Synergizing AHP and SMART: An Integrated Decision Support System for Best Employee Selection

Yance Sonatha*[1], Meri Azmi[1], Resy Liza[1], Rasyidah[1] and Rita Afyenni[1]

{yance@pnp.ac.id*[1], meriazmi@pnp.ac.id[1], resyliza12@gmail.com[1]}

[1,]Department of Information Technology, Politeknik Negeri Padang,
Jl. Kampus, Limau Manis, Kec. Pauh, Kota Padang, Sumatera Barat 25164, Indonesia

Abstract. The preservation of business efficiency and productivity relies on the comprehensive assessment and meticulous selection of ideal personnel. The present study utilized a combination of the Analytical Hierarchy Process (AHP) and Simple Multi-Attribute Rating Technique (SMART) methodologies to determine the personnel with the highest level of competence. The utilization of the Analytic Hierarchy Process (AHP) is employed to determine the relative significance or magnitude of different criteria. In contrast, the SMART framework is employed to determine the hierarchy of individuals following the assignment of weight values to each criterion. The main aim of this strategy is to furnish decision-makers with a quantifiable and substantiated framework for assessing and ranking employees. This strategy is predicated around the utilization of four often utilized criteria for assessing an employee's performance, specifically: attendance record, quality of work, adherence to disciplinary procedures, and length of employment. The SMART technique is utilized to enhance employee ranking outcomes by taking into account the relative significance of the provided criteria. As a result, the findings demonstrate a heightened focus on the ability to measure and confirm data, thereby establishing a strong foundation for making informed decisions. The architecture of the suggested system demonstrates a notable level of versatility, enabling the organization to incorporate or remove evaluation criteria based on its unique requirements and expectations. This implies that diverse firms can potentially utilize the methodology described in this study while maintaining the integrity and accuracy of the findings. This study significantly contributes to the improvement of staff selection procedures through the integration of SMART and AHP approaches dynamically.

Keywords: AHP, Decision Support System, SMART, Human resource

1 Introduction

In this era of globalization, developing human resources is essential for businesses to have a competitive edge. Finding personnel who fit the needs of the business is difficult, but it's also an essential choice for expansion and accomplishing long-term objectives[1]. A planned and quantifiable method is required to get beyond the difficulty of choosing the best staff.

A computer-based interactive application called a Decision Support System (DSS) integrates data and mathematical models to help people make decisions about how to solve problems[2][3]. A decision support system is a source of data that can help executives make

ABEC 2023, September 21, Bengkalis, Indonesia
Copyright © 2024 EAI
DOI 10.4108/eai.21-9-2023.2342893

decisions [4][5]. It should be underlined that the leadership role is not replaced by this decision support system. but creating a system of information that can support the decisions made by the leadership[6]. Decision support systems (DSS) are a distinct category of computerized information systems designed to facilitate and enhance decision-making processes inside businesses and organizations. A well-constructed DSS is a software-based interactive system that aims to aid individuals responsible for making decisions. [7].

The Analytic Hierarchy Process (AHP) is a system that combines math and psychology to organize and analyze complicated choices. Thomas L. Saaty created it in the 1970s, and since then, it has been improved. It consists of three parts: the primary objective or issue you're attempting to resolve, all potential answers, or alternatives, and the standards by which you'll evaluate the options. By putting the decision's criteria and potential outcomes into numerical form and connecting them to the main objective, AHP offers a logical framework for making necessary decisions[8].

AHP, or the Analytic Hierarchy Process, has gained acceptance as a multi-criteria decision-making tool[9]. AHP enables decision-makers to evaluate many factors and assign priorities based on their significance. In the context of hiring employees, it is necessary to describe the goals that will be accomplished through the selection process in addition to evaluating relative priorities[10].

