



DECISION SUPPORT SYSTEM FOR SELECTING THE BEST EMPLOYEES USING THE ANALYTICAL HIERARCHY PROCESS METHOD

Dalieh Iskandar^a, Muhammad Hermansyah^b

^{Department} Industrial Engineering, Yudharta University Indonesia

^{a,b} Department of Industrial Engineering, Yudharta University Indonesia

Writer Related : dalieh.id@yahoo.com

Article Info

Article history

Accepted : June 17, 2023

Revised : July 05, 2023

Accepted : August 02, 2023

Published : August 28, 2023

Keywords : Selection of the best employees, AHP .

ABSTRACT

Human resources are the most important part of the growth and development of a company. Company that can develop properly is certainly influenced by the quality of human resources which in this case are employees who work within the company. Determining the best employees is done not only by direct appointment by the leader or manager, however, a company must conduct a performance appraisal that has been carried out by its employees within a certain period of time, and of course there will be a reward for the success that has been achieved by employees. AHP is a method used to rank decision alternatives and choosing the best alternative decision when the decision maker has various criteria. With AHP decision makers can choose the best alternative that fits the decision criteria, and provide a ranking for each alternative decision based on the feasibility of each alternative that suits their needs. Based on the results of calculations that have been done using the method AHP found that KUD SUMBER REJO UNIT SKT obtain each value for the criterion knowledge a job of 0,663898, the criteria of responsibility of 0,312175 , communication criteria equal to 0,303925, attendance criteria of 0,150883, work productivity criteria of 0,116147, cooperation criteria equal to 0,050099, job initiative criteria of 0,001339. From the results of these scores the criteria for job knowledge is the highest priority in selecting the best employees.



Open Access
License
CC BY SA

DOI: <https://doi.org/10.35891/jkie.vxix.xxxx>

1. Introduction

Human resources are the most important part for the growth and development of a company. A company can develop well of course influenced by the quality of human resources which in this case are employees who work in the company. Determining the best employees is done not only by direct appointment by the leader or manager, but a company must conduct a performance assessment that has been carried out by its employees within a certain period of time, and of course there will be a *reward* for the success that has been achieved by its employees .

Based on the explanation above, researchers are interested in conducting research on the application of decision support systems in selecting the best employees at KUD Sumber Rejo Unit SKT. Researchers also hope that by implementing this method there will be significant developments, especially in terms of quality.

Based on the description above, the formulation of the problem that will be studied in this study is how much influence do the criteria and sub-criteria have in selecting the best employees at KUD Sumber Rejo Unit SKT with the application of a decision support system?. How is the hierarchical structure of the problem of selecting the best employees at KUD Sumber Rejo Unit SKT using the application of a decision support system?. What is the priority order of the best employees based on the assessment with the application of a decision support system?

Based on the formulation of the problem above, the objectives of the research to be achieved are to determine the extent of the influence of criteria and sub-criteria in selecting the best employees at KUD Sumber Rejo Unit SKT with the application of a decision support system. To determine the hierarchical structure of the problem of selecting the best employees at KUD Sumber Rejo Unit SKT using the application of a decision support system. To determine the priority order in selecting the best employees at KUD Sumber Rejo Unit SKT based on an assessment with the application of a decision support system.

Based on the research objectives above, the benefits of the research obtained are that the Company can find out the percentage of the influence of criteria and sub-criteria in selecting the best employees so that the selection is prioritized in the priority order of criteria and sub-criteria. Problems can be seen systematically which are arranged in a hierarchy. The company can prioritize the allocation of the selection of the best employees who have the highest weight based on the criteria and sub-criteria used in selecting the best employees.

2. Review Literature

A. Decision Making Theory

Decision is the result of solving a problem that must be faced firmly. (Dagun, 2006).

The Big Dictionary of Science Decision Making *is defined as the selection of decisions or policies based on certain criteria. "Decision making can be considered as a result or output of a mental or cognitive process* [HYPERLINK "about:blank" that leads to the selection of a course of action among several available alternatives".](#)

B. Decision Making Process

The process of taking decision is a process of choosing alternative action For reach purpose (Turban, 1995). Taking decision is core transactions of the organization . Successful organizations defeat competitor they are the least in 3 ways that is make

more decisions good , make decision more fast , and implement decision the more good . Function taking decision is as following (Harrison & Pelletier, 2000).

