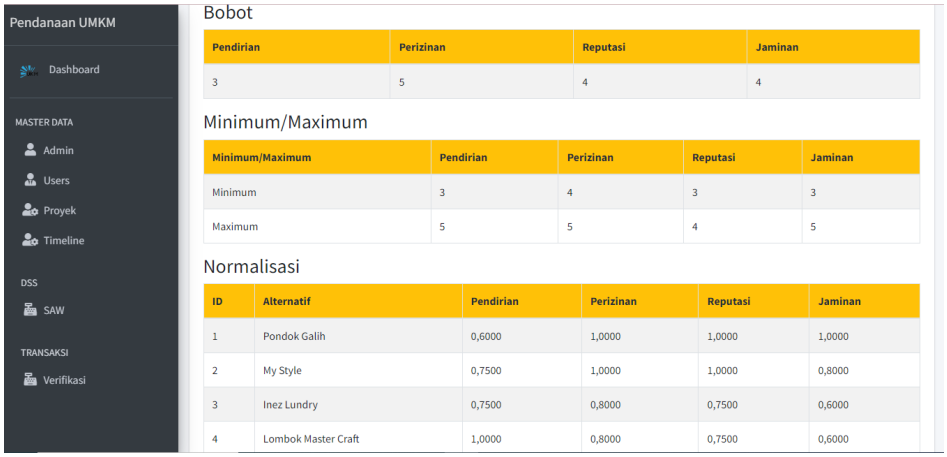

Figure 4.8 User Interface of Menu Simple Additive Weighting (SAW)

Next, the results of the normalization will undergo further calculation by multiplying the normalized results with the predetermined weights. After obtaining the multiplication results, the next stage will be the ranking process. This phase is part of the normalization process.

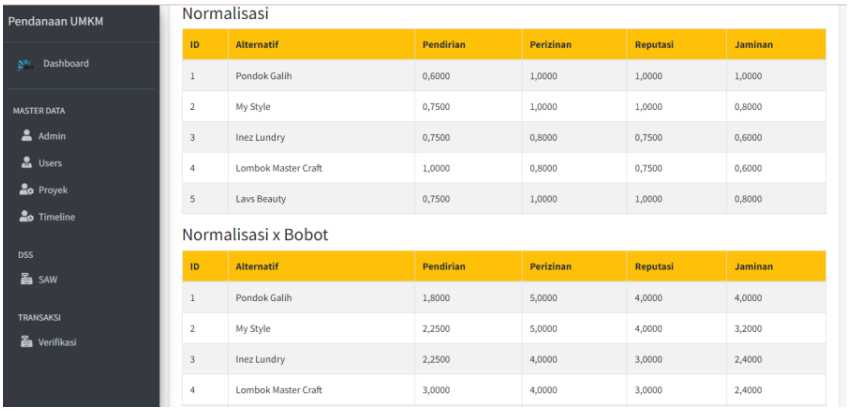

Figure 4.9 User Interface of Menu Simple Additive Weighting (SAW)

After obtaining the values from the previous process, this stage involves summing the scores from the four criteria. The final scores will then be ranked from highest to lowest to determine which MSMEs have successfully qualified for the funding program.

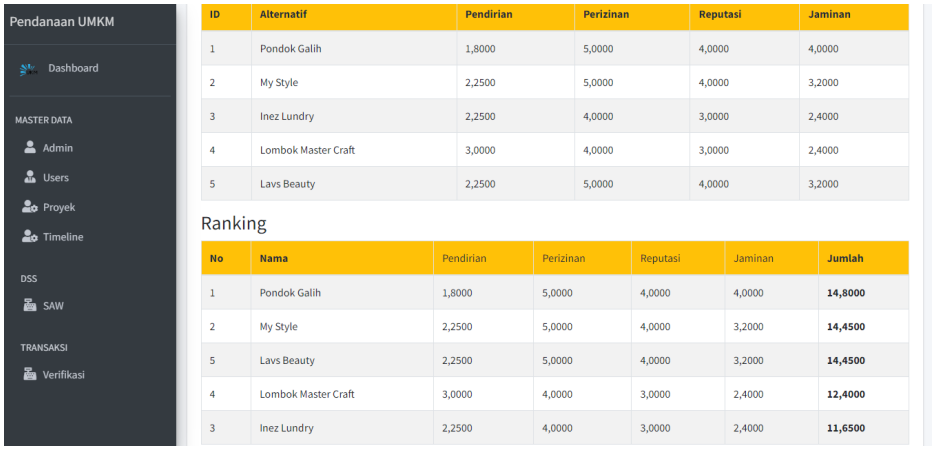

Figure 4.10 User Interface of Menu Simple Additive Weighting (SAW)

The admin will verify the data of MSMEs that receive the highest scores to categorize them as those who have successfully qualified for funding. The verification menu display corresponds to Functional Requirements 17-20 (FRA17-20).