The Simple Multi-Attribute Rating Technique (SMART) can be used in this situation. The SMART method aids in defining and evaluating goals using precise and quantifiable criteria. AHP and SMART are used to provide an integrated strategy that improves the efficiency of hiring top candidates. By combining these two approaches, decision-makers can assess the criteria holistically and gauge how well personnel align with business objectives[11].

The creation of decision support systems employing the AHP approach has been the subject of numerous research, including ones that determined student thesis graduation using the AHP[12], selected a freight forwarder using a multi-criteria decision system[13], and choosing the best location for an Iranian solar power facility using AHP[14]. To improve decision support, the AHP method is frequently integrated with other approaches. Combining the AHP method has been used in several studies, including choosing smartphone purchases using the AHP-VIKOR combination[15], assisting in loan decisions using the AHP and TOPSIS combination[16], choosing wind farm installation locations using the AHP and TOPSIS in Eastern Macedonia and the Thrace region of Greece[17], and combining the AHP and MILP methods. for making strategic decisions in designing global supply chain networks[18], for selecting digital technology using a combination of fuzzy logic and AHP[19], for determining cooperative lending using a combination of AHP, BORDA, and TOPSIS methods[20], and many other topics.

It has been demonstrated that using AHP in conjunction with the SMART technique improves decision support. These two approaches have been blended in several prior studies, including those that dealt with grading systems[21], employee performance rewards and penalties[22], employee promotions[23], supplier selection[24][25], and many more.
This reseacrh attempts to combine AHP and SMART in this situation to create a decision support system for hiring the best candidates. As a result, decision-makers will be able to formulate explicit and quantifiable goals using the SMART concept and assign the proper

priority weights to each criterion based on the AHP analysis. It is envisaged that this integration would offer firms useful advice so they can choose the best personnel more intelligently and based on facts.

2 Research Methods

This study centers on the integration of the AHP and SMART methodologies within the employee evaluation process. This framework not only takes into account the intricate factors involved in assessing employees but also strives to establish criteria that are quantifiable and attainable. Through the synergistic application of AHP and SMART, this study aspires to make a significant contribution towards enhancing employee selection techniques, thereby yielding more precise and elaborate decisions. The diagram in Fig 1 illustrates the research methodology employed in developing a decision support system for employee selection. Within this methodology, the AHP method is utilized to determine criterion weights, which are subsequently used to rank employees and identify the most suitable candidates.

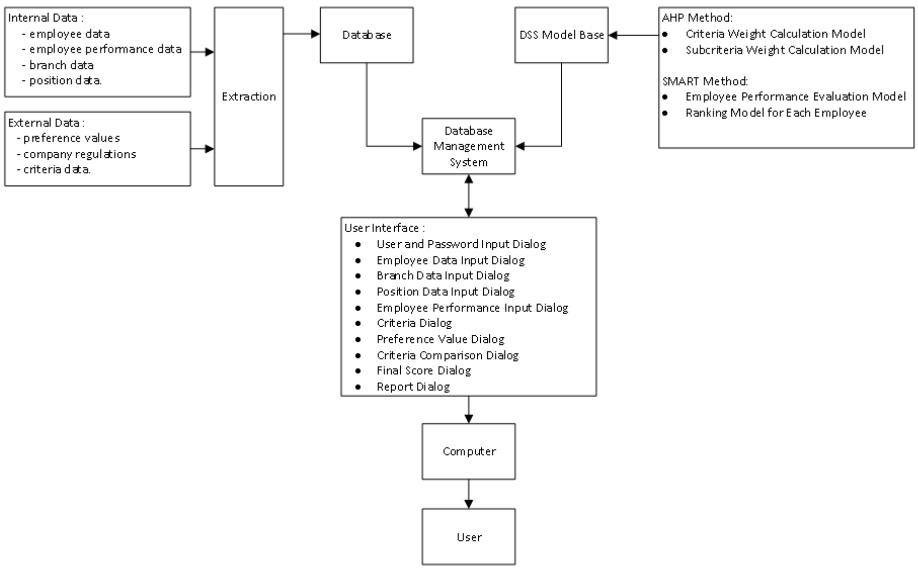

Fig 1. Research Methods

2.1 Analytical Hierarchy Process (AHP)

1. Problem definition

The challenges at hand are divided into components in this initial step using a decision-making hierarchy. Fig 2 depicts the hierarchy's shape. The hierarchy in the figure has the following shape: Goals are regarded as the first level, criteria are the second level, and alternative options are the third level. All decision makers are considered while making decisions using a structured problem hierarchy.