1. Determining managerial objectives

Decision making begins with setting goals and the decision cycle ends once those goals are achieved. Searching for alternatives Searching for alternatives is done by observing the internal and external environment to obtain relevant information in searching for alternatives that might achieve the goals.

2. Comparing and evaluating alternatives

Alternatives are compared and evaluated using applicable techniques and criteria related to the objectives.

3. Election action

The decision maker chooses an action from a set of alternatives.

4. Implementing decisions

Decisions are implemented from abstraction to operational action.

5. Follow-up and control

This function ensures that decisions that have been implemented have results that are in line with the objectives.

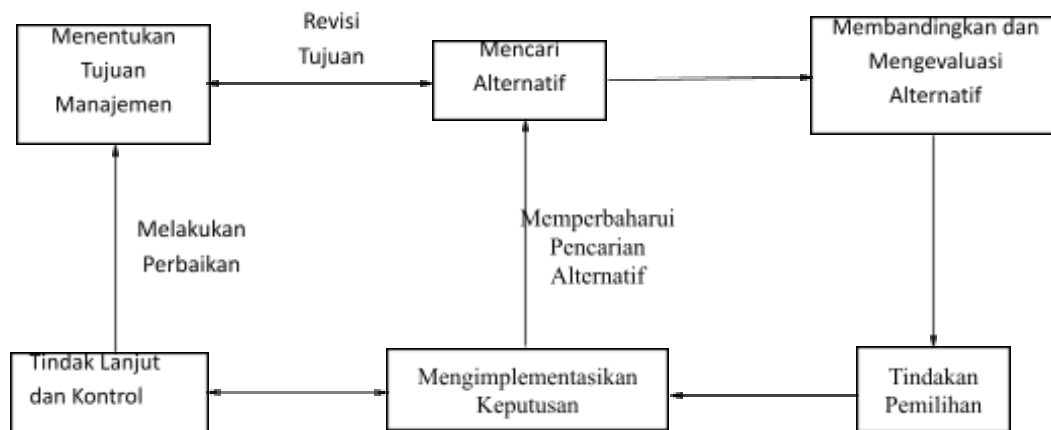


Figure 2.1 Management Decision Making Process

(Source: Harrison & Pelletier, 2000 p. 463)

C. Method

a) *Analytical Hierarchy Process*

The *Analytical Hierarchy Process (AHP)* method is a decision support model developed by Prof. Thomas Lorie Saaty to find the ranking or priority order of various alternatives in solving a problem. In complex situations, decision making is not influenced by one factor but by multiple factors. Basically, AHP is a measurement theory used to find the interval scale of paired comparisons. AHP is used to study

problems that begin by defining the problem and then arranging it into a hierarchy. With a hierarchy, a complex and unstructured problem is broken down into groups and arranged into a hierarchy which then uses various considerations to sort the weight or priority (Saaty, 1993).

b) *Hierarchy*

Saaty (1993) defines hierarchy as a representation of a complex problem in a multi-level structure where the first level is the objective, followed by the level of factors, criteria, sub-criteria, and so on down to the last level, namely alternatives. With hierarchy, a complex problem can be broken down into groups which are then arranged into a hierarchical form so that the problem will appear more structured and systematic. The AHP structure is shown in the following figure:

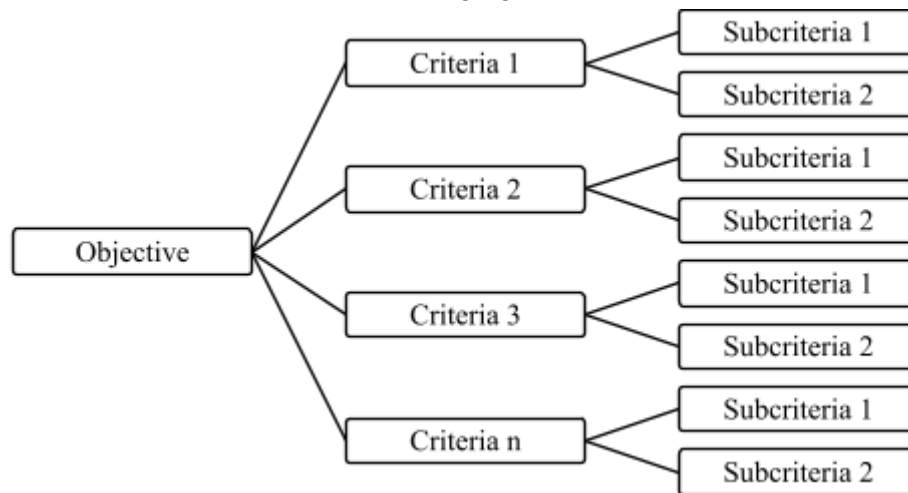


Figure 2.2 AHP Model Hierarchy

c) *Pairwise Comparison Matrix (Pairwise Comparison Matrix) Paired)*

Compiling a pairwise comparison by comparing all elements for each sub-hierarchy in pairs. Aims to determine the priority of the elements. To assess the comparison of the level of importance of one element to another, a scale of 1 to 9 is used. After assessing each comparison between elements, a pairwise comparison matrix is compiled to determine the priority . Then test the consistency and analyze the sensitivity of the overall priority to changes in the comparison .

Table 2.1 Pairwise Comparison Matrix

Intensity Interest	Information	Explanation
1	Second element The same importance	Two elements have the same influence big to objective
3	One element is slightly more important than the other elements.	Little experience and judgment support one element versus element other
5	One element is more important than the other elements	Experience And evaluation very strong support for one element over another other

7	One element is clearly more absolutely important than the other elements.	One element that is strongly supported and dominant is seen in practice.
9	One element is absolutely more important than the other elements	Evidence that supports one element over another has the highest level of assertion that may be possible to strengthen.
2,4,6,8	Values between two adjacent consideration values	This value is given when there are two compromises between two options.

Source: Saaty (1993)

D. Eigen Value

Pairwise comparison matrix will produce eigenvectors that indicate the priority level of the compared elements. What is meant by *eigenvalue* is a scalar number and *eigenvector* is a matrix that both can define matrix A. Where matrix A is a square $n \times n$ matrix. However, not all square matrices have *eigenvalues* and *eigenvectors*.

$$Ax = \lambda x \text{ In general equivalent : } (\lambda I - A)x = 0 \quad (3)$$

$$\text{In order to become an eigenvalue, then } \det(\lambda I - A) = 0 \quad (4)$$

This equation is called the characteristic equation for A and has n roots. The roots of the characteristic equation, which are expressed by $\lambda_i = 1, 2, \dots, n$, are called the eigenvalues of A. While the characteristic vector $x \neq 0$ which will satisfy equation (3) is called the eigenvector of A. As a result of the principal element having a value of 1, then $\text{trace} [A] = n = \sum_{i=1}^n \lambda_i$, it can be concluded that the largest eigenvalue of A is equal to n , and the other eigenvalues are zero. In AHP the largest eigenvalue is expressed by λ_{max} . For a consistent matrix $\lambda_{max} = n$, In practice it cannot be guaranteed that the matrix is consistent One of the reasons is because the human element (*decision maker*) cannot always be absolutely consistent in expressing preferences for the elements being compared. In other words, the assessment given to each element of the problem at a hierarchical level may be *inconsistent*.

