

Decision Support System uses Multi-Objective Optimization By Ratio Analysis (MOORA) Method in Selection of the Best Herbal Medicine Supplier

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Abstract

Jamu is a traditional medicine made from natural cultural heritage that has been passed down from generation to generation for health. Mbak Sum UKM is a small and medium enterprise that operates in the field of medicines, namely herbal medicine, where this business provides various types of herbal medicine. This herbal medicine business is a business that can promise business opportunities. Because there is so much interest in this natural herbal concoction, it makes it difficult for companies to meet product availability. And this makes SMEs need many suppliers to meet product availability for Mbak Sum's SMEs. Therefore, a system is needed to help Mbak Sum's SMEs overcome the problems they face. The system that will help Mbak Sum's UKM is a decision support system in selecting quality suppliers which will later help in fulfilling herbal products in Mbak Sum's UKM as well as in making reports of incoming products from suppliers to Mbak Sum's UKM. The system built to support supplier selection decisions uses the multi-objective optimization by ratio analysis (MOORA) method. The MOORA (Multi-Objective Optimization On The Basis Of Ratio Analysis) method is a multi-objective optimization technique that can be successfully applied to solve various types of complex decision-making problems in decision making. The results obtained were that the first rank was Alternative 3 with a value of 0.284 and the sixth rank was Alternative 6 with a value of 0.164. The calculation process can be concluded that A3 is the best alternative

Keywords: Herbal Medicine, Supplier, Decision Support System, Multi Objective Optimization by the Ratio Analysis.

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1. Introduction

Jamu is a traditional medicine made from natural cultural heritage that has been passed down from generation to generation for health [1]. The definition of herbal medicine in Minister of Health Regulation no. 003/Menkes/Per/I/2010 are ingredients or concoctions of ingredients in the form of plants, animal ingredients, mineral ingredients, serian (generic) preparations, or mixtures of these ingredients which for generations have been used for treatment based on experience and can be applied in accordance with norms that apply in society.

Information systems are one of the factors that influence the success of an organization. Due to information systems and technology, which will continue to develop, an organization needs IS/IT strategy planning [2].

A system is a network of interconnected procedures collected together to carry out an activity or for a certain purpose [3]. Information is data that has been processed into a form that is meaningful to the recipient and is useful for current or future decision making [4]. An information system is a system created by humans consisting of components in an organization to present information [5].

systems are one type of system that is very popular among company management, namely Decision Support Systems. This Decision Support System is information that is expected to help management in the decision making process [6]. Decision support systems are implementations that have been introduced by sciences such as operations research and management science. The only difference is that if previously it was used to find solutions to the problems faced, now it offers the ability to solve the same problems in a relatively short time [7]. Decision support systems are a specific class of computerized information systems that support business and organizational decision-making activities. A properly designed DSS is an interactive software-based system intended to assist decision makers [8].

When modeling in the development of a Decision Support System, the following steps are carried out [9]:

1. Feasibility Study (Intelligence) In this step, targets are determined and procedures are searched, data collection, problem identification, problem ownership identification, problem classification, until finally a problem statement is formed.
2. Design At this stage the model to be used and the criteria to be determined will be formulated. After

that, an alternative model was looked for that could solve this problem.

3. Selection (Choice) After determining various alternative models and their variables at the design stage, at this stage the model selection will be carried out, including the solution to the model.
4. Creating a SPK After determining the model, the next step is to implement it in the SPK application.

Decisions taken to solve a problem seen from the structure of the problem are divided into 3 (three), namely [10]:

1. Structured Decisions: Decisions that are made repeatedly and routinely.
2. Semi Structured Decision (Semi Structured Decision) A decision that has two characteristics. Some decisions can be handled by computers and others must still be made by decision makers.
3. Unstructured Decision: Decisions whose handling is complicated because they do not occur repeatedly or do not always occur.

The characteristics of a decision support system are as follows [11]:

1. Supports decision making to discuss structured and semi-structured problems.
2. Output is shown to organizational personnel at all levels.
3. Support in all phases of the design intelligence decision making process.
4. The existence of a human or machine interface where the human (user)
5. Remain in control of the decision-making process.
6. Use a mathematical model that is appropriate to the discussion.
7. Have dialogue skills to obtain information according to needs.
8. Has integrated subsystems.
9. Requires comprehensive data structure data that can serve information needs.
10. An effective approach to use to deal with the problems faced.
11. Rapidly adapting system capabilities.