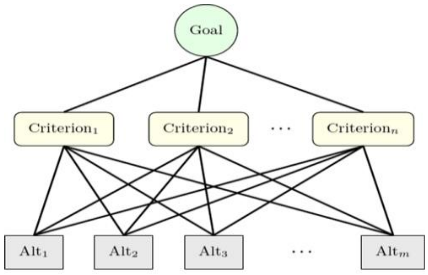

Fig 2. AHP Hierarchy

2. Comparative Judgment

In this phase, pairwise comparisons of the elements are used to rank them in order of importance using the given criteria. The evaluation's findings will be presented as a pairwise comparison matrix, specifically one that shows the relative importance of several alternatives for each criterion. The priority scale is shown in Table 1, with a scale of 1 denoting the lowest priority (equally important) and a scale of 9 denoting the highest priority (extremely important).

Table 2. Pairwise Comparison Matrix

The significance of intensity	Definition	Explanation
1	Equal significance	Both activities make an equal contribution to the purpose.
3	Moderate significance	Based on experience and judgments, there is a minor inclination towards favoring one activity over another.
5	Essential significance	Based on accumulated experience and informed opinion, there is a strong inclination towards favoring one activity over another.
7	Extremely important	One activity exhibits a significantly higher preference over another, as seen by its clear domination in practical application.
9	Extremely significant	The data supporting one action over another is highly affirming.
2,4,6,8	Intermediate values	In situations where a resolution is required between two parties, the concept of compromise becomes essential.

3. Synthesis

At this point, matrix normalization is achieved by adding up the values of each matrix column and then dividing each column's sum by the number of related columns. The average is then obtained by dividing the sum of the values in each row by the total number of items. Its goal is to achieve pairwise comparisons' overall priority consideration.

4. Calculating lambda max (λmax).

At this point, the measurement of consistency is achieved by multiplying each value in the first column by the relative priority assigned to the first element. Similarly, the value in the second column is multiplied by the relative priority assigned to the first column of the second element, and so on. Next, calculate the sum of each row. The aggregate of the row outcomes, split by the elements with the corresponding priority of the associated elements. Next, calculate the sum of the quotient by adding it to the number of elements that are now present.

5. Calculate the Consistency Index (CI) using the formula:
   $CI = (\lambda_{max} – n) / n-1$ (1)
   where n is the number of elements

6. Calculating the ConsistencyRatio(CR) with the formula:
   $CR = CI / RC$ (2)
   Where RC is the Random Consistency index

7. Verify the hierarchy's consistency.

In the present juncture, should the magnitude of the consistency scale beyond 10% (0.1), it becomes imperative to rectify the evaluation of the assessment data. This is due to the existence of a disparity in the determination of the comparison, hence impeding the ability of the Analytic Hierarchy Process (AHP) to yield a valid result. Nevertheless, the accuracy of the computation results can be deemed acceptable if the value of the consistency ratio is less than or equal to 0.1. This can be seen in table 3 below :

Table 3. Index Ratio

N	RI
1	0
2	0
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49

2.2 Simple Multi Attribute Rating Technique (SMART)

The SMART approach is a strategy utilized to facilitate the process of making judgments involving multiple attributes. The utilization of this particular method of multiple-attribute decision-making facilitates the process for decision-makers when faced with the task of selecting an option from a diverse set of alternatives. It is imperative for every decision-maker to possess a choice that aligns with the specified objectives.

