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Decision support system for employee recruitment optimization

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Abstract

In a production process, various production factors can affect the resulting performance. Employees, as a factor of production, play an important role in the production process, so it is necessary to get a high-quality workforce. In this regard, the recruitment process is very important, so it needs to be carried out strictly and thoroughly. The problem that is often encountered in the recruitment process is that applicant files are still handled manually, which allows errors to occur in the recruitment process. This error will impact the resulting performance because the industry has employees who do not fit the criteria. Therefore, a Decision Support System is needed in the recruitment process so that decision-making can be done quickly and accurately, reducing errors. This research aimed to find a decision support system application in employee recruitment. The recruitment process can be faster, more precise, and optimal because we get prospective employees who fit the required criteria. The method used to achieve the research objectives was the Analytical Hierarchy Process (AHP) to develop weights or priorities. The results obtained in this study were an application that shows the ranking of accepted prospective employees based on assessments in the recruitment process. In addition, the test results showed that 95% of the application could meet the Usability and Efficiency characteristics, and 70% meet the overall characteristics.

Keywords: Decision Support System; Optimal; Recruitment; Analytical Hierarchy Process (AHP); Employee

1. Introduction

The production process carried out by industry, both in the service and manufacturing sectors, has various production factors, such as raw materials, capital, equipment, buildings, and human resources, which will affect the performance or output produced by the industry (1). The human resource factor plays a role in the success of an industry. So, it is very important to get a qualified employee (2). In addition, it requires employees who have competence in their fields and accordance with their fields of work (3). For this reason, an industry in its recruitment process needs to know the criteria needed for prospective employees so that employees with the abilities and performance needed in the industry are obtained (3, 4). Suppose employees do not fully meet the predetermined criteria. In that case, they can be given training in addition to checking the references of prospective employees in detail (1), considering that one of the obstacles encountered in the recruitment process is the small number of prospective employees and many competitors need employees with the same qualifications. (5).

In line with the above description, it can be concluded that the recruitment and selection process is very important, so it needs to be carried out strictly and thoroughly. The recruitment system can be defined as finding the right skills and finding the right job for prospective employees. The role of the personnel department in the industry is an important part of an industry. The recruitment system's efficiency influences an industry's success (6). The problem in the recruitment process is that the personnel department encounters difficulties as the applicant files are still handled manually. As a result, errors can occur in accepting employees who do not meet the criteria, affecting the resulting

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performance. Therefore, a Decision Support System is needed in the recruitment process to make decisions quickly, accurately, and with fewer errors (4).

Support System (DSS) is a field of computer science to assist the management of a particular industry or organization in making a policy or decision based on certain criteria (7). DSS is a system intended to support managerial decision-makers who aim to make assessment-based decisions (8). This system processes data into information for decision-making, which is usually carried out by the leader of an industry or organization (9).

Determining the criteria needed in the employee recruitment process can be done using the Analytical Hierarchy Process (AHP) method. This method allows many criteria and sub-criteria to be considered to decide each criterion, and sub-criteria has a rating weight. This will impact decision outcomes: different decision makers will have different assessment rating weights so that the resulting decision results fit the needs (10,11,12,13,14). A large number of criteria and sub-criteria used in the recruitment process causes the process to take time, even though the placement of the right workforce in the right position needs to be done (15). For this reason, it is necessary to make an application so that the recruitment system can run optimally (13,14,16)

Thus, a Decision Support System application is needed in the employee recruitment process to become faster and more precise, considering the number of files submitted for selection and the criteria and sub-criteria. In this case, the application of the Decision Support System for the employee recruitment process is made using the Analytical Hierarchy Process (AHP) method (13,14,17,18,19) to get prospective employees who meet the required criteria. In addition, it is also necessary to evaluate the quality of the software used, adopted from the ISO 9126 test model (2)

2. Material and methods

2.1. Human Resources

The Human Resource factor is one of the factors in the production process that needs to be managed properly so that production activities can run effectively and efficiently. For this reason, human resources or workers who have the ability according to their field of work are needed. So the stages of recruitment and selection of workers must be right to get workers with good abilities and expertise to benefit for the company (1).

