

New Employee Admission Decision Support System at Bangraden Foods using The Web-based Fuzzy Tsukamoto Method

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Abstract— Currently, Bangraden Foods is having problems picking new employees by offering numerous criteria to identify the applicant's abilities and personality, the results are typically recorded and must be compared to make judgments, which takes a long time for the company. In this case, the researcher used the Tsukamoto fuzzy method to develop a decision support system because it is simple, flexible, data-tolerant, faster, and better suited for input from humans rather than robots. Based on black box testing, the web system performance results run 100% smoothly for all existing functions. Testing data on 5 new employee candidates obtained a system value difference of 0.001-0.02 with 100% data accuracy, and the system recognized the graduation of two prospective workers with a decision of 'pass' since it reached an average score of 75, according to HRD, and three candidates 'did not qualify' due to below-average grades. In addition to testing service quality, throughput of 16Kb/s is classed as 'bad', packet loss of 0.273594% as 'very good', and delay of 293ms as 'good'. As a result, Bangraden Foods management may use the system to make data processing quicker and provide advice for decisions on recruiting new personnel based on the company's needs.

Keywords— *Decision Support System Application, Fuzzy Tsukamoto, PHP, Quality of Service, Web.*

I. INTRODUCTION

The Employees are an important asset for an organization or company in order to achieve its goals. According to Law number 13 of 2003 concerning employment, article 1 paragraph 2 states that employees are people who are able to do work to produce goods and services both to meet their own needs and that of society, both within and outside the work relationship [1]. Many companies see that the level of employee performance is a determining factor in the sustainability of their company [2]. So, to achieve this, efforts are needed from the start, namely by paying attention to the criteria of prospective employees [3].

In this case Bangraden Foods is a company engaged in the snack food processing industry in the form of stone bananas located in Tanjungrejo, Malang City. Bangraden Foods itself conducts employee selection by providing several requirements to find out the applicant's personal criteria. Applicants' data is usually stored in an archive of applicants which must then be compared in advance to find out the results of the decision. Of course this takes a long time. We often see a phenomenon where many new employees enter a company not for a long time. This error in reception is the main reason why this happened. When this employee has entered and been accepted into the company, it will be seen that this employee does not have the skills

needed by the company, especially in the production department.

Making a decision support system is one step that can be used to solve the problem. Decision Support System (Decision Support System) is an interactive computer-based system to assist decision making by utilizing data and models to solve unstructured problems. Decision Support Systems can share alternative solutions when a person or group of people has difficulty making the right decision [4]. to support all decision-making sessions starting from identifying problems, sorting out relevant information, ensuring the approach used in the decision-making process, to evaluating alternative choices [5].

In this discussion, researchers try to solve problems in the selection of new employees with the Fuzzy Tsukamoto method. The method focuses on rules in the form of IF-THEN which are represented by fuzzy sets with monotone membership functions, as well as the criteria and rules used to determine the final result. So with that the use of the Fuzzy Tsukamoto method used in this study is the right choice in dealing with the problem of making a decision using several criteria. The Tsukamoto Fuzzy method was chosen because it is simple, flexible, has tolerance for existing data, is faster in computing, more intuitive, accepted by many parties, more suitable for input received from humans not by

machines. With the Fuzzy Tsukamoto method, all of these criteria have the same value so they don't have different weights like other methods which are then followed by a ranking process to select prospective employees. By applying this method, the ranking results will be obtained who will be accepted using this method.

II. METHOD

A. Research Design

Research Design The type of research that will be carried out is the type of manufacturing and development research. To answer the formulation of the problem, it is necessary to carry out the stages of making system design, tool design, preparation of materials and equipment, parameter determination, design implementation, up to the formation of tools, systems that are suitable for use.