The MOORA (Multi-Objective Optimization On The Basis Of Ratio Analysis) method is a multi-objective optimization technique that can be successfully applied to solve various types of complex decision-making problems in decision making [12]. The MOORA method is easy to understand and flexible in separating objects to the process of evaluating decision weight criteria. This method also has a good level of selectivity

because it can determine conflicting goals and criteria, namely criteria that are beneficial or unprofitable (Cost) [13]

UML is a language for building and documenting artifacts (part of the information used or produced by the software creation process, these artifacts can be models, descriptions or software) of software systems, such as in business modeling and non-software systems [14] . UML is also a language based on graphics/images to visualize and specify an object-oriented software development system [15].

A Database Management System (DBMS) is a collection of data that can be manipulated by adding, deleting or changing data, as well as software that functions as a user interface for carrying out data transaction activities where the databases in a DBMS must be interconnected with each other [16].

MySQL is the most popular open source database software in the world. MySQL is the main choice for many software and application developers, this is because MySQL's advantages include its easy-to-understand syntax, support for common programs such as C, C++, Java, PHP, Python [17].

2. Research methodology

The research framework is the concept or stages that will be carried out in the research. So that the steps taken in this design do not deviate from the main discussion and are easier to understand, the sequence of research steps will be made systematically so that they can be used as clear and easy guidelines for resolving existing problems. The research framework will be described in the following figure :

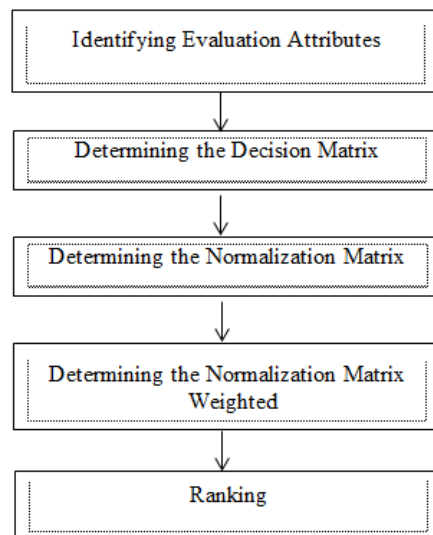


Figure 1 Research Framework

Step 1. The first step that will be taken is to determine the direction of objectives and identify the attributes of the evaluation in question

Step 2 Displays all available information for the attributes so that they can form a matrix in a decision. The data given by equation 1 is represented as a matrix x . where X_{ij} shows the size of the i th alternative on the j th attribute, m shows the number of alternatives and n shows the number of attributes. Then a ratio system is developed for each result of an alternative which is compared to a denominator which represents all alternatives regarding that attribute as in equation 1.

$$X = \begin{matrix} & x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & & & & \\ x_{m1} & & & & \dots & x_{mn} \end{matrix}$$

Step 3 Denominator, the best choice of the square root of the sum of the squares of each alternative per attribute. This ratio can be expressed in equation 2.

$$X_{ij} = \frac{x_{ij}}{\sqrt{\sum_{j=1}^m x_{ij}^2}}$$

Where X_{ij} is the dimension value in the interval $[0,1]$ in the normalized results presented by the i th alternative on the j th attribute d . Step 4 for multi-objective optimization, the normalization result is addition in terms of maximization (from favorable attributes) and subtraction in terms of minimization (from unfavorable attributes). Next, the optimization problem becomes like equation 3:

$$Y_i = \sum_{j=1}^g x_{ij} - \sum_{j=g+1}^n x_{ij}$$

Where g is the value of the criterion to be maximized, (ng) is the value of the criterion to be minimized, and Y_i is the value of the normalized assessment of alternative i against all attributes. In some cases, it is often observed some other more important criteria. ordering to give more importance to an attribute, it is done with appropriate weights (significant coefficients). When the weight of this criterion is considered, the Y_i equation is in equation 4

$$Y_i = \sum_{j=1}^g W_j X_{ij} - \sum_{j=g+1}^n W_j X_{ij}$$

Where W_j is the weight of attribute j .

e. Step 5: The Y_i value can be Positive or Negative depending on the maximum (favorable criteria) and minimum (unfavorable criteria) in the decision matrix

3. Results and Discussion

The following is an example of the calculations used in the system being developed. The company will choose the best supplier, there are 6 criteria data with attributes, namely price, quality, service, estimated delivery, quantity, consistency which can be seen in the table.