2.2. Employee Recruitment

Recruitment is an activity to gather several applicants according to the criteria determined by an industry/organization. While employee selection is a process of selecting and determining qualified employees according to predetermined criteria. The selection process that is carried out properly and correctly will get employees who meet the criteria to do the right job (1).

Recruitment aims to accept many applicants according to predetermined criteria. With the correct and appropriate selection process, qualified employees will be obtained according to the criteria to produce a good performance (5).

The development of quality Human Resources is a supporting factor in an industry or organization. So, selecting quality employees with the right jobs according to needs is very important. The problem often encountered is due to the large number of applicant files that enter and must be assessed, adjusting to predetermined employee criteria, resulting in errors in selecting applicant files (4). For this reason, a Decision Support System is needed to facilitate the recruitment and selection process.

2.3. Decision Support System (DSS)

Decision Support Systems are made to support a solution to a problem. DSS aims to provide information, guidance, and predictions for information users so they can make the right decisions (8). This computer-based system produces some alternative decisions aimed at helping the management team take action in dealing with problems. DSS is a specific system concept that connects computerized information with decision-makers(14).

2.4. Analytical Hierarchy Process (AHP)

AHP is a comprehensive decision-making method. This method takes into account both qualitative and quantitative aspects as well. Several criteria are compared with each other (level of importance). AHP is a method of determining or making decisions that combine the principles of subjectivity and objectivity of the DSS or decision-maker (8).

This AHP procedure is so powerful that it is widely used in making important decisions. AHP has the task of solving a problem that tends to be complicated by running a hierarchy of criteria (14). The AHP method helps solving complex problems through a hierarchical structure of criteria, stakeholders, results and through consideration to develop weights or priorities. The structure of the AHP model is an inverted tree model. Goal Weight should be divided between ranking points by rating (15).

The stages in the Analytical Hierarchy Process (AHP) are as follows (18) :

- Define the problem and determine the desired solution.
- Create a hierarchical structure of the problem
- Priority Setting

1. *Relative Measurement*
2. *Priority Weight Comparison Matrix*
3. *Consistency*

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

CI : Consistency Index
λ max : sum (comparison value x weight)
N : Matrix Orde

$$CR = CI / RI$$

CR = Consistency Ratio
RI = Random Index

- Make decisions based on comparisons that have been made

2.5. ISO 9126

ISO 9126 is an international standard issued by ISO for software quality evaluation and Capability Testing. Several aspects of the test used are (2):

1. Functionality

The software's ability to provide functions according to user requirements when used under certain conditions.

2. Reliability

The ability of the software to maintain a certain level of performance when used under certain conditions.

3. Usability

Software capabilities that will be understood, learned, used, and attractive to users when used under certain conditions.

4. Efficiency (Efficiency)

The ability of the software to provide appropriate performance relative to the number of resources used in the circumstances

Table 1 ISO 9126 Capability Aspects

Characteristics	Sub Characteristics	Description
Functionality	Suitability	The ability of software to provide a set of functions suitable for specific tasks and user goals.
	Accuracy	The ability of the software to provide precise and correct results as needed.
	Security	The ability of the software to prevent unwanted access by intruders (hackers) as well as authorization in data modification.
Usability	Interoperability	The capability of the software to interact with one or more specific systems

Characteristics	Sub Characteristics	Description
	Compliance	The ability of the software to meet standards and requirements in accordance with applicable regulations.
Reliability	Maturity	The ability of the software to avoid failure due to errors in the software.
	Error Tolerance	The ability of the software to maintain its performance in the event of a software error.
	Recoverability	The ability of the software to rebuild performance levels in the event of a system failure, including data and network connections.
Usability	Understandability	The ability of the software to be easy to understand.
	Learnability	The ability of the software to be easy to learn.
	Operability	The ability of the software to be easy to operate.
	Attractiveness	The ability of the software to attract users.
Efficiency	Time behaviour	The ability of the software to provide appropriate response and processing time while performing its functions.
	Resource behaviour	The ability of the software to use its resources according to function requirements.