1. Establish the criteria's weight.
   Each criterion's weight will be determined by the priority value that results from the AHP calculation.

2. Normalizing the criterion' weight.
   At this point, normalization of the weight of each criterion is accomplished by comparing the value of each criterion's weight with its combined weight using the following formula:

$$w_i = \frac{w_i'}{\sum_{j=1}^{m} w_j} \quad (3)$$

   where w_i : normalized criteria weight for the i-criteria
   w_i' : weight of the i-criterion
   w_j : weight of the j-criterion
   j : 1,2,3, ... , m number of criteria

3. Provide parameter values for each criterion.
   During this phase, criteria values are allocated to each alternative. These criteria values can take the form of either quantitative (numeric) data or qualitative data. For instance, values for specific price criteria are expressed in quantitative terms, whereas values for determination criteria can be qualitative in nature (e.g., very complete, complete, incomplete). In the event that the criteria value is of a qualitative nature, it is necessary to substitute it with quantitative data through the establishment of the criterion value parameter.

4. Determine the utility value.
   Currently, the determination of value is achieved through the conversion of each criterion's criterion value into the standard criterion data value. The application of this figure may vary depending on the specific characteristics of the condition. There are two types of criteria.

   a. Cost criteria
      The following equation can be used to determine the "best is lower value" criterion, which is typically expressed in terms of costs incurred:

$$u_i(a_i) = \frac{(c_{max} - c_{out})}{(c_{max} - c_{min})} \quad (4)$$

      where $u_i(a_i)$: utility value of the i^{th} criterion for the i^{th} alternative
      c_{max} : maximum criterion value
      c_{min} : minimum criterion value
      c_{out} : i^{th} criterion value

   b. Benefit criteria
      The requirement that "higher value is desirable" is frequently expressed as an advantage. The following formula is used to calculate the value of this kind of utility:

$$u_j(a_i) = \frac{(c_{out} - c_{min})}{(c_{max} - c_{min})} \quad (5)$$

      where $u_j(a_i)$: utility value of the j^{th} criterion for the i^{th} alternative
      c_{max} : maximum criterion value
      c_{min} : minimum criterion value
      c_{out} : i^{th} criterion value

5. Determines the final grade.
   At this stage, the final value of each value is determined by multiplying the value obtained by normalizing the standard criterion data value with the criterion weight normalization value. Then add up the multiplication value.
   $$u(a_i) = \sum_{j=1}^{m} w_j * u_j(a_i) \quad (6)$$

   where $u(a_i)$: total value for the i^th alternative
   w_j : normalized value of the weight of the j^th criterion
   $u_j(a_i)$: utility value of the j^th criterion for the i^th alternative

6. Perform ranking.
   The final values obtained from the calculation are subsequently arranged in descending order, with the option possessing the highest final value being identified as the optimal choice.

3. Result and Discussion

3.1 Calculation Results using the AHP Method

The initial step in AHP calculation is to determine which criteria are more important when compared to others. This research aimed at identifying the best employee utilizes 4 criteria: absences, work quality, discipline, and years of service. Subsequently, pairwise comparisons of the importance among these four criteria are conducted, resulting in the following table 4 :

Table 4. Pairwise comparison matrix

Criteria	Absences	Work Quality	Discipline	Years of Service
Absences	1	2	3	3
Work Quality	0.50	1	2	4
Discipline	0.33	0.50	1	5
Years of Service	0.33	0.25	0.20	1
Total	**2.16**	**3.75**	**6.20**	**13**

The subsequent step involves dividing the values of each criterion by the sum of the values in the respective column. Next, proceed to ascertain the eigenvalue for each criterion. The determination of priority is achieved by dividing the sum of each row by the total number of criteria. The determination of the relative weight of each criterion or choice is accomplished through the utilization of the eigenvalue, ultimately facilitating the process of decision-making. The results of dividing the values of each criterion by the total number of criteria in the 'sum' column and the priority for each criterion are displayed in Table 5 below.