1. Steps for inputting criteria values

Where these values will later be processed and the results will become a decision.

Criteria	Information	Value Weight
C1	Price	20%
C2	Quality	20%
C3	Service	15%
C4	Estimated Delivery	15%
C5	Quantity	20%
C6	Consistency	10%

2. Steps to Create a Decision Matrix

Represents all available information for each attribute in the form of a decision matrix. Represents a matrix X $m \times n$. Where x_{ij} is the performance measurement of the i th alternative on the e_j th attribute, m is the number of alternatives and n is the number of attributes/criteria. Then a ratio system is developed where each performance of an alternative on an attribute is compared with a denominator which is a representative for all alternatives on that attribute.

Alternative	C1	C2	C3	C4	C5	C6
A1	4	3	2	3	5	2
A2	4	3	3	2	3	4
A3	3	3	4	5	2	5
A4	3	2	5	5	3	2
A5	5	2	5	2	3	2
A6	3	4	3	3	2	3

Defining a decision matrix with alternatives as rows and criteria as columns is an important step in multi-criteria decision analysis. The purpose of this step is to describe the relationship between various alternatives (options that can be selected) and criteria (attributes or factors used to evaluate these alternatives) in tabular form. From alternative data a decision matrix and normalization matrix can be produced.

$$x = \begin{pmatrix} 4 & 3 & 2 & 3 & 5 & 2 \\ 4 & 3 & 3 & 2 & 3 & 4 \\ 3 & 3 & 4 & 5 & 2 & 5 \\ 3 & 2 & 5 & 5 & 3 & 2 \\ 5 & 2 & 5 & 2 & 3 & 2 \\ 3 & 4 & 3 & 3 & 2 & 3 \end{pmatrix}$$

This decision matrix will be the basis for analyzing and comparing existing alternatives based on various criteria.

3. Determine the normalization matrix

Matrix normalization is an important step in multi-criteria decision analysis that helps convert the initial decision matrix, which may have different scales or units, into a matrix with standardized or normalized values. The aim is to ensure that comparisons between criteria and alternatives can be carried out correctly, even though the criteria may have different units or varying scales. The calculation results of matrix normalization X_{ij}^* are:

$$x * ij = \begin{pmatrix} 0.44 & 0.42 & 0.21 & 0.34 & 0.65 & 0.25 \\ 0.44 & 0.42 & 0.32 & 0.23 & 0.39 & 0.50 \\ 0.33 & 0.42 & 0.43 & 0.57 & 0.26 & 0.64 \\ 0.33 & 0.28 & 0.53 & 0.57 & 0.39 & 0.25 \\ 0.54 & 0.28 & 0.53 & 0.23 & 0.39 & 0.25 \\ 0.33 & 0.56 & 0.32 & 0.34 & 0.26 & 0.38 \end{pmatrix}$$

Produces a weighted decision normalization table as follows:

Table 3 Decision Alternatives

Alternative	C1	C2	C3	C4	C5	C6
A1	0.44	0.42	0.21	0.34	0.65	0.25
A2	0.44	0.42	0.32	0.23	0.39	0.50
A3	0.33	0.42	0.43	0.57	0.26	0.64
A4	0.33	0.28	0.53	0.57	0.39	0.25
A5	0.54	0.28	0.53	0.23	0.39	0.25
A6	0.33	0.56	0.32	0.34	0.26	0.38

Next, the optimization value is calculated by multiplying the weight value by normalizing the decision. And obtained the following matrix results:

$$Xwj = \begin{pmatrix} 0.088 & 0.084 & 0.032 & 0.051 & 0.13 & 0.025 \\ 0.088 & 0.084 & 0.048 & 0.034 & 0.078 & 0.050 \\ 0.066 & 0.084 & 0.064 & 0.086 & 0.052 & 0.064 \\ 0.066 & 0.056 & 0.080 & 0.086 & 0.078 & 0.025 \\ 0.109 & 0.056 & 0.080 & 0.034 & 0.078 & 0.025 \\ 0.066 & 0.112 & 0.048 & 0.052 & 0.052 & 0.038 \end{pmatrix}$$