3. Results and discussion

3.1. Data Collection

The results of this study are simulations carried out using the following data:

Table 2 Criteria and Sub Criteria Data

Code	Criteria	Sub Criteria	Source
C1	Age	20, 21,22, 23, 24	(4)(6)(13)
C2	Education	High School, D3, S1	(4)(13)
C3	Work Experience	> 1 year, ≤ 1 year, 0 year	(2) (3)(4)(6) (13)
C4	Interview Result	50, 60, 70, 80, 90	(2)(3)(13)
C5	Written Test Result	60, 70, 80, 90, 100	(3)(13)

Table 3 Prospective Employee Data Simulation

No	Criteria	Prospective Employee Code	Age	Education	Work Experience	Interview Result	Written Test Result
1	Ahmad	A1	24	High School	> 1 year	80	80
2	Budi	A2	20	High School	≤ 1 year	70	80
3	Agus	A3	23	S1	> 1 year	90	90
4	Bambang	A4	20	D3	0 year	60	70
5	Andi	A5	22	High School	≤ 1 year	70	60

Table 2 shows the criteria and sub-criteria used to carry out assessments in the recruitment process. Based on these criteria and sub-criteria, weighting will then be carried out.

In Table 3, there is a simulation of prospective employee data. These data will determine the weight of the assessment for each prospective employee.

3.2. Analytical Hierarchy Process (AHP)

Table 4 Criteria Comparison Matrix

Code	C1	C2	C3	C4	C5
C1	1	3	7	3	5
C2	0.3	1	5	3	7
C3	0.14	0.2	1	3	5
C4	0.33	0.33	0.33	1	5
C5	0.2	0.14	0.2	0.2	1

Table 4 shows the weight values of the criteria contained in Table 2. These values will later be used as the basis for the next calculation process.

Table 5 Weighting Criteria

Code	C1	C2	C3	C4	C5	Amount	Weight
C1	0.5060241	0.64154786	0.73426573	0.49295775	0.33333333	2.70812877	0.54162575
C2	0.15180723	0.21384929	0.1048951	0.21126761	0.2	0.88181923	0.17636385
C3	0.07	0.04276986	0.1048951	0.21126761	0.33333333	0.76455506	0.15291101
C4	0.17	0.07	0.03	0.07042254	0.06666667	0.41201203	0.08240241
C5	0.10120482	0.03	0.02097902	0.01408451	0.06666667	0.23348491	0.04669698

λ maks : 5,054113
IR: 1.12
CI: 0,0135
CR: 0.012079 (CR < 0,1= Consistent)

Table 5 is a continuation of the calculation process from Table 4. Table 5 shows the consistency of the weighting assessment from Table 4. Calculations for all criteria and sub criteria will be carried out in the same way as those in Tables 4 and 5, and will produce data presented in Table 6.

Table 6 Weight of Criteria and Sub Criteria

Criteria and Sub Criteria	Rating Weight	Employee 1	Employee 2	Employee 3	Employee 4	Employee 5
Age (C1)	0.542					
20 Year	0.201	0.039	0.399	0.066	0.357	0.139
21 Year	0.168	0.039	0.399	0.066	0.357	0.139
22 Year	0.084	0.039	0.399	0.066	0.357	0.139
23 Year	0.052	0.039	0.399	0.066	0.357	0.139
24 Year	0.036	0.039	0.399	0.066	0.357	0.139