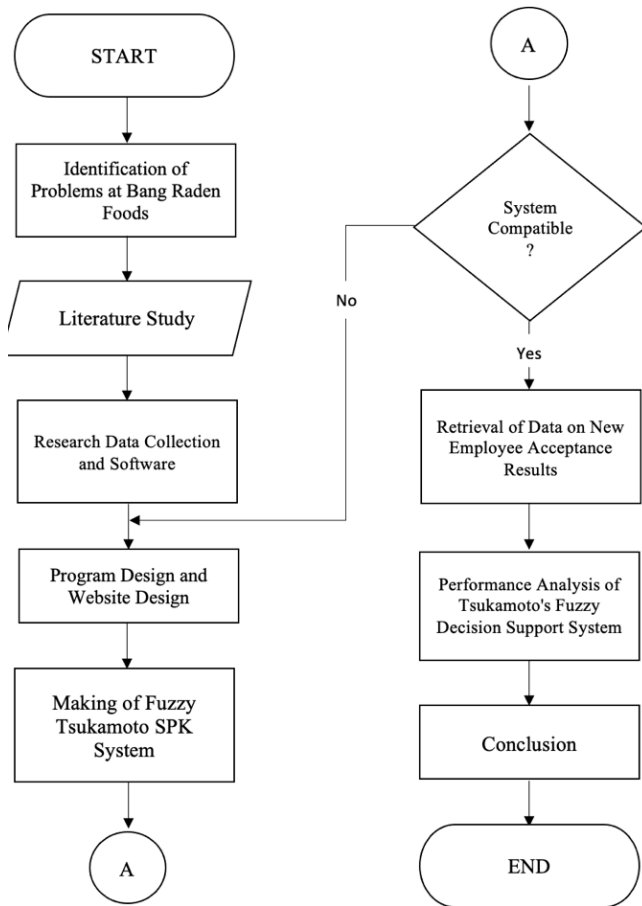


Figure 1. Research design

B. Overall Block Diagram

The first explanation is Fig. 2 is overall block diagram and which from the data block diagram above, it is a block diagram consisting of admin entities and there are process blocks in making a decision, namely from prospective new employees, alternative data, fuzzification, inference and defuzzification of the process block, then produces an output which consists of data -new employee ranking decision data.

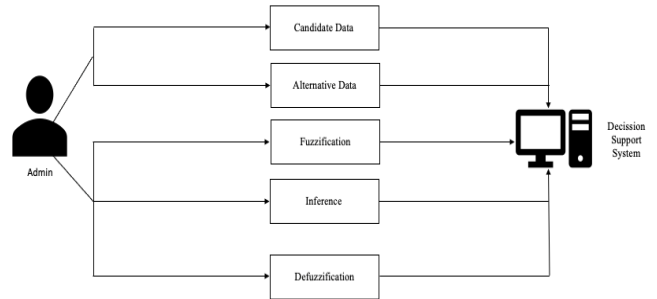


Figure 2. Overall block diagram

C. Context Diagrams

Fig. 3 is context diagrams where for analysis of the overview of the decision-making system here, there are 2 external entities in this system, namely Administrators and Prospective Employees (Users). The following is an explanation of DFD Level 0 above:

1. User administrators can access prospective employee data input, criteria data input, prospective employee value data input, rule data input, and system calculation output results.
2. The decision support system for hiring new employees can display prospective employee data, criteria data, prospective employee input value data, rule data, and output data from prospective employee selection calculations to the user administrator.
3. User prospective employees can access the registration menu as well as input registration data and view the results of the new employee acceptance assessment.
4. The new employee hiring decision support system can display prospective employee registration data and the results of the new employee acceptance assessment received to prospective employee users.

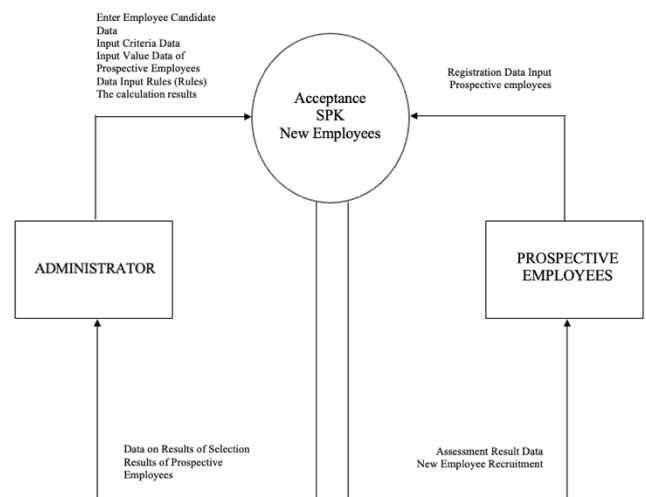


Figure 3. Context diagrams

D. DFD Level 1

Fig. 4 is the contents of DFD Level 1 from system.