E. Consistency

Perception as decision making may occur an inconsistency. In matrix theory it can be known that small errors in the coefficients will cause small deviations in *the eigenvalues*. By combining what has been described previously, if the main diagonal of the matrix A is one and if A is consistent then small deviations from a_{ij} will still show the largest *eigenvalue* λ_{max} , its value will approach n and the remaining *eigenvalues* will approach zero. But if A is an inconsistent matrix, small variations on a_{ij} will make the largest *eigenvalue* λ_{max} always greater than or equal to n , namely $\lambda_{max} \geq n$. The deviation from the consistency of λ_{max} with n can be used to see how big the inconsistency of A is, expressed by the consistency index with the equation:

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

According to Saaty (1993), a pairwise comparison matrix is declared consistent if *the consistency ratio* (CR) value is $\leq 10\%$. If *the CI* is zero, it means the matrix is consistent. The inconsistency limit that is set is measured using *the Consistency Ratio* (

CR), which is the comparison of the consistency index with *the Random Index* (RI) value. This value depends on the order of the matrix n .

$$CR = C / RI$$

Table 2.2 Random Index Value

N	1	2	3	4	5	6	7	8
Republic of Indonesia	0	0	0.58	0.90	1.12	1.24	1.32	1.41

3. Methodology

This study uses quantitative research, meaning that this study uses data obtained and analyzed in the form of numbers, starting from data collection, interpretation of the data and to the appearance of the results. Quantitative research methods are quantitative or statistical data analysis with the aim of testing the established hypothesis.

The conceptual framework used in this study is to describe the stages in the process of selecting the best employees. The approach used is Multi Criteria Decision Analysis (MCDA), in supplier selection using the *Analytical Hierarchy Process* (AHP) method. The problem of supplier selection is very complex, there is qualitative data in the company evaluation, so the approach used is AHP. The framework of thought in this study is described in the flowchart in the following study:

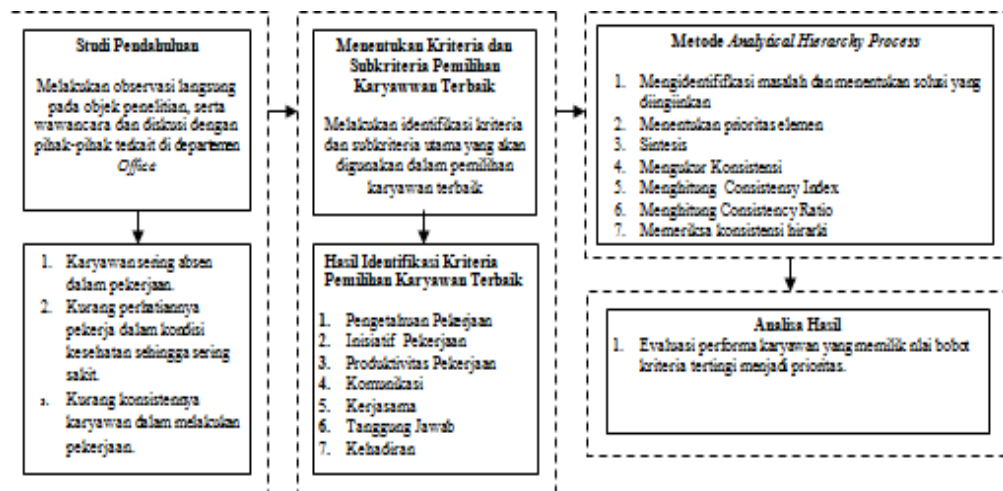


Figure 3.1 Framework Draft Thinking

4. Results and Discussion

a. Data Collection with AHP Method

Data collection was conducted using a survey method through in-depth structured interviews and questionnaires. Interviews were conducted with respondents who had sufficient experience in the procurement field. While the questionnaire was conducted after validating and analyzing the interview data. The target of the questionnaire in particular was the same respondents at the time of the interview, and the addition of

several respondents with sufficient experience in the procurement field who had not been reached previously at the time interview.

Both methods require detailed, complete, accurate and clear recording. To achieve completeness, accuracy and clarity of data, data recording must be equipped with:

1. Name of data collector
2. Date and time of data collection
3. Data collection location
4. Additional information on data/terms/respondents
5. Respondent: the person who is the source of the data
 - Respondent's position
 - Respondents' work experience

b. Expert Validation

After the results of the interview and questionnaire are obtained and analyzed, the results obtained are asked for opinions / approval from experts. The experts in question are people who have experience working in the company for more than 20 years and in this study, experts who have sufficient knowledge about selecting the best employees are specifically selected.