Education (C2)	0.176					
SMA	0.113	0.301	0.283	0.042	0.074	0.301
D3	0.050	0.301	0.283	0.042	0.074	0.301
S1	0.013	0.301	0.283	0.042	0.074	0.301
Experience (C3)	0.153					
>1 Year	0.099	0.342	0.130	0.342	0.056	0.130
<=1 Year	0.044	0.342	0.130	0.342	0.056	0.130
0 Year	0.011	0.342	0.130	0.342	0.056	0.130
Interview Result (C4)	0.082					
50	0.004	0.245	0.105	0.497	0.047	0.105
60	0.006	0.245	0.105	0.497	0.047	0.105
70	0.010	0.245	0.105	0.497	0.047	0.105
80	0.021	0.245	0.105	0.497	0.047	0.105
90	0.041	0.245	0.105	0.497	0.047	0.105
Written Test Result (C5)	0.047					
60	0.002	0.202	0.202	0.464	0.089	0.044
70	0.003	0.202	0.202	0.464	0.089	0.044
80	0.006	0.202	0.202	0.464	0.089	0.044
90	0.012	0.202	0.202	0.464	0.089	0.044
100	0.023	0.202	0.202	0.464	0.089	0.044

Table 6 is the final result table from the process of calculating all criteria and sub criteria for all prospective employees. From these calculations, the final results of the assessment for each existing employee candidate are obtained, which are listed in Table 7.

Table 7 Aggregation Table

Employee	**Aggregation**	**Rank**
Prospective Employee 1	0.1561	5
Prospective Employee 2	0.3040	1
Prospective Employee 3	0.1583	4
Prospective Employee 4	0.2229	2
Prospective Employee 5	0.1587	3

Table 7 displays the final calculation of the Analytical Hierarchy Process (AHP), showing the ranking of existing prospective employees, based on the assessment that has been carried out.

3.3. Application Output

After the manual calculation, the next step is to make an application based on the AHP method. The following displays the application from the input display to the output display.

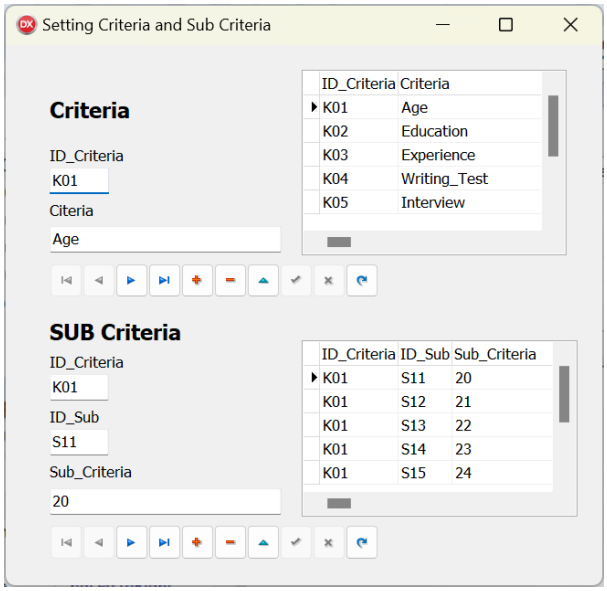


Figure 1 Display Input of Criteria and Sub Criteria

Figure 1 displays the input data criteria and sub criteria that will be used in making applications for the AHP calculation process, which will later be included in the database.

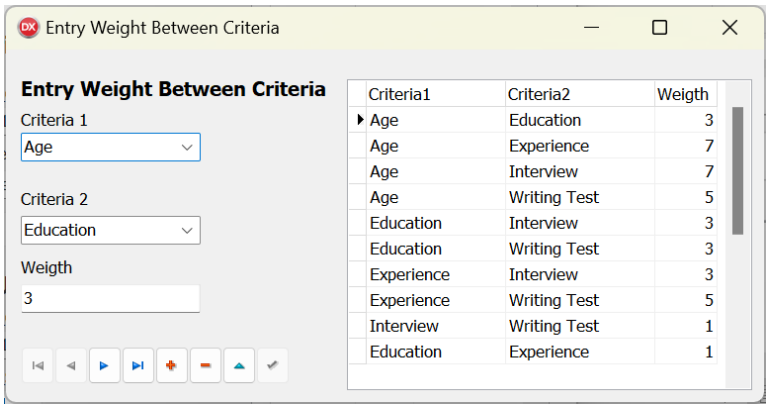


Figure 2 Display of Input Weight Comparison between Criteria

In Figure 2, the weight data input is shown to compare between criteria used in making AHP applications.