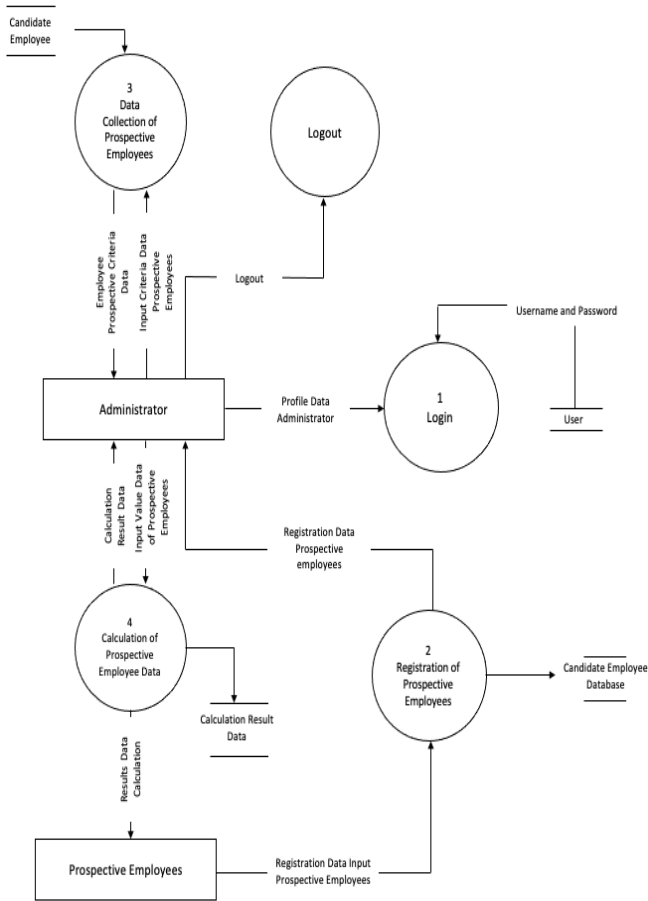


Figure 4. DFD level 1

E. DFD Level 1 SPK Login Process New Employee Acceptance

Fig. 5 is the contents of DFD Level 1 SPK Login Process New Employee Acceptance.

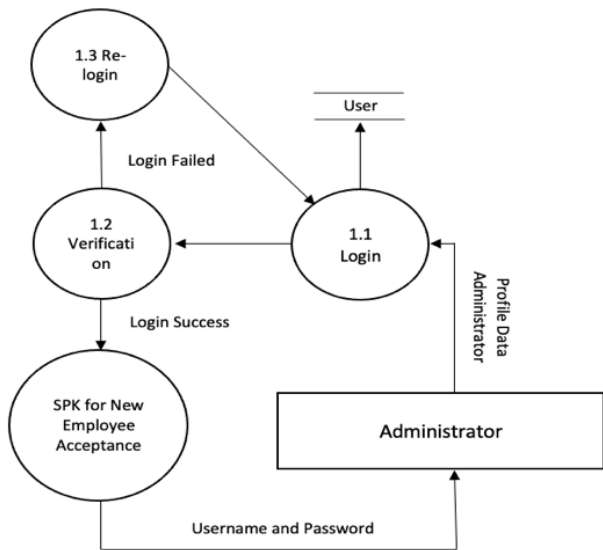


Figure 5. DFD level 1 SPK login process new employee acceptance

F. DFD Level 1 Calculation of Prospective Employee Data

Fig. 6 is the contents of DFD Level 1 Calculation of Prospective Employee Data. And from Fig. 3 to Fig. 6 the explanation is the application flow from the running of the system is shown by the existing processes. The process DFD includes:

1. User administrator login to be able to access the main page of the system.
2. Administrators input prospective employee data, criteria data, rules data, and prospective employee value data.
3. Administrator manages prospective employee data such as edit, add and delete.
4. User prospective employees can input registration data for prospective employees and can edit, add and delete registration data.
5. User administrator manages data for calculating the value of prospective employees such as editing data, adding data, and deleting data. In this calculation process using the Tsukamoto fuzzy method.
6. Users of prospective employees can see data from the results of the calculation of the assessment of new prospective employees which have been calculated using the Tsukamoto fuzzy method.
7. Administrators can logout from the system.

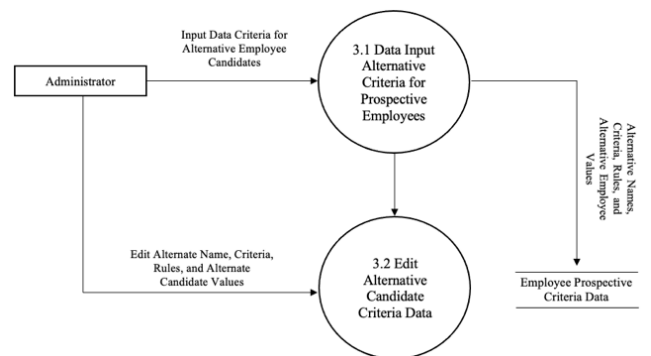


Figure 6. DFD Level 1 Calculation of prospective employee data

G. Working Flowchart System

Fig. 7 is a flowchart of how the system works starting from first logging in to HRD and then being able to choose the menu that will be listed, of course in the assessment process you must first determine the criteria used for assessment by inputting them on the criteria menu, then inputting participant or employee data to then the storage process is carried out, if the data has changes it can be edited on the edit or change menu, after the criteria and employee data have been inputted, only then can input values for each participant whose final results can be displayed on the calculation menu. If HRD wants to change the password, they can edit it on the password menu and after the process is complete HRD can log out to end the session.



