IMPLEMENTATION OF THE SIMPLE ADDITIVE WEIGHTING METHOD IN A DECISION SUPPORT SYSTEM FOR DETERMINING THE BEST EMPLOYEE

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Abstract: *The best and most qualified employees are a very valuable asset for the company. They can make various significant contributions, which have a positive impact on the Company's growth and sustainability. Therefor a decision support system is needed to be able to support this. The Simple Additive Weighting (SAW) method is used in decision making which is used to evaluate and compare various alternatives based on several criteria, especially in determining the best employees. In discussing the criteria for determining the best employees, there are 4 assessment categories, namely performance, skills and competence, initiative and creativity and cooperation and work ethics. Every employee must have these criteria. Determining the best employee is done by adding up the weights of the alternative rating categories in the assessment criteria. The largest value is the alternative result of selecting the best employee. So that through this method the selection of the best employees will be easier and more effective.*

Keywords: *Decision Support System, SAW, best employee*

Introduction

The use of technology in the field of information and communication (ICT) is very important in supporting company activities, especially in managing Human Resources (HR). With an integrated system, companies can manage human resources better, support productivity, and create a better work environment for employees. Investments in ICT for HR not only improve the efficiency of business processes, but also contribute to the company's long-term growth and success.

Top performers refer to individuals who demonstrate extraordinary achievement in their job duties and responsibilities. This usually involves criteria such as: having skills, having initiative, being able to work in a team, being good at communicating, having a leadership spirit, adhering to ethical standards and organizational values, and the ability to adapt to change and face new work. The best and most qualified employees are a very valuable asset for the company. They can make various significant contributions, which have a positive impact on the Company's growth and sustainability. So far, the performance appraisal process has only been subjective. Without an efficient decision support system, performance appraisals can be ineffective and even detrimental to employee career development. Therefore, it is important for companies to adopt appropriate information and communication technology to improve assessment systems and support better decision making. That way, companies can not only improve employee performance, but also create a more positive and productive work environment.

A decision support system is a decision-making tool where we can take into consideration the decisions we want to achieve. The decisions taken once again depend on the

policy maker, not on the tools. Data and information in the decision support system is always updated so that the latest information can be used as an appropriate basis for decision making. The SAW method is a useful tool in making decisions that involve many criteria, and can help individuals or organizations make better choices based on systematic analysis. In previous research, the Simple Additive Weighting method was more efficient and the time required for calculations was shorter. and easy. (Nisnaini et al., 2022)

Being the best is the desire of every employee in a company or agency. However, there are often obstacles in the field in determining who is the best, mainly due to unclear assessment indicators. This situation often leads to subjective judgments. To avoid subjectivity in assessment, companies need to set clear and measurable indicators. With transparent indicators, assessments can be carried out objectively. This will ensure a fairer assessment and more precise and accurate decision making. A decision support system that is ready to help is also very necessary to perfect this process. Overall, a structured and systematic approach to employee performance appraisal will increase trust and motivation among employees, and create a more productive work environment. (Erlangga, 2017)

Literature Review

1. Decision Support Systems

Decision making is a crucial process in management that involves choosing between several alternatives to achieve predetermined goals. In this context, decision support systems (DSS) play an important role as tools that use data and computer models to produce various alternative decisions. (Simatupang, 2018)

Decision Support Systems (DSS) are an important tool in decision making, functioning to organize information to support the process. According to Keen and Scott Morton, DSS integrates individual intelligence sources with the capabilities of system components to improve the quality of decisions taken. Decision making itself is the selection of several existing alternative actions to achieve a predetermined goal. McLeod formulated that a decision support system is a structured system that utilizes data and computer models to produce various decision alternatives. This aims to assist management in dealing with various problems, both structured and unstructured (Sudarsono et al., 2016). Overall, the use of DSS in the decision-making process is becoming increasingly important, especially in today's complex and competitive business context.

