**Application of the Divide and Conquer and Simple Additive Weighting (SAW) to Determine the Best Employee**

**at Dharmawangsa University**

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**ABSTRACT :**

The research proposes the application of the divide and conquer algorithm to select the best employees at Dharmawangsa University based on the value points each employee gets based on several assessment criteria. Each employee is assessed based on responsibility, discipline, cleanliness, initiative, cooperation, and skill. In ranking employees, the simple additive weighted (SAW) method is used. The basic concept of the SAW method is to find the weighted sum of the performance ratings for each alternative on all attributes. The SAW method requires a process of normalizing the decision matrix (X) to a scale that can be compared with all existing alternative ratings. One application of the Simple Additive Weighting (SAW) method is the selection of the best employees. The purpose of this research is to choose the best employees at Dharmawangsa University in Medan. The goal to be achieved is to create a system that helps decision makers carry out an optimal decision adoption process using the SAW (Simple Additive Weighting) method.

Key Word : divide and conquer; employee; simple additive weighting; ranking;

1. **INTRODUCTION**

Technology is growing rapidly at this time to make all fields take advantage of a technology [1]. One of The influence of technology is the internet which is a global online network without limits providing millions of types information[2]. Development of information technology so needed by various fields life so that it can be warmly welcomed by society [3]. Therefore, making a technology as a means to help solve problems in various fields [4]**.** Human resources are the most important part in advancing the company. So it really needs every human resource that is competent and expert in their field, so that the company. In this case, the object of assessment is Dharmawangsa University Medan employees. As educators, good service quality is needed so that Dharmawangsa University can develop for the better. In addition to the selection of employees who are strictly recruited and actually have skills, it is also necessary to evaluate employee performance as a form of consistency in the employee's contribution to Dharmawangsa University. Evaluation of employee performance at each company is different as well as at Dharmawangsa University in Medan, there are several important criteria in evaluating the performance of Dharmawangsa University employees, namely responsibility, discipline, cleanliness, initiative, teamwork. work), and the abilities (skills) possessed by the employee. A decision support system (DSS) or decision support system (DSS) using the simple additive weighting (SAW) method can be used to assist Dharmawangsa University in determining the best employee by comparing each of the predetermined criteria. At the beginning of each year, Dharmawangsa University gives prizes to the best employees from each faculty in order to motivate each employee to improve their performance in each work unit. The model that will be used in this decision support system is the simple additive weighting model, this method was chosen because it can determine the weight value for each attribute, after that there is a ranking process that will select the best employee from several employees at Dharmawangsa University [5]. With this ranking method, it is hoped that it will be able to obtain an appropriate assessment because it is based on several predetermined criteria and weight values[6]**.** Decision Support System (DSS) as a computer-based system in which this system consists of three components that interact with each other, namely, the language system (mechanism to provide communication between users and components, other Decision Support Systems), knowledge systems (repositories of problem domain knowledge that exist in Decision Support Systems or as data or as procedures), and problem processing systems (relationships between the other two components, consisting of one or more general problem manipulation capabilities required for decision making [5]

1. **LITERATURE REVIEW**
	1. **Decision Support System**

The concept of a Decision Support System (DSS) or Decision Support System (DSS), was first introduced in the 1970s by Little. According to Little (1970), a Decision Support System is a collection of model-based procedures, which are used as data and considerations to assist managers in making decisions (Turban, 2011: 88).

The initial definition of SPK shows DSS as a system intended to support managerial decision makers in semi-structured decision situations. The DSS is intended to be a tool for decision makers to expand their capabilities, but not to replace their judgment. SPK is intended for decisions that require assessment or decisions that cannot be supported by the algorithm at all (Turban, 2011: 88). The key characteristics and capabilities of DSS include the following (Turban, 2011:90) :

1. DSS supports semi-structured problems (problems that are routinely repeated, but human judgment is still needed in implementing the solutions) or unstructured (problems that are unclear and complex so that there are no immediate solutions).
2. DSS support decisions for multiple layers of managers.
3. DSS supports decisions for both groups and individuals.
4. DSS supports decisions that are interdependent and/or cascading.
5. DSS support a variety of ways and styles of decision making.
6. DSS are flexible (users can add, remove, and change the basic elements that the DSS manages) and adaptable (users adapt the system to deal with rapidly changing conditions).
7. DSS is user friendly so that it can be easily adapted by users who are not experienced with using computers.
8. The purpose of using DSS is to increase the effectiveness of decision making (time and quality), not efficiency (minimizing costs).
9. DSS are used to support decision makers, not replace them.
10. DSS must be easy to configure, flexible in use, and easy to modify to meet the various needs of each decision maker.
11. DSS can use modeling for the analysis of situations and problems that require decisions. Modeling capabilities allow users to try different action strategies in different circumstances and configurations.
12. Access is provided to various data source forms, formats, and types.
13. DSS can be developed as a standalone tool used by a decision maker in one location and integrated with other applications, and distributed via network or internet technology.
	1. **Phases of the Decision Making Process**

According to Simon, the decision-making process includes three main phases, namely intelligence, design, and criteria, which is then added to a fourth phase, namely implementation [7]**.**

The decision-making process starts from the intelligence phase. Reality is tested, and problems are identified and determined. The ownership of the problem is also defined. Furthermore, in the design phase, a model that represents the system will be constructed. This is done by making assumptions that simplify reality and writing down the relationships among all variables. This model is then validated and criteria are determined using the principle of choosing to evaluate alternative actions that have been identified.