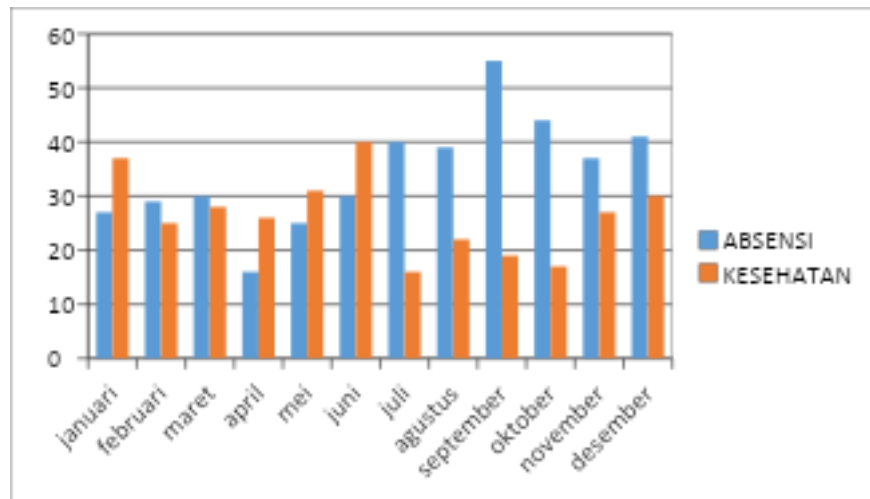


Figure 3.4 Employee Data Percentage

Evaluation level interest between criteria with use method AHP, then taken average mark from 20 respondents, so that a pairwise comparison matrix was obtained for the criteria related to the objectives as shown in Table 3 below:

Table 3.1 Pairwise comparison of criteria

	C1	C2	C3	C4	C5	C6	C7
C1	1	1	3	3	4	5	4
C2	0.5	1	0.33	3	2	4	3
C3	0.33	3	1	3	3	3	5

C4	0.33	0.33	0.33	1	3	3	3
C5	0.25	0.5	0.33	0.33	1	4	3
C6	0.2	0.2	0.33	0.33	0.25	1	4
C7	0.25	0.33	0.25	0.33	0.33	0.25	1
JUMLA H	2.86	6.36	5.57	10.99	13.58	20.25	23

Source : Questionnaire Data

Description: Pairwise comparison table C1-C7, means 7 criteria, first is job knowledge, second is job initiative, third is job productivity, fourth is communication, fifth is cooperation, sixth is responsibility, and seventh is attendance.

Table 3.2 Normalization Comparison Couple

Criteria	C1	C2	C3	C4	C5	C6	C7
C1	0.34965	0.157233	0.5386	0.272975	0.294551	0.246914	0.173913
C2	0.174825	0.157233	0.059246	0.272975	0.147275	0.197531	0.130435
C3	0.115385	0.471698	0.179533	0.272975	0.220913	0.148148	0.217391
C4	0.115385	0.051887	0.059246	0.090992	0.220913	0.148148	0.130435
C5	0.087413	0.078616	0.059246	0.030027	0.073638	0.197531	0.130435
C6	0.06993	0.031447	0.059246	0.030027	0.018409	0.049383	0.173913
C7	0.087413	0.051887	0.044883	0.030027	0.0243	0.012346	0.043478
JUMLAH	1	1	1	1	1	1	1

Create normalization by dividing each cell in the table by the total according to its column. For example: the value 8 for income (row) → agroecosystem (column), divided by the total; which is 14. So that the normalization table is obtained as follows: The next step is to carry out the same steps to determine the alternative paired comparisons.