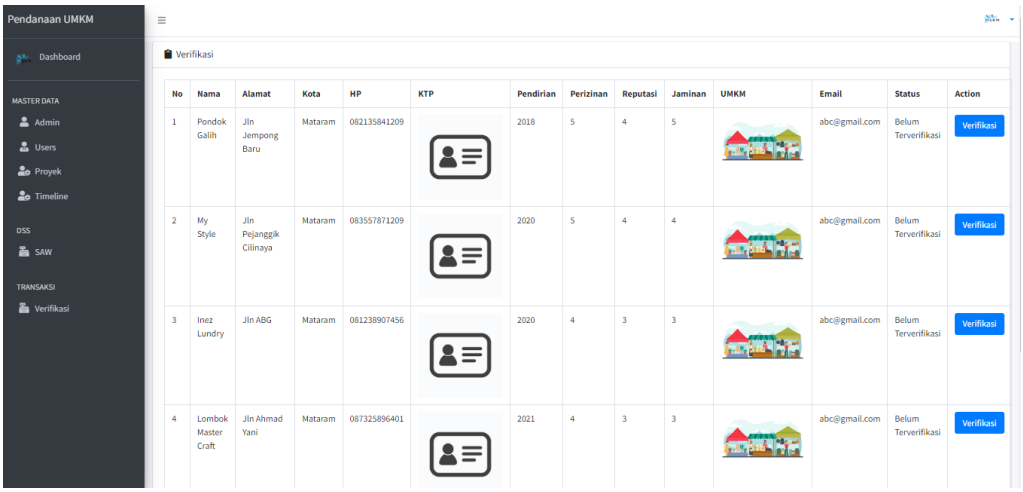

Figure 4.11 User Interface of Verification Menu

This section provides a summary of the final scores for the applicants, along with information regarding their status and notes on the funding process they applied for. The scores menu will be managed by the admin and corresponds to Functional Requirements 21-24 (FRA21-24).

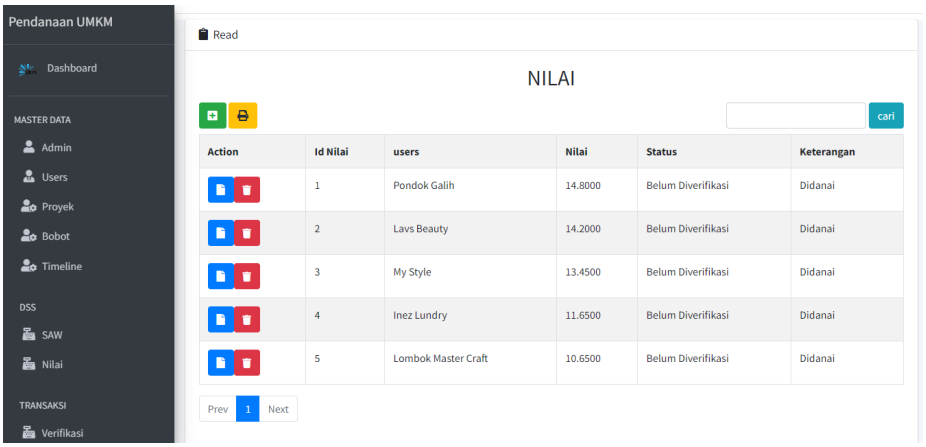

Figure 4.12 User Interface of Score Menu

B. Blackbox Testing

Black-box testing is the process of evaluating the performance and functionality of a software application to ensure it operates as expected. In software development, testing is crucial to achieve the goals of the software, such as measuring its quality and identifying any bugs. To test the system, an implementation of a testing plan for trial runs of the program is created..

In black-box testing, two types of testing are used: alpha testing and beta testing. These tests include results and analysis conducted across all testing phases. The purpose is to determine whether the system has achieved the expected level of functionality. Here is the process for alpha testing:

Alpha testing is conducted towards the end of the development process for a website or application. The goal of this testing is to ensure that the website or application operates smoothly without any errors or bugs. This test is considered successful if the output matches the expected results. In this research, the alpha testing will be performed on the developed website.

To test the functionality of the MSME website, the interface design will be examined in detail at the following link: https://bit.ly/HasilPengujianUMKM.