Produces a weighted decision table as follows:

Table 4 Weighted decision alternatives

Alternative	C1	C2	C3	C4	C5	C6
A1	0.088	0.084	0.032	0.051	0.13	0.025
A2	0.088	0.084	0.048	0.034	0.078	0.050
A3	0.066	0.084	0.064	0.086	0.052	0.064
A4	0.066	0.056	0.080	0.086	0.078	0.025
A5	0.109	0.056	0.080	0.034	0.078	0.025
A6	0.066	0.112	0.048	0.051	0.052	0.038

4. Yi Value Calculation Steps

Determining the value yi, if the attributes or criteria for each alternative are not given a weight value. The normalized size is added in the case of maximization (for favorable attributes) and subtracted in minimization (for unfavorable attributes) or in other words subtracts the maximum and minimum values in

each row to get the ranking in each row, if formulated then:

$$y_j^* = \sum_{i=1}^{i=g} x_{ij}^* - \sum_{i=g+1}^{i=n} x_{ij}^* \quad (2)$$

Table 5 Yi Calculation

Alternative	Max (C2+C3+C4+C5+C6)	Min (C1)	Yi = Max - Min
A1	0.084+0.032+0.051+0.13+0.025	0.088	0.234
A2	0.084+0.048+0.034+0.078+0.050	0.088	0.207
A3	0.084+0.064+0.086+0.052+0.064	0.066	0.284
A4	0.056+0.064+0.086+0.078+0.025	0.066	0.259
A5	0.056+0.080+0.034+0.078+0.025	0.109	0.164
A6	0.112+0.048+0.051+0.52+0.038	0.066	0.235

5. Ranking

The next step is to arrange these alternatives in a certain order based on the optimization values that have been generated. The alternative with the highest score or value is placed at the top rank, while the alternative with the lowest score is placed at the lowest rank. The following are the results of the optimization values, shown in the table

Table 6 Ranking

Alternative	Table Yi	Ranking
A1	0.234	3
A2	0.207	5
A3	0.284	1
A4	0.259	4
A5	0.164	6
A6	0.235	2

After getting the optimization value results, it was concluded that the first rank was Alternative 3 with a value of 0.284 and the sixth rank was Alternative 6 with a value of 0.164. To determine the best herbal medicine supplier , look at the highest value calculation results. From this calculation process, we can conclude that A3 is the best alternative

4. Conclusion

After the author conducted research with several stages needed to evaluate the decision support system by managing data from UKM Mbak Sum. The results obtained were that the first rank was Alternative 3 with a value of 0.284 and the sixth rank was Alternative 6 with a value of 0.164. The calculation process can be concluded that A3 is the best alternative. By obtaining these results, Mbak Sum can help MSMEs make decisions.

References

[1] Purwaningsih, EH (2013). Jamu, traditional medicine native to Indonesia: the ups and downs of its use in Indonesia. Indonesian Medical EJournal, 1(2), 85-89.
 [2] Yusti, I. (2016). Php and MySQL Based Letter Management Information System at the Indonesian Institute of the Arts Padangpanjang. Journal of Science and Technology: Journal of