Figure 7. Flowchart system

III. RESULT AND DISCUSSION

A. Evaluation Black Box Testing

This evaluation is carried out by testing the web features that have been made with reference to the items that have been arranged in the designed needs list.

This test uses the Black Box method which places more emphasis on system performance and a list of existing requirements. This evaluation is used to determine whether the system is in accordance with what is required. The evaluation results are shown in the table below.

TABLE I
EVALUATION BLACK BOX TESTING

Name	Test Cases	Expected Results	Evaluation
Login	Enter the username and password then press the login button	The input data is successfully processed and can access the system that has been created.	In accordance
Dashboard	Access the features contained in the system dashboard.	The system can manage the information that will be displayed on the features contained in the dashboard.	In accordance

Data Training	Access the training data feature and perform searches as desired.	The system can display processed data information and perform fuzzy calculations automatically for each existing data.	In accordance
Data Master Rules	Accessing the master rules data feature and editing existing rules.	The system can display existing data rules and can save edits for each edited rule.	In accordance
Fuzzy Tsukamoto	Accessing Tsukamoto's fuzzy features and data input to perform calculations.	The system can display information, process fuzzy tsukamoto calculations obtained from user input and display calculation results.	In accordance
Result	Displays the calculated data according to user input.	The system can display detailed calculation results data information that has been input by the user.	In accordance

B. Implementation Fuzzy Tsukamoto

Implementation of Fuzzy Tsukamoto is an explanation of the steps to solving a problem using the Fuzzy Tsukamoto method with a case. One case example for calculating the value obtained by 2 prospective applicants with the criteria for the value obtained is as follows below.

TABLE II
PROSPECTIVE EMPLOYEE VALUE DATA

Name	Input Variable	Output
	Knowledge Test	70
Mirandha	Achievement Test	7
	Skill Test	80
Agus	Knowledge Test	55
	Achievement Test	5
	Skill Test	60

After the prospective employee's value data has been obtained, it can then be seen in the table for the range of prospective employee criteria values in the table below.

TABLE III
CRITERIA VALUE RANGE

Criteria	Range
Knowledge Test	0-100
Achievement Test	0-10
Skill Test	0-100

C. Fuzzification

The fuzzification process is the calculation of crisp values or input values into degrees of membership [6]. Calculations in the fuzzification process are based on the limits of the membership function. The following is a fuzzy set membership function with 3 input criteria:

1) *Fuzzy Set of Knowledge Tests*: The membership function limits for the lower limit = 15 and the upper limit = 90. The membership degrees of Very Low, Low, Medium, High, and Very High are obtained by the following equation.

$$\mu \text{ Very Low}(x) = \begin{cases} 1; x \leq 15 \\ \frac{(30-x)}{(15)}; 15 \leq x \leq 30 \\ 0; x \geq 30 \end{cases} \quad (1)$$

$$\mu \text{ Low}(x) = \begin{cases} 1; x = 30 \\ \frac{(x-15)}{(15)}; 15 \leq x \leq 30 \\ \frac{(45-x)}{(15)}; 30 \leq x \leq 45 \\ 0; x \leq 15 \text{ or } x \geq 45 \end{cases} \quad (2)$$

$$\mu \text{ Medium}(x) = \begin{cases} 1; x = 45 \\ \frac{(x-30)}{(15)}; 30 \leq x \leq 45 \\ \frac{(60-x)}{(15)}; 45 \leq x \leq 65 \\ 0; x \leq 30 \text{ or } x \geq 60 \end{cases} \quad (3)$$

$$\mu \text{ High}(x) = \begin{cases} 1; x = 60 \\ \frac{(x-45)}{(15)}; 45 \leq x \leq 60 \\ \frac{(75-x)}{(15)}; 60 \leq x \leq 75 \\ 0; x \leq 45 \text{ or } x \geq 75 \end{cases} \quad (4)$$

$$\mu \text{ Very High}(x) = \begin{cases} 1; x > 75 \\ \frac{(x-60)}{(15)}; 75 \leq x \leq 90 \\ 0; x \leq 60 \end{cases} \quad (5)$$

2) *Fuzzy Set of Achievement Test*: Membership function limits for the lower limit = 1.5 and the upper limit = 9. The membership degrees of Very Few, Few, Enough, More, and Very More are obtained by the following equation.