2. Definition of Employee

Employees are a supporting factor in a company or agency, because with employees who have the company's qualification standards, the company's productivity will definitely be maintained and increase. The process of selecting outstanding employees is a complicated process and requires careful consideration. To obtain fast and accurate information about employee performance achievements (meeting the expected criteria), an automation process using technology is needed. Therefore, the need for a computer-based system is deemed very necessary to meet the demands for information needs. The definition of employee performance is the result of certain work processes in a planned manner at the time and place of the employee and the organization concerned. According to Mangkuprawira and Hubeis (Mangkuprawira & Hubeis, 2009) According to Stolovitch and Keeps (in the Mangkuprawira blog) Performance is a set of results achieved and refers to the act of achieving and carrying out the work requested.

Methodology

1. Simple Additive Weighting Method (SAW) Design Model

The SAW (Simple Additive Weighting) method is one of the most commonly used techniques in Multi-Attribute Decision Making (MADM) decision making. The following are

the steps and explanation of the SAW (Penta et al., 2019)method:

a. Determine Criteria and Alternatives
- Identify the attributes or criteria that will be used to assess alternatives.
- Determine the alternatives to be evaluated.

b. Prepare a Decision Matrix
- Arrange a decision matrix (X) with row components as alternatives and columns as attributes.

c. Determine the weight for each attribute
- Give weight (wi) to each attribute based on its importance. This weight is usually expressed in the form of a percentage or a value between 0 and 1.

d. Decision Matrix Normalization

Normalization is needed so that each rating on an attribute is on a scale that can be compared. For increasingly better attributes (e.g., higher performance), normalization can be done with the formula:

$$r_{ij} = \begin{cases} \dfrac{X_{ij}}{\max_i X_{ij}} \\ \dfrac{\min_i X_{ij}}{X_{ij}} \end{cases}$$

Information:
rij = normalized performance rating value
Xij = attribute value for each criterion
Max Xij = largest value of each criterion
Min Xij = smallest value of each criterion
Benefit = if the greatest value is the best value
Cost = if the smallest value is the best value

e. Calculating Total Score

Calculate the total score for each alternative with the formula

$$\mathrm{Vi} = \sum_{j=1}^{n} wj^{r}ij$$

Where:
Vi = ranking for each alternative
Wj = weight value of each criterion
rij = normalized performance rating value
A greater Vi value indicates that the Ai alternative is preferred

f. Compare Total Scores

After all alternatives have their total scores calculated, compare the value \(S_i \) of each alternative. The alternative with the highest score is the most recommended.

Results & Discussion

1. Data Analysis

To determine the best employees, we need to clearly define the criteria and alternatives. The following are the steps and examples of decision support system calculations for determining

the best employees using the Simple Additive Weighting (SAW) method.
The following are examples of criteria that can be used, along with alternatives that constitute the group of employees that will be evaluated.

Table 1. Criteria

Kriteria		Bobot
C1	performance	30 %
C2	Keterampilan dan Kompetensi	25%
C3	Initiative and Creativity	20%
C4	Cooperation and Work Ethics	25%

Table 2. Weight

Bobot	Nilai
Weight Very Low (SR)	**1**
Low (R)	**2**
Enough (C)	**3**
Height (T)	**4**
Very High (ST)	**5**

The alternative suitability rating data is as follows:

A1: Employee 1
A2: Employee 2
A3: Employee 3
A4 : Employee 4
A5: Employee 5

Arrange a decision matrix based on the values obtained from employee evaluations, according to the following table:

Table 3. Assessment Matrix

No	Alternatif	kriteria			
		C1	C2	C3	C4
1	A1	4	3	3	5
2	A2	4	3	4	3
3	A3	4	3	3	4
4	A4	4	4	4	2
5	A5	3	4	4	4

$$X=\left\{\begin{array}{cccc} 4 & 3 & 3 & 5 \\ 4 & 3 & 4 & 3 \\ 4 & 3 & 3 & 4 \\ 4 & 4 & 4 & 2 \\ 3 & 4 & 4 & 4 \end{array}\right\}$$

The matrix above is a decision matrix based on the assessment results of each employee. This table is used as an initial matrix for making decisions.