Table 5. Determination of the quantity and priority of each criterion

Criteria	Absences	Work Quality	Discipline	Years of Service	Sum	Priority
Absences	0.46	0.53	0.48	0.23	1.71	0.43

Work Quality	0.23	0.27	0.32	0.31	1.13	0.28
Discipline	0.15	0.13	0.16	0.38	0.83	0.21
Years of Service	0.15	0.07	0.03	0.08	0.33	0.08

The values obtained are displayed in the following Table 5 after finding the eigenvalue, which is the product of the priority in Table 5 and the sums of each criterion in Table 4.

Table 6. The eigenvalue of each criterion.

Criteria	Total	Priority	Eigen Values
Absences	2.16	0.43	0.92
Work Quality	3.75	0.28	1.06
Discipline	6.20	0.21	1.29
Years of Service	13	0.08	1.07
Maximum eigen values			1.29

From Table 6 we can determine the maximum eigenvalue (λmax), which is 1.29. The λmax value is the highest eigenvalue of the criterion or alternative comparison matrix in AHP. This value is used to calculate the criteria or alternatives that have the highest priority in decision making. This λmax value will then be used to find the Consistency Index (CI) value with the following calculation:

$$CI = (\lambda maks - n) / (n-1) = (1.29 - 4) / (4-1) = -0.903$$

The next step is to determine the consistency ratio. Consistency ratio or abbreviated CR is one of the tools used in AHP to measure the level of consistency in comparisons between elements in a hierarchical structure. AHP is a method used to make decisions based on multi-criteria considerations, which decomposes complex problems into lower level hierarchies. To find the CR value, we must first find the index ratio (IR) value of the criteria used. Based on table 2, the IR value is 0.9 because there are 4 criteria used.

$$CR = CI/RI = -0.903/0.9 =-1.003$$

if $CR \leq 0.1$, the consistency is generally considered acceptable. The judgments are reasonably consistent, and the priority rankings derived from the AHP analysis can be considered reliable [26]. The CR value obtained is -1.003. then the weighting of each criterion can be said to be consistent because $CR \leq 0.1$.

The weight of each criterion for choosing the best employee based on the AHP technique is provided in Table 6 below, which can be inferred from the steps above:

Table 7. The weight of each criterion

Criteria	**Weight Value**
Absences	0.43
Work Quality	0.28
Discipline	0.21
Years of Service	0.08

The results of the weight values for each criterion in table 7 are what will later be used in the SMART method for ranking each employee alternative in determining the best employee.

3.2 Calculation results using the SMART method

The outcomes of the use of the Analytic Hierarchy Process (AHP) method in determining the weights for each criterion are afterwards utilized in the evaluation of individual employees. For the purposes of this study, a sample of ten employees was picked at random from a fried chicken retail outlet. There are several steps to implementing the SMART method's calculating procedure in order to determine each employee's ranking, including:

a. Determine $Cmin$ and $Cmax$
Each criterion has a value of Cmin, which is the least, and a value of Cmax, which is the largest. The table of employee values is as Table 8 below:

Table 8. Alternative value of employee

Alternative of employee	Absences	Work Quality	Discipline	Years of Service
Alt_Emp 1	88	90	77	72
Alt_Emp 2	78	70	90	97
Alt_Emp 3	88	78	88	90
Alt_Emp 4	99	60	87	70
Alt_Emp 5	88	78	76	67
Alt_Emp 6	80	90	87	66
Alt_Emp 7	89	77	87	80
Alt_Emp 8	78	95	87	80
Alt_Emp 9	80	88	87	90
Alt_Emp 10	99	70	76	87
Cmin	78	60	76	66
Cmax	99	95	90	97

b. Calculating Utility Values
The utility value is derived by subtracting the smallest criteria value from the alternative values in the table above, and then dividing the result by the difference between the biggest criterion value and the smallest criterion value. The utility value can be seen in table 9 below.