Table 3.3 Comparison alternatives C1

ALTERNATIVE COMPARISON MATRIX				
knowledge	milling	pc ira	ana pack	Ria Bandrol
milling	1	0.2	3	4
pc ira	5	1	2	0.2

ana pack	0.333333	0.5	1	4
Ria Bandrol	0.25	5	0.25	1
Amount	6.583333	6.7	6.25	9.2

Table 3.4 C1 Normalization

Eigenvalues				amount	average
0.111111	0.052632	0.2	0.090909	0.454651781	0.11366294 5
0.333333	0.157895	0.2	0.090909	0.782137161	0.19553429
0.222222	0.315789	0.4	0.545455	1.483466241	0.37086656
0.333333	0.473684	0.2	0.272727	1.279744817	0.31993620 4
					1

$$CI = (\max-n)/(n-1)$$

for max. 7.1701

IN 0.597508

CR=CI/IR 0.663898

Based on the results of the data processing above, the priority weights for the criteria are in the following order:

1. Job knowledge criteria (A1) has the highest priority weight of **0.663898**
2. The responsibility criteria (A6) has a priority weight **0.312175**
3. Communication criteria (A4) has a priority weight **0.303925**
4. The presence criteria (A7) has a priority weight **0.150883**
5. The work productivity criteria (A3) has a priority weight **0.116147**
6. Cooperation criteria (A5) has a priority weight **0.050099**
7. Criteria initiative job (A2) has a priority weight of **0.001339**

5. Conclusion

Study This aiming For to obtain criteria and subcriteria evaluation performance employee Then do weighting to criteria and subcriteria the with comparison in pairs . In accordance with objective research , some the conclusion that can be drawn taken is as following :

1. Criteria used in election employee best is knowledge work with weight 0.663898. The most influential criteria in election employee best is cooperation with weight 0.312175. Priority second is criteria communication with weight 0.303925 Priority third is criteria presence with weight 0.150883. Priority fourth is productivity work with weight 0.116147. Priority fifth is cooperation with weight 0.050099 Priority sixth is initiative work with weight 0.001339
2. Structure hierarchy problem election employee best consists of of 7 criteria and 4 subcriteria
3. Order priority election employee best based on evaluation with implementation AHP method as following .

Reference

- Anggria, RC, Afriyudi, A., & Panjaitan, F. (2015). Application of Fuzzy TOPSIS Method in Employee Performance and Position Assessment Decision Support System of Sembawa Research Center. *Student Colloquium of Information Systems & Informatics Engineering (SC-SITI) 2015* , 1 . <http://eprints.binadarma.ac.id/2456/>
- Dagun, SM (2000). A comprehensive dictionary of science. (*No Title*) . <https://cir.nii.ac.jp/crid/1130000794601459072>
- Harrison, E.F., & Pelletier, M.A. (2000). The essence of management decisions. *Management Decision* , 38 (7), 462–470.
- Hasan, MI (2004). *Basic material of decision making theory* . <https://library.stik-ptik.ac.id/detail?id=3843&location=lokal>
- Iskandar, D., & Hermansyah, M. (2020). Decision Support System for Selecting the Best Employees Using the Analytical Hierarchy Process Method. *JKIE (Journal of Knowledge Industrial Engineering)* , 7 (3), 90–99.
- Kurniasih, NA, & Astuti, SP (2021). *IMPLEMENTATION OF ANALYTICAL HIERARCHY PROCESS (AHP) METHOD AS AN ALTERNATIVE SOLUTION IN SELECTING SOYBEAN RAW MATERIAL SUPPLIERS (Case Study of the Sehat Sari Tofu Factory)* [PhD Thesis, UIN Surakarta]. http://eprints.iain-surakarta.ac.id/981/1/Full%20Skripsi_175211083.pdf
- Kusaeri, A., Hermansyah, M., & Bashori, H. (2016). Supplier Selection Analysis Using Analytical Hierarchy Process Method Approach at PT. XX. *JKIE (Journal Knowledge Industrial Engineering)* , 3 (2). <http://jurnal.yudharta.ac.id/v2/index.php/jkie/article/view/878>
- Marimin, M. (2004). Multiple Criteria Decision Making Techniques and Applications. *PT. Grasindo, Jakarta* .