The model development process often identifies alternative solutions and vice versa. Next is the choice phase which includes the choice of solutions proposed for the model (does not require the problem presented). This solution is tested to determine its viability. Once the proposed solution seems reasonable, then we are ready to enter the final phase, namely the decision implementation phase. The result of successful implementation is that real problems can be solved. Meanwhile, implementation failure requires us to return to the previous phase

* 1. **Divide and Conquer Algorithm**

The divide and conquer algorithm has 3 sub-plots namely the divide plot, the conquer path, and the combine path. The divide flow divides the problem into several sub-problems that are similar to the original problem but are smaller (ideally almost the same size) [8]**.** Conquer flow, solving (resolving) each sub-problem (recursively). The combine flow combines the solutions of each sub-problem to form the original problem solution. The division is done on input objects in the form of tables (arrays), matrices, exponents, and other objects depending on the problem at hand. Each sub-problem must have problem characteristics that are similar to the characteristics of the initial problem, so that the divide and conquer method can work well on problems that are solved by repetition by calling itself (recursive). Algorithm Implementation of the Divide and Conquer Algorithm in determining the best employees.

* 1. **Simple Additive Weighting (SAW)**

The basic concept of the SAW method is to find a weighted sum of performance ratings for each alternative on all attributes. The SAW method requires a process of normalizing the decision matrix (X) to a scale that can be compared with all existing alternative ratings [9]. The Simple Additive Weighting (SAW) method is one of the methods in the decision-making process. This method has a more precise and accurate assessment capability, because it is based on predetermined criteria and weights, thus helping solve the problem of selecting outstanding employees quickly and precisely. According to Fishburn and MacCrimmon stated that the Simple Additive Weight (SAW) Method, often also known as the weighted sum method. The basic concept of the Simple Additive Weight (SAW) method is to find the weighted sum of the performance ratings for each alternative on all attributes.

Assessment criteria can be determined according to the needs of the company.

$$rij=\left\{\begin{array}{c}\frac{X\_{ij}}{Max\_{i}X\_{ij}} jika j adalah atribut keuntungan\\\frac{Min\_{i}X\_{ij}}{X\_{ij}} jika j adalah atribut biaya (cost)\end{array}\right. $$

Where :

Rij : Normalized performance rating

Maxij : Maximum value of each row and column

Minij : Minimum value of each row and column

Xij : Rows and columns of the matrix

With Rij : is the normalized performance rating of alternative Ai on Cj attribute; i = 1,2,…..m and j = 1,2,…,n.

$$V\_{i}=\sum\_{j=1}^{n}W\_{j}R\_{ij}$$

A larger value of Vi indicates that alternative Ai is more preferred.

Where :

Vi : Final value of the alternative

Wi : Predetermined weight

Rij : Normalized matrix

A larger value indicates that the alternative is preferred. The Simple Additive Weighting (SAW) method is recommended for solving selection problems in multi-process decision making systems. The Simple Additive Weight (SAW) method is a method that is widely used in decision making which has many attributes.

There are several steps in completing the Simple Additive Weight (SAW) method, which are as follows :

1. Determine the criteria used as a reference in decision support, namely Ci.

2. Determine the suitability rating of each alternative on each criterion.

3. Create a decision matrix based on criteria (Ci).

4. Then normalize the matrix based on the equation adjusted for the type of attribute (attributes of profit and attributes of cost) so that a normalized matrix R is obtained.

5. The final 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 (Ai) as a solution.

**III. RESEARCH METHOD**

The SAW method is often also known as the weighted sum method. The basic concept of the SAW method is to find a weighted sum of performance ratings for each alternative on all attributes . The SAW method requires the process of normalizing the decision matrix (x) to a scale that can be compared with all existing alternative ratings. This research is in the form of a case study with research subjects at Dharmawangsa University in Medan, and was conducted using a descriptive analytical research method. Analytical descriptive research is research that aims to provide an overview of the reality of the object being studied objectively. Data analysis was carried out in this study using interview techniques and documentation studies. Interviews were used to find out the flow of the best employee selection process and to find out the problems that existed in the best employee selection process. A documentation study was conducted to collect data in the form of documents that are used as guidelines in selecting the best employees at Dharmawangsa University in Medan.