Table 9. Utility value

Alternative of employee	Absences	Work Quality	Discipline	Years of Service
Alt_Emp 1	0.48	0.86	0.07	0.19
Alt_Emp 2	0.00	0.29	1.00	1.00
Alt_Emp 3	0.48	0.51	0.86	0.77
Alt_Emp 4	1.00	0.00	0.79	0.13

Alternative of employee	Absences	Work Quality	Discipline	Years of Service
Alt_Emp 5	0.48	0.51	0.00	0.03
Alt_Emp 6	0.10	0.86	0.79	0.00
Alt_Emp 7	0.52	0.49	0.79	0.45
Alt_Emp 8	0.00	1.00	0.79	0.45
Alt_Emp 9	0.10	0.80	0.79	0.77
Alt_Emp 10	1.00	0.29	0.00	0.68

c. Calculating Final Value
Multiplying the utility value from the SMART method results by the weight of each criterion (wj) acquired from the AHP method results will get the final value. The outcomes from the table 10 are as follows:

Table 10. Final Value

Alternative of employee	Absences	Work Quality	Discipline	Alternative of employee	Final Value
Alt_Emp 1	0.20	0.24	0.01	0.02	0.48
Alt_Emp 2	0.00	0.08	0.21	0.08	0.37
Alt_Emp 3	0.20	0.14	0.18	0.06	0.59
Alt_Emp 4	0.43	0.00	0.16	0.01	0.60
Alt_Emp 5	0.20	0.14	0.00	0.00	0.35
Alt_Emp 6	0.04	0.24	0.16	0.00	0.45
Alt_Emp 7	0.22	0.14	0.16	0.04	0.56
Alt_Emp 8	0.00	0.28	0.16	0.04	0.48
Alt_Emp 9	0.04	0.23	0.16	0.06	0.49
Alt_Emp 10	0.43	0.08	0.00	0.06	0.56

Table 10 displays the outcomes of the final value for each alternative. The employee with the best employee title is identified by the highest overall score. The employee with the highest final score in table 9 is Alt_Emp 4, with a value of 0.60, indicating that employee number 4 is the best employee.

4. Conclusion

This research aims to create an integrated decision support system for best employee selection by combining the Analytical Hierarchy Process (AHP) method and the Simple Multi Attribute Rating Technique (SMART). The goal of this strategy is to provide decision-makers with a quantifiable and verifiable framework for assessing and ranking employees. The system is based on four standards: absences, work quality, discipline, and years of service. The SMART approach is used to get the best employee ranking outcomes depending on the weight of the defined criteria, offering a solid foundation for decision-making. The proposed system is flexible in design, enabling the addition or removal of assessment criteria in accordance with business requirements. This indicates that different kinds of businesses can adapt the framework discussed in this research without jeopardizing the veracity and accuracy of the findings. This research provides a significant contribution to the creation of more efficient and successful staff selection procedures by fusing SMART and AHP in a dynamic way.

The Analytic Hierarchy Process (AHP) is a decision-making methodology that integrates mathematical principles and psychological insights to effectively structure and evaluate complex options. The technique has been widely accepted in the field of multi-criteria decision-making, allowing decision-makers to assess numerous elements and allocate priorities based on their relative importance. Within the realm of employee recruitment, it is vital to articulate the objectives that shall be achieved via the process of selection, alongside the assessment of comparative priorities. The SMART approach facilitates the process of creating and assessing goals by employing specific and measurable criteria. Through the integration of these two methodologies, decision-makers are able to comprehensively evaluate the criteria and determine the extent to which individuals are aligned with the objectives of the organization. This integration would provide organizations with valuable guidance for making better informed employee selection decisions, grounded in factual evidence. The final value calculations are arranged in descending order, with the option possessing the highest final value being deemed the optimal choice.