$$\mu \text{ Very Few}(x) = \begin{cases} 1; x < 1.5 \\ \frac{(3-x)}{(1.5)}; 1.5 \leq x \leq 3 \\ 0; x \geq 3 \end{cases} \quad (6)$$

$$\mu \text{ Few}(x) = \begin{cases} 1; x = 3 \\ \frac{(x-1.5)}{(1.5)}; 1.5 \leq x \leq 3 \\ \frac{(4.5-x)}{(1.5)}; 3 \leq x \leq 4.5 \\ 0; x \leq 1.5 \text{ or } x \geq 4.5 \end{cases} \quad (7)$$

$$\mu \text{ Enough}(x) = \begin{cases} 1; x = 4.5 \\ \frac{(x-3)}{(1.5)}; 3 \leq x \leq 4.5 \\ \frac{(6-x)}{(1.5)}; 4.5 \leq x \leq 6 \\ 0; x \leq 3 \text{ or } x \geq 6 \end{cases} \quad (8)$$

$$\mu \text{ More}(x) = \begin{cases} 1; x = 6 \\ \frac{(x-4.5)}{(1.5)}; 4.5 \leq x \leq 6 \\ \frac{(7.5-x)}{(1.5)}; 6 \leq x \leq 7.5 \\ 0; x \leq 4.5 \text{ or } x \geq 7.5 \end{cases} \quad (9)$$

$$\mu \text{ Very More}(x) = \begin{cases} 1; x > 7.5 \\ \frac{(x-6)}{(1.5)}; 7.5 \leq x \leq 9 \\ 0; x \leq 6 \end{cases} \quad (10)$$

3) *Fuzzy Set of Skill Tests*: Membership function limits for the lower limit = 15 and the upper limit = 90. The membership degrees of Very Poor, Poor, Enough, Good, and Very Good are obtained by the following equation.

$$\mu \text{ Very Poor}(x) = \begin{cases} 1; x \leq 15 \\ \frac{(30-x)}{(15)}; 15 \leq x \leq 30 \\ 0; x \geq 30 \end{cases} \quad (11)$$

$$\mu \text{ Poor}(x) = \begin{cases} 1; x = 30 \\ \frac{(x-15)}{(15)}; 15 \leq x \leq 30 \\ \frac{(45-x)}{(15)}; 30 \leq x \leq 45 \\ 0; x \leq 15 \text{ or } x \geq 45 \end{cases} \quad (12)$$

$$\mu \text{ Enough}(x) = \begin{cases} 1; x = 45 \\ \frac{(x-30)}{(15)}; 30 \leq x \leq 45 \\ \frac{(60-x)}{(15)}; 45 \leq x \leq 65 \\ 0; x \leq 30 \text{ or } x \geq 60 \end{cases} \quad (13)$$

$$\mu \text{ Good}(x) = \begin{cases} 1; x = 60 \\ \frac{(x-45)}{(15)}; 45 \leq x \leq 60 \\ \frac{(75-x)}{(15)}; 60 \leq x \leq 75 \\ 0; x \leq 45 \text{ or } x \geq 75 \end{cases} \quad (14)$$

$$\mu \text{ Very Good}(x) = \begin{cases} 1 & ; x \geq 75 \\ \frac{(x-60)}{(15)} & ; 75 \leq x \leq 90 \\ 0 & ; x \leq 60 \end{cases} \quad (15)$$

D. Membership Degree Value of Each Input Variable

The next step is to input the prospective employee's value data into a table of the degree of membership for each input variable which can be seen in tables IV and V.

TABLE IV
MEMBERSHIP DEGREE VALUE OF EACH INPUT VARIABLE MIRANDHA
EMPLOYEE PROSPECTIVE

Name	Variable Input	Input Value	Set	μ
Mirandha	Knowledge Test	70	Very Low	0
			Low	0
			Medium	0
			High	0,333
			Very High	0,667
	Achievement Test	7	Very Few	0
			Few	0
			Enough	0
			More	0,333
			Very More	0,667
	Skill Test	80	Very Poor	0
			Poor	0
			Enough	0
			Good	0
			Very Good	1

TABLE V
MEMBERSHIP DEGREE VALUE OF EACH INPUT VARIABLE AGUS EMPLOYEE
PROSPECTIVE

Name	Variable Input	Input Value	Set	μ
Agus	Knowledge Test	55	Very Low	0
			Low	0
			Medium	0,333
			High	0,667
			Very High	0
	Achievement Test	5	Very Few	0
			Few	0
			Enough	0,333
			More	0,667
			Very More	0
	Skill Test	60	Very Poor	0
			Poor	0
			Enough	0
			Good	1
			Very Good	0

If it has been entered into the table, the next step is to input it into the calculation of the fuzzy inference system to get the value of α -predicate and Z.

E. System Inference Fuzzy

Inference is the process of combining many rules based on available data [7]. Formation of rules can be done by experts or experts in accordance with the criteria desired by a predetermined company. From the description above, 15 fuzzy sets have been formed, so about 125 fuzzy rules are obtained.