- Mondy, R. W., & Noe, R. M. (2005). *Human resource management*. Pearson Educación.
<https://books.google.com/books?hl=en&lr=&id=UkWaAvHmBswC&oi=fnd&pg=PA2&dq=R.+M.+N.+R.+Wayne+Mondy,+2005+%E2%80%9CHuman+Res+ource+Management,%E2%80%9D+in+Ninth+Edition,+USA:+Pearson+Prentice+Hall.&ots=YyRsVcxNV4&sig=BqQW9yOUSCO7QQ4DffaQmgTlii0>
- Mustika, M., Lisnawita, L., Yunefri, Y., & Costaner, L. (2022). Employee Performance Assessment Decision Support System Using the AHP Method. *Multidisciplinary Scientific Paper Journal (JURKIM)*, 2 (1), 1–10.
- Noorul Haq, A., & Kannan, G. (2006). Fuzzy analytical hierarchy process for evaluating and selecting a vendor in a supply chain model. *The International Journal of Advanced Manufacturing Technology*, 29 (7–8), 826–835. <https://doi.org/10.1007/s00170-005-2562-8>
- Özdağoğlu, A., & Özdağoğlu, G. (2007). Comparison of AHP and fuzzy AHP for the multi-criteria decision making processes with linguistic evaluations. *İstanbul Ticaret Üniversitesi Fen Bilimleri Dergisi*, 6 (11), 65–85.
- Palasara, N. (2017). The best employee selection decision-making system using the analytic hierarchy process method. *Bina Insani ICT Journal*, 4 (1), 31–46.
- Rakhmat, J. (2007). *Communication Psychology*. Revised Edition, 24th Printing. Bandung: PT. Remaja Rosdakarya Offset.
- Rijayana, I., & Okirindho, L. (2012). Decision support system for selecting outstanding employees based on performance using the Analytical Hierarchy Process method. *National Informatics Seminar 2012*. <https://www.neliti.com/publications/173024/sistem-pendukung-keputusan-pemilihan-karyawan-berprestasi-berdasarkan-kinerja-me>
- Saaty, T. L., & Vargas, L. G. (2012). *Models, methods, concepts & applications of the analytic hierarchy process* (Vol. 175). Springer Science & Business Media.
[https://books.google.com/books?hl=en&lr=&id=6J9XI811qjwC&oi=fnd&pg=PR5&dq=Models,+Methods,+Concepts,+%26+Applications+of+the+analytic+hierarchy+process.+\(2000\).&ots=ZQNWl6CY2q&sig=XTDSrgrSOxw0h8C6PusWpwu5Q1A](https://books.google.com/books?hl=en&lr=&id=6J9XI811qjwC&oi=fnd&pg=PR5&dq=Models,+Methods,+Concepts,+%26+Applications+of+the+analytic+hierarchy+process.+(2000).&ots=ZQNWl6CY2q&sig=XTDSrgrSOxw0h8C6PusWpwu5Q1A)
- Salusu, J. (2015). *Strategic decision making*. Gramedia Widiasarana Indonesia.
- Sinaga, ASR (2019). Decision Support System for Determining the Best Employees Using the AHP Method. *JISKA (Sunan Kalijaga Informatics Journal)*, 3 (2), 119–125.
- Suharnan, MS (2005). *Cognitive psychology*. Surabaya: Srikandi.
- Syamsi, I. (2021). *Decision making and information systems*.

- Tegal, W.-AB (2015). Analysis of College Selection Factors in Tegal Based on Education Level Using the Analytical Hierarchy Process (AHP) Method. *Indonesian Journal on Software Engineering (IJSE)* , 1 (1), 45–51.
- Turban, E. (1995). *Decision support and expert systems Management support systems* . Prentice-Hall, Inc. <https://dl.acm.org/doi/abs/10.5555/203412>
- Turban, E., Aronson, J.E., & Liang, T.P. (2005). *Decision support systems and intelligent systems*. Yogyakarta: Andi .
- Woods, D., Dekker, S., Cook, R., Johannesen, L., & Sarter, N. (2017). *Behind human error* . CRC Press. <https://www.taylorfrancis.com/books/mono/10.1201/9781315568935/behind-human-error-leila-johannesen-david-woods-richard-cook-sidney-dekker-nadine-sarter>
- Yuliawati, D. (2014). Application of AHP Method in Improving the Quality of Employee Structural Position Mapping (Case Study of Ibi Darmajaya). *Sembistek Proceedings 2014* , 1 (02), 601–612