A1 = $R1 = \frac{4}{Max\,\{3,5,1,2\}} = \frac{4}{5} = 0{,}8$ **A2** = $R1 = \frac{4}{Max\,\{3,5,1,2\}} = \frac{4}{5} = 0{,}8$

$R2 = \frac{3}{Max\,\{2,4,5,2\}} = \frac{3}{5} = 0{,}6$ $R2 = \frac{3}{Max\,\{2,4,5,2\}} = \frac{3}{5} = 0{,}6$

$$R3 = \frac{3}{Max\ \{5,4,1,3\}} = \frac{3}{5} = 0{,}6 \qquad R3 = \frac{4}{Max\ \{5,4,1,3\}} = \frac{4}{5} = 0{,}8$$

$$R4 = \frac{5}{Max\ \{2,3,5,5\}} = \frac{5}{5} = 1 \qquad R4 = \frac{3}{Max\ \{2,3,5,5\}} = \frac{3}{5} = 0{,}6$$

A3 = $R1 = \frac{4}{Max\ \{3,5,1,2\}} = \frac{4}{5} = 0{,}8$ **A4** = $R1 = \frac{4}{Max\ \{3,5,1,2\}} = \frac{4}{5} = 0{,}8$

$$R2 = \frac{3}{Max\ \{2,4,5,2\}} = \frac{3}{5} = 0{,}6 \qquad R2 = \frac{4}{Max\ \{2,4,5,2\}} = \frac{4}{5} = 0{,}8$$

$$R3 = \frac{3}{Max\ \{5,4,1,3\}} = \frac{3}{5} = 0{,}6 \qquad R3 = \frac{4}{Max\ \{5,4,1,3\}} = \frac{4}{5} = 0{,}8$$

$$R4 = \frac{4}{Max\ \{2,3,5,5\}} = \frac{5}{5} = 0{,}8 \qquad R4 = \frac{2}{Max\ \{2,3,5,5\}} = \frac{2}{5} = 0{,}4$$

A5 = $R1 = \frac{3}{Max\ \{3,5,1,2\}} = \frac{3}{5} = 0{,}6$

$$R2 = \frac{4}{Max\ \{2,4,5,2\}} = \frac{4}{5} = 0{,}8$$

$$R3 = \frac{4}{Max\ \{5,4,1,3\}} = \frac{4}{5} = 0{,}8$$

$$R4 = \frac{4}{Max\ \{2,3,5,5\}} = \frac{4}{5} = 0{,}8$$

An important step after normalization is calculating the total score for each alternative by multiplying the normalization value by the criteria weight and adding up the results.

Table 4. Normalized Matrix

0,8	0,6	0,6	1
0,8	0,6	0,8	0.6
0,8	0,6	0,6	0,8
0,8	0,8	0,8	0,4
0,6	0,8	0,8	0,8

rij= { same matrix }

Total Score Calculation:

V1 = ((0,8x30)+(0,6x25)+(0,6x20)+(1x25)) = 76

V2 = ((0,8x30)+(0,6x25)+(0,8x20)+(0,6x25)) = 70

V3 = ((0,8x30)+(0,6x25)+(0,6x20)+(0,8x25)) = 71

V4 = ((0,8x30)+(0,8x25)+(0,8x20)+(0,4x25)) = 70

V5 = ((0,6x30)+(0,8x25)+(0,8x20)+(0,8x25)) = 74

Based on the results of manual calculations, the largest value was obtained for V1, namely 76, so alternative A1 was the best alternative because it got the highest value based on calculations using the SAW method.

2. System Design and Implementation

After the analysis has been carried out, as a form of design for the assessment needs, the following is the design flow for the Decision Support System for Determining the Best Employees:

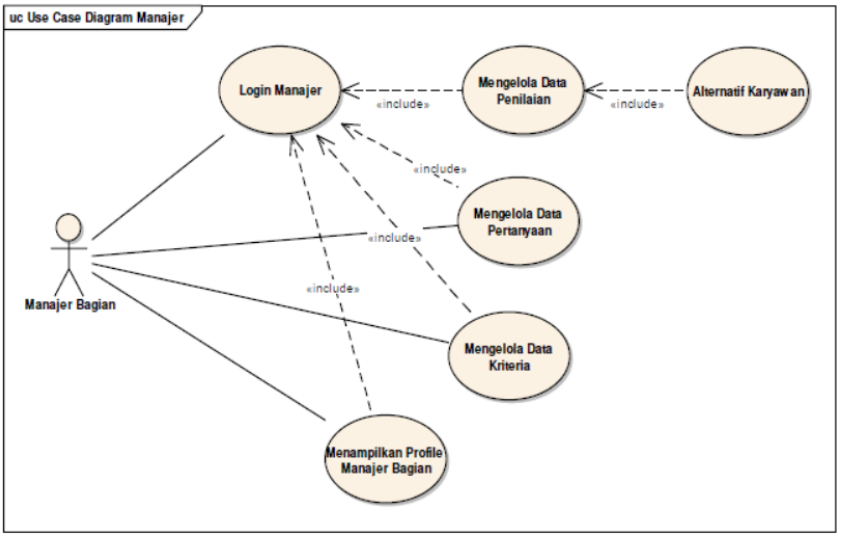


Figure 1. Use case diagram of SPK for Determining the Best Employees

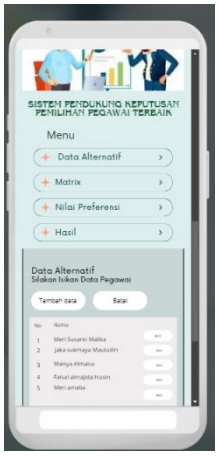
Next, the implementation is implemented in a web-based application, with the following description:

a. Home Page

On this page, the menu consists of login, data input, matrix, preference values, results and logout. The login menu is used to determine user access rights, where the only users given access are section heads and directors. The Data menu contains alternative data input which can be filled in with data on the names of employees in the Company, which is equipped with additional alternative data and actions that can be taken against the employee.

Figure 2. Main Page Menu

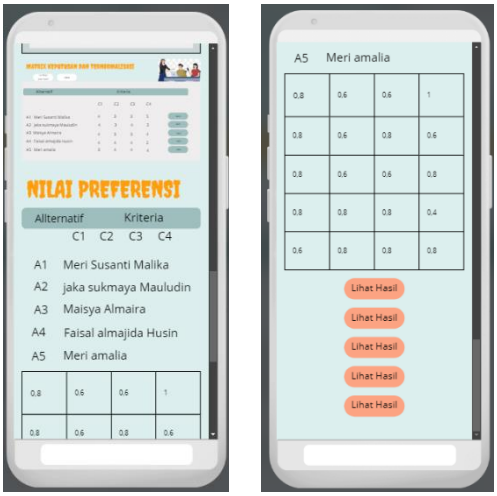
b. Alternative Input Page



The following is a description of the main menu page in the data submenu section for alternative management:In this submenu, there are two main options, namely Alternative and Criteria Weight. In the Alternative Menu, after the admin selects the Alternative menu, a list of alternatives that have been entered previously will appear. Each alternative can be managed with the following features: Add Alternative, Edit Alternative, Delete Alternative, ,Search and Filter buttons.

Figure 3. Alternative Input Menu

c. Matrix Page and Preference Results



The following is a description of the desired menu display for the matrix page, including a list of decision matrices as well as normalized matrices. At the top of the page, there is a list of all the decision matrices that the admin has input. Below the list of matrices, there is a decision matrix table that presents the data, while Below the decision matrix table, there is a table for normalized matrices. The structure of this table is similar to a decision table, but displays normalized values.

Figure 4. Matrix Page Menu and Preference Results

d. Results Page

The results page displays the final results of the scores obtained from each alternative/name of employee and automatically the employee who gets the highest score will immediately receive an award certificate as the best employee

The conclusions that can be drawn after analyzing, designing and implementing the decision support system for employee performance assessment using the SAW method are as follows:

1. Structured Performance Processing

By using the SAW method, all employee performance assessment criteria can be grouped and calculated systematically. The results of this process provide a ranking of employee performance, allowing management to easily identify employees with the highest to lowest performance. This helps in more accurate and objective decision making.

2. Time and Resource Efficiency

The application developed allows employee performance calculations to be carried out more quickly and efficiently compared to processing data manually using archives. In this way, the HR department no longer needs to sort through archives to look for data, so they can allocate their time and resources to other, more strategic tasks.

By implementing this system, it is hoped that it can increase the efficiency of managing employee performance appraisals, as well as provide a stronger basis for decision making regarding human resources.

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