The maximum eigenvalue (λmax) is 1.29, which is used to calculate the criteria or alternatives with the highest priority in decision-making. This value is then used to find the Consistency Index (CI) value, which is -0.903, which is the highest eigenvalue of the criterion or alternative comparison matrix in AHP. The consistency ratio (CR) is a tool used in AHP to measure the level of consistency in comparisons between elements in a hierarchical structure. The CR value obtained is -1.003, indicating that the weighting of each criterion is consistent. The weight of each criterion for choosing the best employee based on the AHP technique is provided in Table 6. The results of the weight values for each criterion are used in the SMART method to rank each employee alternative in determining the best employee. This study offers the potential for further advancement through the integration of several decision-making approaches, hence facilitating a more comprehensive comparison to determine the optimal mix of methodologies for decision assistance in staff selection.

Acknowledgments

We thank you very much for supporting this research

References

[1] Martin-Alcazar, F., Romero-Fernandez, P.M. & Sanchez-Gardey, G. Effects of Diversity on Group Decision-Making Processes: The Moderating Role of Human Resource Management. Group Decis Negot 21, 677–701 (2012)

[2] Turban , Efraim & Aronson. Decision Support Systems and Intelligent Systems. 6th edition. Prentice Hall: Upper Saddle River, NJ.2001

[3] A. Yulianto, “Decision Support System for Selection of Outstanding Students at the Faculty of Mathematics in Natural Sciences at the University of Yogyakarta with AHP and TOPSIS Methods”, Journal of Intelligent Decision Support System (IDSS), vol. 4, no. 3, pp. 72-83, Sep. 2021.