F. Defuzzification

The last step in the Tsukamoto Fuzzy method is to find the output value in the form of a crisp (z) value known as the defuzzification process, namely changing the fuzzy output to a firm value based on a predetermined membership function, the method used in this process is the Center Average Defuzzifier method [8].

1) *Tsukamoto Fuzzy Inference Calculation of Prospective Employees Passing Selection:* The following is a calculation table using Tsukamoto's Fuzzy Inference for prospective employees who qualify with the acquisition of the degree of membership for each input variable obtained in table IV.

TABLE VI
CALCULATION OF FUZZY TSUKAMOTO INFERENCE FOR MIRANDHA
EMPLOYEE CANDIDATES

Rule	K	A	S	α -pre	Z	α -pre*Z
95	0,333	0,333	1	0,333	83,333	27,748
100	0,333	0,667	1	0,333	83,333	27,748
120	0,667	0,333	1	0,333	83,333	27,748
125	0,667	0,667	1	0,667	91,67	61,143
Total				1,666		144,387

Information:

K = Knowledge

A = Achievement

S = Skill

2) *Fuzzy Tsukamoto Inference Calculation of Prospective Employees Not Passing Selection:* The following is a calculation table using Tsukamoto's Fuzzy Inference for prospective employees who do not pass the selection with the acquisition of the membership degree value for each input variable obtained in table V.

TABLE VII
CALCULATION OF FUZZY TSUKAMOTO INFERENCE FOR AGUS EMPLOYEE
CANDIDATES

Rule	K	A	S	α -pre	Z	α -pre*Z
64	0,333	0,667	1	0,333	50	16,65
69	0,333	0,333	1	0,333	50	16,65
89	0,667	0,667	1	0,667	91,67	61,143
94	0,667	0,333	1	0,333	83,33	27,748
Total				1,666		122,191

Information:

K = Knowledge

A = Achievement

S = Skill

G. Finding Crisp Value (Z)

After obtaining the values that have been entered into the fuzzy inference calculation table, the next step is to find the crisp (z) value of the data obtained.

To find the Z value, use the following formula:

$$Z = \frac{\sum (\alpha \pi_i * z_i)}{\sum \alpha \pi_i} \tag{16}$$

Information:

Z = Centralized average defuzzification (yield).

$\alpha \pi_i$ = predicate alpha value (minimum value of membership degree).

Z_i = Crisp value obtained from the inference results.

I = Number of fuzzy rules.

1) Calculation of Crisp Value (Z) of Prospective Employees Passing Selection: After getting the results of calculations using Tsukamoto Fuzzy Inference, the next step is to find the crisp value (z) by adding the value obtained from α -pre*Z and then dividing it by the total value of α -pre in table VI.

$$\begin{aligned} \sum \alpha\text{-pre} * Z &= 27,748 + 27,748 + 27,748 + 61,143 \\ &= 144,387 \\ \sum \alpha\text{-pre} &= 0,333 + 0,333 + 0,333 + 0,667 \\ &= 1,666 \end{aligned}$$

After getting the total value of α -pre*Z and α -pre, the next step is to divide the total α -pre*Z by the total α -pre, in the following equation:

$$Z = \frac{\sum \alpha\text{-pre} * Z}{\sum \alpha\text{-pre}} \tag{17}$$

$$Z = \frac{144,387}{1,666} = 86,666$$

Then the Z value obtained is 86.666 for manual calculations for prospective Mirandha employees.

2) Calculation of Crisp Value (Z) of Prospective Employees Not Passing Selection: After getting the results of calculations using Tsukamoto Fuzzy Inference, the next step is to find the crisp value (z) by adding the value obtained from α -pre*Z and then dividing it by the total value of α -pre in table VII.

$$\begin{aligned} \sum \alpha\text{-pre} * Z &= 16,65 + 16,65 + 27,748 + 61,143 \\ &= 122,191 \\ \sum \alpha\text{-pre} &= 0,333 + 0,333 + 0,667 + 0,333 \\ &= 1,666 \end{aligned}$$

After getting the total value of α -pre*Z and α -pre, the next step is to divide the total α -pre*Z by the total α -pre, in the following equation:

$$Z = \frac{\sum \alpha\text{-pre} * Z}{\sum \alpha\text{-pre}}$$

$$Z = \frac{122,191}{1,666} = 73,343$$

Then the Z value obtained is 73.343 for manual calculations for Agus prospective employees.

H. Matching and Comparison of Calculation Result

After getting the Z value, the next step is to match it with the standard value of passing the selection that has been implemented by the company. The standard value of passing the selection that has been set by the company is 75, if the Z value = 86.666 for prospective employees on behalf of Mirandha, then the decision is made that the prospective employees are accepted as new employees at the company and if Z value = 73.343 for prospective employees on behalf of Agus then the decision taken is that the prospective employee is not accepted as a new employee at the company.