After completing alpha testing, beta testing will be conducted by PT. XYZ. The scenarios for the beta testing process are as follows:

Beta testing is a type of software testing conducted by end users, also known as User Acceptance Testing (UAT). This testing is performed objectively to determine how well the developed website helps in solving the identified problems and meets user expectations. The goal is to assess whether the website effectively addresses the issues described in the problem identification and aligns with user needs and expectations.

The scenarios for beta testing in this research can be viewed at the following link: https://bit.ly/HasilPengujianUMKM.

C. Manual Modeling of Simple Additive Weighting (SAW)

In processing data using the Simple Additive Weighting (SAW) method, calculations are performed in four stages: defining the criteria to be used as a reference, determining suitability ratings, creating a decision matrix, and finally, ranking. The criteria to be used can be tailored to the company's needs by interviewing performance, risk, and quality of service (QoS) managers. Based on the interviews, the following criteria data was obtained.

Table 4.2 Critea of Data

Code Criteria	Name of Criteria	Type
C1	Establishment	Benefit
C2	Funding	Cost
C3	Reputation	Benefit
C4	Guarantee	Benefit

Next, calculations will be performed using the Simple Additive Weighting (SAW) method. The data used in the research is tailored to the preferences of PT XYZ. The following is the table of alternative data selection:

Table 4.3 Alternative of Data

Code	UMKM	Alternative
A1	UMKM of the culinary field	Pondok Galih
A2	UMKM of the fashion field	My Style
A3	UMKM of the service field	Inez Laundry
A4	UMKM of the creative field	Lombok Master Craft
A5	UMKM of the beauty field	Lavs Beauty

The criteria data used for selection in PT. XYZ's funding program are as follows:

Tabel 4.4 Tabel Bobot Kriteria

Code Criteria	Name of Criteria	Criteria Weight
C1	Establishment	5
C2	Funding	3
C3	Reputation	4
C4	Guarantee	4

In this research, several alternative data will be used as case examples by the researcher. The data for each criterion can be seen in Table 4.5.

Tabel 4.5 Alternative Data

Code	Establishment	Funding	Reputation	Guarantee
A1	5	5	4	5
A2	4	4	4	4
A3	4	4	3	3
A4	3	4	3	3
A5	4	3	4	4

The next step is to create the normalization matrix using the data provided in Table 4.5.

$$X = \begin{Bmatrix} 5 & 5 & 4 & 5 \\ 4 & 4 & 4 & 4 \\ 4 & 4 & 3 & 3 \\ 3 & 4 & 3 & 3 \\ 4 & 3 & 4 & 4 \end{Bmatrix}$$

Next, normalization matrix X will be converted into normalization matrix R, resulting in the matrix R as shown below:

$$r_{11} = \frac{5}{max\ (5,4,4,3,4)} = \frac{5}{5} = 1 \qquad r_{12} = \frac{\min(5,4,4,4,3)}{5} = \frac{3}{5} = 0{,}6$$

$$r_{21} = \frac{4}{max\ (5,4,4,3,4)} = \frac{4}{5} = 0{,}8 \qquad r_{22} = \frac{\min(5,4,4,4,3)}{4} = \frac{3}{4} = 0{,}75$$

$$r_{31} = \frac{4}{max\ (5,4,4,3,4)} = \frac{4}{5} = 0{,}8 \qquad r_{32} = \frac{\min(5,4,4,4,3)}{4} = \frac{3}{4} = 0{,}75$$

$$r_{41} = \frac{3}{max\ (5,4,4,3,4)} = \frac{3}{5} = 0{,}6 \qquad r_{42} = \frac{\min(5,4,4,4,3)}{4} = \frac{3}{4} = 0{,}75$$

$$r_{51} = \frac{4}{max\ (5,4,4,3,4)} = \frac{4}{5} = 0{,}8 \qquad r_{52} = \frac{\min(5,4,4,4,3)}{3} = \frac{3}{3} = 1$$

$$r_{13} = \frac{4}{\max(4,4,3,3,4)} = \frac{4}{4} = 1 \qquad r_{14} = \frac{5}{\max(5,4,3,3,4)} = \frac{5}{5} = 1$$

$$r_{23} = \frac{4}{\max(4,4,3,3,4)} = \frac{4}{4} = 1 \qquad r_{24} = \frac{4}{\max(5,4,3,3,4)} = \frac{4}{5} = 0{,}8$$

$$r_{33} = \frac{3}{\max(4,4,3,3,4)} = \frac{3}{4} = 0{,}75 \qquad r_{34} = \frac{3}{\max(5,4,3,3,4)} = \frac{3}{5} = 0{,}6$$

$$r_{43} = \frac{3}{\max(4,4,3,3,4)} = \frac{3}{4} = 0{,}75 \qquad r_{44} = \frac{3}{\max(5,4,3,3,4)} = \frac{3}{5} = 0{,}6$$

$$r_{53} = \frac{4}{\max(4,4,3,4)} = \frac{4}{4} = 1 \qquad r_{54} = \frac{4}{\max(5,4,3,3,4)} = \frac{4}{5} = 0{,}8$$