[4] Vercellis, Carlo. Business intelligence : data mining and optimization for decision making. Chichester: John Wiley and Sons (2009)
[5] Febriana, Trisna and Budiarto, Arif. Decision Support System Design Model for Choosing Effective Learning Method in Higher Education Institution. Commit (Communication and Information Technology) Journal (2021)
[6] Suraraksa, J and Kwang Sup Shin. Comparative Analysis of Factors for Supplier Selection and Monitoring : The Case of the Automotive Industry in Thailand. Sustainability, Vol 11, 981. doi: 10.3390/su11040981. 2019
[7] R. Ramanathan. Multicriteria Analysis of Energy, Editor(s): Cutler J. Cleveland. Encyclopedia of Energy. Elsevier,Pages 77-88. 2004
[8] Saaty, T.L and Vargas, L.G. Models, Methods, Concepts & Applications of the Analytic Hierarchy Process 2nd Edition, Springer New York. 2012
[9] Maryam Fatima, N.U.K. Sherwani and Vaishali Singh. Comparative analysis among doctors working in private and government hospitals in identifying and prioritizing essential stress factors during COVID-19- an AHP-TOPSIS approach. Intelligent Pharmacy, Volume 1 Issue 1,Pages 17-25. ISSN 2949-866X. 2023
[10] M. Imran, M. H. Agha, W. Ahmed, B. Sarkar, and M. B. Ramzan, "Simultaneous Customers and Supplier's Prioritization: An AHP-Based Fuzzy Inference Decision Support System (AHP-FIDSS) - International Journal of Fuzzy Systems," SpringerLink, Oct. 30, 2020.
[11] Wibawa, S et al. Comparison Fuzzy AHP, TOPSIS and SMART Methods for Supplier Selection. Jurnal Manajemen Industri dan Logistik vol 05 No 02, pp 121-129. 2021
[12] V. H. Valentino, H. S. . Setiawan, A. Saputra, Y. Haryanto, and A. S. Putra, "Decision Support System for Thesis Session Pass Recommendation Using AHP (Analytic Hierarchy Process) Method", IJERSC, vol. 2, no. 1, pp. 215–221, Apr. 2021.
[13] Mohsenm Baha M. Multi-Criteria Decision System for the Selection of A Freight Forwarder Using AHP. Procedia Computer Science,Vol 220, Pages 135-144, ISSN 1877-0509. 2023. https://doi.org/10.1016/j.procs.2023.03.020.
[14] Ahadi, P et al,Optimal site selection for a solar power plant in Iran via the Analytic Hierarchy Process (AHP),Renewable Energy, Volume 215.2023, 118944, ISSN 0960-1481
[15] A. Akmaludin, A. D. . Suriyanto, N. Iriadi, B. Santoso, and T. . Sukendar, "Decision Support System for SmartPhone Selection with AHP-VIKOR Method Recommendations ", SinkrOn, vol. 8, no. 2, pp. 657-665, Apr. 2023.
[16] Azmi, M, et al. Hybrid of AHP and TOPSIS for Loan Approval Decision. Journal of Theoretical and Applied Information Technology,vol 96 No.13, pp 4282-4293. 2018
[17] Konstantinos,I., Georgios, T and Garyfalos, A. A Decision Support System methodology for selecting wind farm installation locations using AHP and TOPSIS: Case study in Eastern Macedonia and Thrace region, Greece. Energy Policy, Volume 132, Pages 232-246,ISSN 0301-4215. 2019
[18] Juri Reich, Aseem Kinra and Herbert Kotzab. Strategic Decision-Making in Global Supply Chain Network Design – How a Decision Support System Combining MILP and AHP on a Pareto Front Can Alleviate Decision-Making. IFAC-PapersOnLine, Volume 52, Issue 13, pp 2285-2290, ISSN 2405-8963. 2019
[19] L. Maretto, M. Faccio, D. Battini.A Multi-Criteria Decision-Making Model Based on Fuzzy Logic and AHP for the Selection of Digital Technologies.IFAC-PapersOnLine, Volume 55, Issue 2,Pages 319-324, ISSN 2405-8963. 2022
[20] Sonatha, Y., Azmi,M and Rahmayuni, I. Group Decision Support System Using AHP, Topsis and Borda Methods for Loan Determination in Cooperatives. International Journal on Informatics Visualization, Vol 5 No 4, pp 372-379. 2021
[21] Siregar, D et al. Research of Simple Multi-Attribute Rating Technique for Decision Support, Journal of Physics: Conference Series Volume 930. International Conference on Information and Communication Technology (IconICT). 2017
[22] B. Sari Br Sembiring, Mahdianta Pandia, Fransisca Br Sebayang, and Harianta Sembiring, "Decision Support System For Providing Work Allowances And Punishments To Employees Using The Ahp And Smart Method", infokum, vol. 10, no. 02, pp. 758-763, Jun. 2022.

[23] A. Akmaludin, A. D. . Suriyanto, N. . Iriadi, T. . Sukendar, and B. . Santoso, “AHP-SMART Method as Evaluation Decision Support for Employee Promotion”, SinkrOn, vol. 7, no. 2, pp. 341-350, Feb. 2022.
[24] Setiawan, B.A., Siswanti,S and Hasbi, M. Metode Analitychal Hierarchy Process Dan Simple Multi Attribute Rating Technique Sebagai Penunjang Keputusan Pemilihan Supplier, Jurnal Ilmiah Sinus, vol 18 No 2, pp 63-73. 2020.
[25] Dusanapudi Sivanagaraju Pitchaiah, Manzoor Hussaian, D. Govardhan. A review on multi attribute decision making for evaluation and selection of supplier for materials. Materials Today: Proceedings. Volume 39, Part 1,Pages 296-300, ISSN 2214-7853. 2021
[26] Harjanto,S.,Setiyowati and Vulandari R.T. Application of Analytic Hierarchy Process and Weighted Product Methods in Determining the Best Employees. Indonesian Journal of Applied Statistics Volume 4 No. 2, pp. 103-112. 2021