TABLE VIII
TABLE OF COMPARISON OF THE CALCULATION RESULTS OF ACCEPTANCES OF PROSPECTIVE NEW EMPLOYEES

Rank	Name	Total Manual	Total SPK	Difference	Info
1	Mirandha	86,666	86,667	0,001	Pass
2	Andy	88,892	88,889	0,003	Pass
3	Sari	62,972	62,693	0,009	Not Pass
4	Agus	73,343	73,333	0,01	Not Pass
5	Wardani	53,313	53,333	0,02	Not Pass

Table VIII displays the results of manual calculations with a comparison of calculations using the Decision Support System that has been made. There is a slight difference in the number of around 0.001 due to the rounding of numbers in the system. So from the table it can be measured the level of accuracy by using the accuracy formula as follows:

$$\text{Accuracy} = \frac{\text{number of correct predictions}}{\text{total number of predictions}} \times 100\% \tag{18}$$

$$\begin{aligned} \text{Accuracy} &= \frac{5}{5} \times 100\% \\ &= 1 \times 100\% \\ &= 100\% \text{ (Accurate Data)} \end{aligned}$$

I. Implementation of Web Photos

From Fig. 8 to Fig. 9 is a picture of the web implementation of a successful decision support system.



Figure 8. System main page

Fuzzy Tsukamoto Login Registrasi Profil Peneliti Perancangan

Rank	Nama	Total Nilai	Keterangan
1	Andy	88.889	Lolos
2	Mirandha	86.667	Lolos
3	Agus	73.333	Tidak Lolos
4	Sari	62.963	Tidak Lolos
5	Wardani	53.333	Tidak Lolos

Sistem Pendukung Keputusan

Figure 9. Employee ranking results page

J. Throughput Test Result

Throughput, is the actual bandwidth that is measured at a certain time in transmitting files [9]. Throughput testing is testing the effective data transfer rate (rate), which is measured in bps (bits per second). Testing is carried out using wireshark software and selecting the network source used. Then the package delivery process will appear and wait until the sample package taken is deemed sufficient. The following is a data traffic packet that will be used to test the throughput shown in Fig. 10.

Figure 10. Data traffic packages for QOS testing

After the packets have been obtained, Wireshark is stopped and selects the Statistics menu and presses the Capture File Properties option as shown in Fig. 11.

Figure 11. Menu statistics and capture file properties

Figure 12. A new window contains details of the network in use

From Fig. 12 contains details of the network that can be used to calculate throughput, the equation for calculating throughput is [10]:

$$\text{Throughput} = \frac{\text{(Pakckets Received)}}{\text{(Data Transmission Time)}} \tag{19}$$

From table It is known that the data packets received can be seen from Fig. 12 in Measurement with the name Bytes and in the Captured column, which is 375876 Bytes.

As for the length of observation, it can be seen in the Measurement with the name Time span and in the Captured column, which is 181.759 Second, the duration of the observation. From the results of Fig. 12, throughput can be calculated as follows:

$$\begin{aligned} \text{Throughput} &= \frac{\text{(Packet Received)}}{\text{(Data Transmission Time)}} \\ &= \frac{375876 \text{ Bytes}}{181,759} \\ &= 2.067,991 \text{ Bytes/s} \\ &= 2,067 \text{ KB/s} \end{aligned}$$

Because Throughput is measured in units of bps (bits per second), then from KiloBytes/s it is converted into units of Kilobits/s. The calculation is as follows:

$$\begin{aligned} \text{Throughput} &= 2,067 \text{ KB/s} \times 8 \\ &= 16,536 \text{ Kb/s} \\ &= 16 \text{ Kb/s} \end{aligned}$$

From the results of these calculations, it is obtained that the throughput is 16.536 Kb/s and is rounded up to 16 Kb/s. The throughput results can be matched by looking at Fig. 12 in the Measurement - Average bits/s section which also shows 16 Kb/s.

Based on the results of the calculations that have been done, it can be concluded that the quality of the network used falls into the poor throughput category

K. Packet Loss Result

Packet loss is the number of packets that fail to reach their intended destination [11]. Packet Loss testing aims to determine the percentage of the total number of lost packets that can occur due to collisions and congestion on the network. Testing is done using wireshark software and sample packages that have been taken.

Then to calculate the percentage of Packet Loss the sample has, it must be filtered first by typing "tcp.analysis.lost_segment" on wireshark. The following shows how Wireshark looks when it is filtered, which is shown in Fig. 13.