- Science and Industrial Technology Applications, 16(1), 41-54.
<http://dx.doi.org/10.36275/stsp.v16i1.53>
- [3] Fajar, MM, Salsabila, AA, Ariani, MD, & Yaqin, MA (2022). Decision Support System for Selecting Suppliers Using the MOORA Method. *ILKOMNIKA: Journal of Computer Science and Applied Informatics*, 4(3), 351-364.
<https://doi.org/10.28926/ilkomnika.v4i3.367>
- [4] Prayitno, H., & Rozi, AF (2023). Decision Support System Recommendations for the Best Raw Material Suppliers for Tapioca Rambak Crackers Using the Evaluation Method Based on Distance From Average Solution (EDAS). *Journal of Science and Technology (JSIT)*, 3(1), 193-197.
<https://doi.org/10.47233/jsit.v3i1.581>
- [5] Sukerti, NK (2014). Decision support system for village aid recipients in Klungkung sub-district using the saw method. *Journal of Informatics*, 14(1), 84-93.
<https://doi.org/10.30873/ji.v14i1.511>
- [6] Apri, M., & Aldo, D. (2020). SELECTION OF FEED SUPPLIERS IN MARINE FISH CULTIVATION USING THE ANALYTICAL HIERARCHY PROCESS (AHP) METHOD. *Journal of Science and Informatics: Research of Science and Informatics*, 6(2), 84-91.
<http://doi.org/10.22216/jsi.v6i2.5638>
- [7] Gustina, D., & Meirianto, IF (2020). DECISION SUPPORT SYSTEM FOR ADMISSION OF COMPETENCE AID PROGRAM PARTICIPANTS IN ASTRAGRAPHIA USING THE SAW METHOD. *JSI (Journal of Information Systems) Suryadarma University*, 5(1), 1-10.
<https://doi.org/10.35968/jsi.v5i1.16>
- [8] Ulva, A., Iqbal, D., Nuraini, N., Mesran, M., Sutiksno, DU, & Yuhandri, Y. (2018, July). Decision Support System for Selecting the Best Catfish Seeds Using the MOORA (Multi-Objective Optimization On The Basis Of Ratio Analysis) and WASPAS (Weight Aggregated Sum Product Assessment) Methods. In *National Seminar on Information Science and Technology (SENSASI) (Vol. 1, No. 1)*.
- [9] Sinaga, RF, Andani, SR, Poningsih, P., & Solikhun, S. (2018, July). SPK for Selecting Cellular Operators Using the Multi-Objective Optimization Method on the Basis of Ratio Analysis (MOORA). In *National Seminar on Information Science and Technology (SENSASI) (Vol. 1, No. 1)*.
- [10] Ikwan, I., Lumbantoruan, G., Simanullang, PM, & Zega, S. (2018, July). The Decision Support System for Selection of the Best Lecturers Implements the Multi-Objective Optimization Method on the Basis of Ratio Analysis (MOORA). In *National Seminar on Information Science and Technology (SENSASI) (Vol. 1, No. 1)*.
- [11] Sianturi, CF, Tondang, M., Batubara, S., & Siahaan, APU (2018, July). Decision Support System for Selection of Wardrobe Goods Suppliers Applying the MOORA Method. In *National Seminar on Information Science and Technology (SENSASI) (Vol. 1, No. 1)*.
- [12] Wati, E. (2020). Decision Support System in Selecting Goods Suppliers Using the Moora Method at CV. CXY Computer Web Based. *JURSIMA*, 8(2), 70-80.
<https://doi.org/10.47024/js.v8i2.201>
- [13] Putri, MA, Qadriah, L., Salat, J., & Razi, Z. (2023). The decision support system in selecting building material suppliers at the Hai Ujong Rimba service store uses the Moora method. *Journal of Real Research*, 5(2), 365-371.
<https://doi.org/10.47647/jrr.v5i2.1190>
- [14] Manurung, S. (2018). Decision Support System for Selecting the Best Teachers and Employees Using the Moora Method. *Symmetric: Journal of Mechanical Engineering, Electrical and Computer Science*, 9(1), 701-706.
<https://doi.org/10.24176/simet.v9i1.1967>
- [15] Amanda, AD, Arieni, FN, & Windarto, AP (2021). Application of the Multi Objective Optimization on the Basic of Ratio Analysis (MOORA) Method in Selecting Organic Face Masks Based on Criteria. *Journal of Computer Systems and Informatics (JSON)*, 2(3), 289-296.
<http://dx.doi.org/10.30865/json.v2i3.3011>
- [16] Proboningrum, S., & Sidauruk, A. (2021). Decision Support System for Selection of Fabric Suppliers Using the Moora Method. *JSiI (Journal of Information Systems)*, 8(1), 43-48.
<https://doi.org/10.30656/jsii.v8i1.3073>
- [17] Umam, MIH, Lubis, FS, & Muzakir, MR DETERMINING SUPPLIER SELECTION DECISIONS USING THE MULTI-OBJECTIVE OPTIMIZATION METHOD ON THE BASIS OF RATIO ANALYSIS (MOORA). *SITEKIN: Journal of Science, Technology and Industry*, 18(2), 268-273.
<http://dx.doi.org/10.24014/sitekin.v18i2.12684>