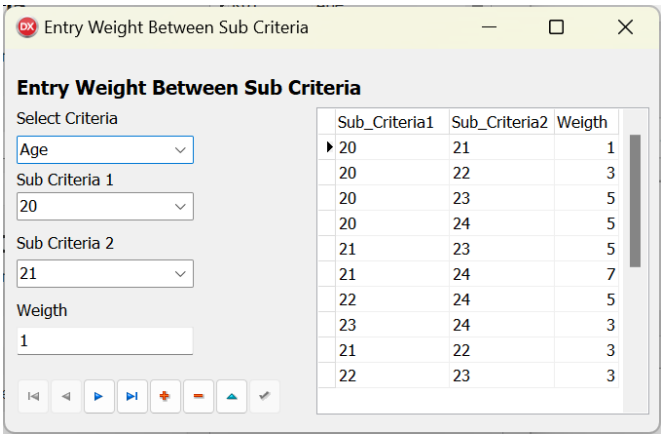
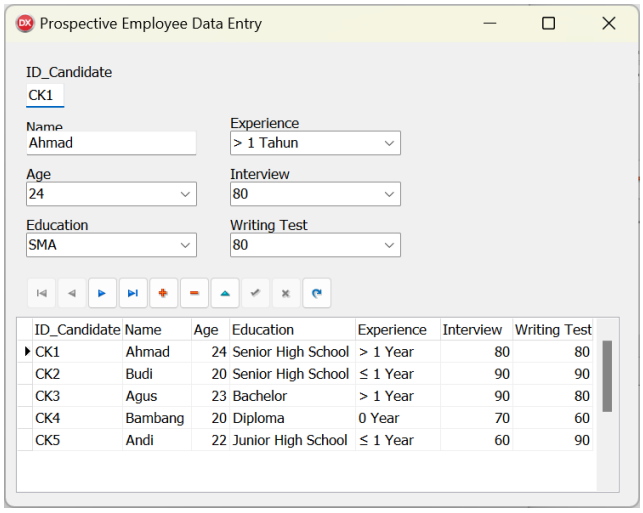


Figure 3 Display of Input Comparison Weights Between Sub-Criteria

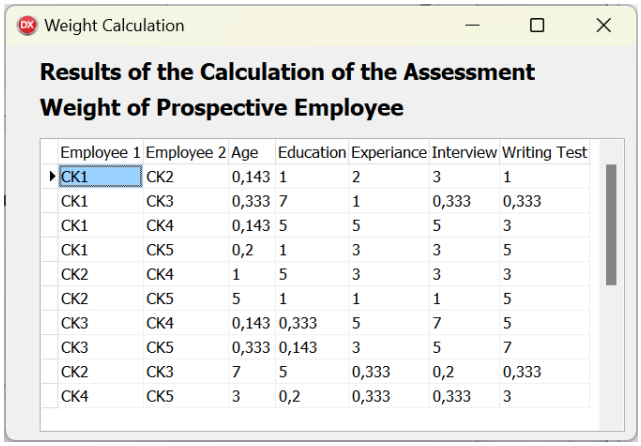
In Figure 3, the weight data input is shown to compare between sub-criteria. This data will be used in the application development process for AHP calculations.



ID_Candidate	Name	Age	Education	Experience	Interview	Writing Test
CK1	Ahmad	24	Senior High School	> 1 Year	80	80
CK2	Budi	20	Senior High School	≤ 1 Year	90	90
CK3	Agus	23	Bachelor	> 1 Year	90	80
CK4	Bambang	20	Diploma	0 Year	70	60
CK5	Andi	22	Junior High School	≤ 1 Year	60	90