The calculations above are for matrix RRR. The computation for matrix RRR is adjusted according to the type of criterion. If the criterion is a **cost criterion**, the formula used is as follows:

$$r_{ij} = \left\{\frac{X_{ij}}{\max X_{ij}}\right\}$$

If the criterion is a **benefit criterion**, the calculation formula used is as follows:

$$r_{ij} = \left\{\frac{\min X_{ij}}{X_{ij}}\right\}$$

In the calculation of matrix RRR, the funding criterion is computed using the cost formula, as it falls under the cost criteria category. After performing the calculations for matrix RRR, the next step is to calculate the weighted scores. The results of the normalization and weight multiplication can be seen in Table 4.6.

Table 4.6. Normalization Score

Code	Establishment	Funding	Reputation	Guarantee
A1	1	0,6	1	1
A2	0,8	0,75	1	0,8
A3	0,8	0,75	0,75	0,6
A4	0,6	0,75	0,75	0,6
A5	0,8	1	1	0,8

The formula for calculating the ranking (V) is obtained by multiplying each alternative's score by the weight of each criterion and then summing the results. The formula for ranking calculation is as follows:

V1 = (5*1) + (3*0,6) + (4*1) + (4*1) = 5 + 1,8 + 4 + 4 = 14,8

V2 = (5*0,8) + (3*0,75) + (4*1) + (4*0,8) = 4 + 2,25 + 4 + 3,2 = 13,45

V3 = (5*0,8) + (3*0,75) + (4*0,75) + (4*0,6) = 4 + 2,25 + 3 + 2,4 = 11,65

V4 = (5*0,6) + (3*0,75) + (4*0,75) + (4*0,6) = 3 + 2,25 + 3 + 2,4 = 10,65

V5 = (5*0,8) + (3*1) + (4*1) + (4*0,8) = 4 + 3 + 4 + 3,2 = 14,2

The result of the ranking calculation (V) represents the final score that will be used for the UMKM funding program in Kota Mataram. The following is the ranking of the funding program for UMKM based on their respective fields:

Table 4.7 Results of the UMKM Funding Program Ranking in Kota Mataram

No	Name	Ranking (V)
1	Pondok Galih	14,8
2	My Style	13,45
3	Inez Laundry	11,65
4	Lombok Master Craft	10,65
5	Lavs Beauty	14,2

Based on the calculations using the Simple Additive Weighting (SAW) method, it is concluded that the selected UMKM for funding assistance in Kota Mataram is UMKM Pondok Galih, with a score of 14.8.

D. Modeling Simple Additive Weighting Using a Program

The calculations performed using both the program and manual methods yielded the same results. In both cases, the highest score was obtained by UMKM Pondok Galih.

Ranking

No	Nama	Pendirian	Dana	Reputasi	Jaminan	Jumlah
1	Pondok Galih	5,0000	1,8000	4,0000	4,0000	**14,8000**
5	Lavs Beauty	4,0000	3,0000	4,0000	3,2000	**14,2000**
2	My Style	4,0000	2,2500	4,0000	3,2000	**13,4500**
3	Inez Lundry	4,0000	2,2500	3,0000	2,4000	**11,6500**
4	Lombok Master Craft	3,0000	2,2500	3,0000	2,4000	**10,6500**

Gambar 4.13 Results of Calculations Using Program Code

V. Conclusion

Based on the objectives and results of the analysis and testing conducted in the design and development of the Decision Support System (DSS) website for the MSME funding program in Mataram City, it can be concluded that the design and development of this website have been successful. The research results indicate that the designed database adequately supports the DSS in terms of effectively and efficiently storing and managing MSME data.

The use of the Simple Additive Weighting (SAW) method has also successfully developed the system quickly and provided accurate values for selecting MSMEs. Testing was conducted in two ways: manually and using the developed code, with consistent final results of 14.8 for the MSME named Pondok Galih.

Additionally, the effectiveness testing performed on the system using the black-box method shows that the developed system meets the desired requirements. All features operate as intended, and no errors or bugs were found in its functionality. Thus, the developed UI proves to be adequate for processing and displaying decision alternatives easily and efficiently.

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