1. **RESULTS AND DISCUSSION**
	1. Determination of Criteria for the Simple Additive Weighting (SAW) Method

In this discussion there are several criteria for determining decision making using the Simple Additive Weighting (SAW) method, each of these criteria has a preference weight (W). The following is the data :

C1 = responsibility (15%) = 0.15

C2 = discipline (15%) = 0.15

C3 = cleanliness (10%) = 0.1

C4 = initiative (20%) = 0.2

C5 = cooperation (20%) = 0.2

C6 = skills (20%) = 0.2

For each criterion has a different weight value, the following is the weight value of each criterion used :

**a. Responsibility**

The indicators used in determining the best employee are based on the employee's responsibility for the job he has received.

Table 1. Responsibilities

|  |  |  |
| --- | --- | --- |
| Weight | Range | Criteria |
| Responsibility | >80% (Good) | 0.8 |
| 50%-79% (Typical) | 0.5 |
| <49% (Not Good) | 0.2 |

**b.** **Discipline**

The indicators used in determining the best employee based on the employee's discipline in daily activities :

Table 2. Dicipline

|  |  |  |
| --- | --- | --- |
| Weight | Range | Criteria |
|  Dicipline | >80% (Good) |  0.7 |
| 50%-79% (Typical) | 0.4 |
| <49% (Not Good) | 0.1 |

**c. Cleanliness**

The indicators used in determining the best employee are based on the cleanliness of the employee in the office environment where the employee works.

Table 3. Cleanliness

|  |  |  |
| --- | --- | --- |
| Weight | Range | Criteria |
|  Cleanliness | > = 80% (Clean) |  0.8 |
| <=79% (Moderate) | 0.4 |

**d. Initiative**

The indicators used in determining the best employee based on the employee's initiative in daily activities :

Table 4. Initiatives

|  |  |  |
| --- | --- | --- |
| Weight | Range | Criteria |
|  Initiatives | >80% (Good) |  0.7 |
| 50%-79% (Less) | 0.4 |

**e. Cooperation**

The indicators used in determining the best employee based on the employee's cooperation with his colleagues in one work unit or other work unit :

Table 5. Cooperation

|  |  |  |
| --- | --- | --- |
| Weight | Range | Criteria |
|  Collaboration | >80% (Good) |  0.6 |
| 50%-79% (Moderate) | 0.3 |
| <49% (Not Good) | 0.1 |

**f. Skills**

The indicators used in determining the best employee based on the skill of the employee in solving the given work problem.

Table 6. Skills

|  |  |  |
| --- | --- | --- |
| Weight | Range | Criteria |
|  Skills | >80% (Good) |  0.6 |
| 50%-79% (Moderate) | 0.3 |
| <49% (Not Good) | 0.1 |

In determining the best employee at Dharmawangsa University using the Simple Additive Weighting (SAW) method based on the above criteria data, the following results are obtained :

Table 7. Assessment results for each criterion

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **No** | **Name** | **Position** | **C1** | **C2** |
| 1 | Yulia | Sekretaris WR 2 | 1 | 0.57 |
| 2 | Armansyah | Pegawai BAAK | 0.25 | 1 |
| 3 | M. Yunus | LPM | 0.62 | 0.57 |
| 4 | Neni  | Keuangan | 0.62 | 0.57 |
| 5 | Aidil | LPM | 0.25 | 0.57 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| C3 | C4 | C4 | C5 | C6 |
| 0,5 | 0,57 | 0,57 | 0,5 | 0,75 |
| 0,5 | 0,57 | 0,57 | 0,5 | 0,75 |
| 0,5 | 0,57 | 0,57 | 1 | 1 |
| 1 | 0,57 | 0,57 | 0,5 | 0,75 |
| 1 | 1 | 1 | 0,5 | 0,75 |

**4.2. Ranking results using the Divide and Conquer method**

The following is a table of the results of calculating the best employees at Dharmawangsa University using the Simple Additive Weighting (SAW) Method :

Table 8. Calculation results of the SAW method

|  |  |  |
| --- | --- | --- |
| **No** | **Name** | **Rating result** |
| 1 | Yulia | 0.65 |
| 2 | Armansyah | 0.601786 |
| 3 | M. Yunus | 0.74375 |
| 4 | Neni  | 0.64375 |
| 5 | Aidil | 0.673214 |

Based on the data above, it is necessary to do a ranking to determine the best employee at Dharmawangsa University so that the divide and conquer algorithm is used in sorting. The divide and conquer method is solving the problem by dividing it into smaller forms and then solving the problem.



Figure 1. The sorting process uses the divide and conquer method

In the picture above the black arrows indicate the divide condition while the blue color indicates the conquer and combine conditions.

Based on the results of sorting using the divide and conquer method, the one with the maximum score is the employee who gets the best rating, so the following conclusions can be drawn :

Table 9. Employee Ranking Results

|  |  |  |  |
| --- | --- | --- | --- |
| **No** | **Name** | **Rating result** | **Ranking** |
| 1 | Yulia | 0.743 | 1 |
| 2 | M. Yunus | 0.673 | 2 |
| 3 | Neni | 0.65 | 3 |
| 4 | Aidil | 0.643 | 4 |
| 5 | Armansyah | 0.601 | 5 |

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