Figure 4 Display of Employee Candidate Data Input

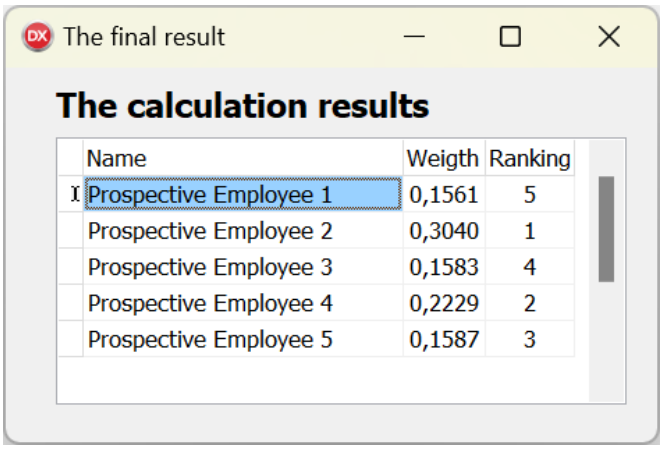
Figure 4 shows the input data for prospective employees. This data will be entered into the database and used in the application development process for AHP calculations.



Employee 1	Employee 2	Age	Education	Experiance	Interview	Writing Test
CK1	CK2	0,143	1	2	3	1
CK1	CK3	0,333	7	1	0,333	0,333
CK1	CK4	0,143	5	5	5	3
CK1	CK5	0,2	1	3	3	5
CK2	CK4	1	5	3	3	3
CK2	CK5	5	1	1	1	5
CK3	CK4	0,143	0,333	5	7	5
CK3	CK5	0,333	0,143	3	5	7
CK2	CK3	7	5	0,333	0,2	0,333
CK4	CK5	3	0,2	0,333	0,333	3

Figure 5 Display of Appraisal Weights for Prospective Employees

Figure 5 shows the results of weighting calculations for both criteria and sub criteria, which come from applications made with previously entered data.



Name	Weigth	Ranking
Prospective Employee 1	0,1561	5
Prospective Employee 2	0,3040	1
Prospective Employee 3	0,1583	4
Prospective Employee 4	0,2229	2
Prospective Employee 5	0,1587	3

Figure 6 Display of Prospective Employee Ranking Output

Figure 6 shows the final result of the AHP calculation process from the application.

3.4. ISO 9126

The following shows some of the characteristics used in application assessment and the results of the assessment:

Table 8 Characteristics and Application Assessment Results

Characteristics	Sub Characteristics	Description	Assessment + Analysis
Usability	Suitability	The ability of software to provide a set of functions suitable for specific tasks and user goals.	80%
	Accuracy	The ability of the software to provide precise and correct results as needed.	75 %
	Security	The ability of the software to prevent unwanted access by intruders (hackers) as well as authorization in data modification.	0 % (not yet available)
	Interoperability	The capability of the software to interact with one or more specific systems	0 % (not yet available)
	Compliance	The ability of the software to meet standards and requirements in accordance with applicable regulations.	60 % Can fulfill the rules of the object of the simulation)
Reliability	Maturity	The ability of the software to avoid failure due to errors in the software.	70 %
	Error Tolerance	The ability of the software to maintain its performance in the event of a software error.	70 %
	Recoverability	The ability of the software to rebuild performance levels in the event of a system failure, including data and network connections.	50 %
Usability	Understandability	The ability of the software to be easy to understand.	100 %
	Learnability	The ability of the software to be easy to learn.	100 %
	Operability	The ability of the software to be easy to operate.	100 %
	Attractiveness	The ability of the software to attract users.	100 %
Efficiency	Time behaviour	The ability of the software to provide appropriate response and processing time while performing its functions.	80 %
	Resource behaviour	The ability of the software to use its resources according to function requirements.	90 %

4. Conclusion

This research resulted in an application based on manual calculations using the AHP method. It had the final result of ranking prospective employees who would be accepted based on all predetermined criteria and sub-criteria weight. This application was created so that the recruitment process can be carried out more optimally because if done

manually, the process is lengthy, and errors are possible. The application assessment shows that 95% have fulfilled in terms of Usability and Efficiency characteristics. Regarding Reliability and Usability, not all sub-characteristics are available in the application, so an assessment cannot be carried out. In general, 70% of this application has fulfilled all the existing characteristics. Thereupon, the recruitment process is more optimal using this application than manually.

Compliance with ethical standards

Conflict of interest statement

No conflict of interest.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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