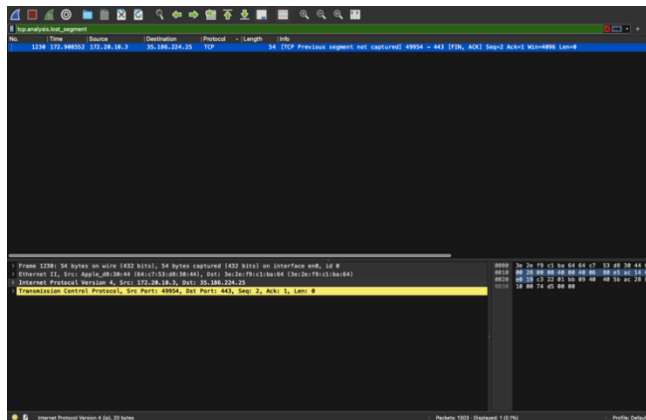


Figure 13. Packets are filtered to calculate packet loss

After filtering, then selecting the Statistics menu and pressing the Capture File Properties option, it will appear as shown in Fig. 14.

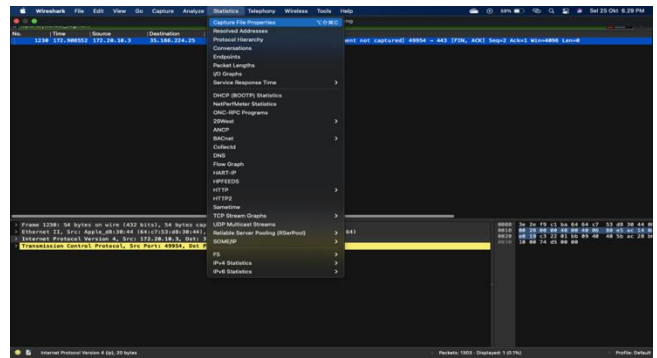


Figure 14. Menu statistics and capture file properties

After pressing the Statistics menu and Capture File Properties, details will appear as shown in Fig. 15.

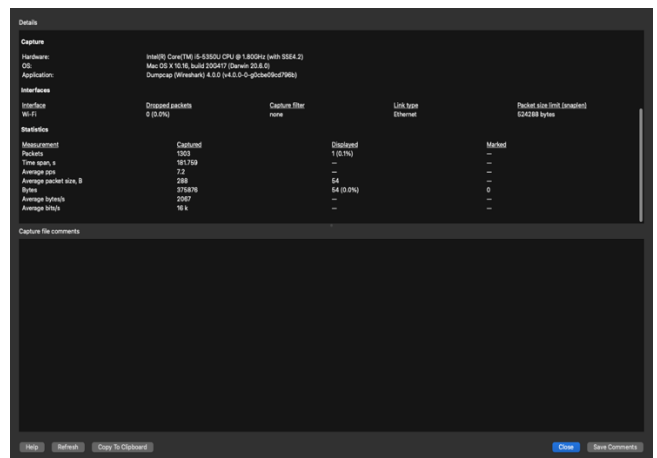


Figure 15. Package details menu that has been filtered to calculate packet loss

From Fig. 15 it is known that the network details can be used to calculate the Packet Loss percentage. The first is the data packets sent as can be seen in the Measurement – Packets Captured column, namely 1303 packets. Then the data packets received can be seen with the result of reducing the data packets sent minus the lost data packets. In this research, 1 packet is lost, so the data packet received is 1303-1, which is 1302 data packets. Then to calculate the percentage of Packet Loss you can use the following equation [12][13]:

$$\begin{aligned} \text{Packet Loss} &= \frac{(\text{Packets Send} - \text{Packets Received})}{(\text{Packets Send})} \times 100\% \quad (20) \\ &= \frac{1303 - (1303 - 1)}{1303} \times 100\% \\ &= \frac{1303 - 1302}{1303} \times 100\% \\ &= \frac{1}{1303} \times 100\% \\ &= 0.00076746 \times 100\% \\ &= 0.076746\% \end{aligned}$$

From the results of these calculations, it is obtained that the percentage of Packet Loss is 0.076746%. Packet loss data

retrieval is done by testing ten times. The following is a table of packet loss test results:

TABLE IX
PACKET LOSS TESTING RESULT

Packets Send	Packets Received	Packets Loss	Packet Loss (%)
1303	1302	1	0,076746
475	474	1	0,210526
828	828	0	0
1409	1407	2	0,141945
1192	1190	2	0,167785
1014	1013	1	0,098619
975	970	5	0,512821
578	575	3	0,519031
489	485	4	0,817996
526	525	1	0,190476

Table IX shows the 10 times delivery test based on the results of the calculations that have been done, it can be concluded that the quality of the network used is in the good category.

L. Delay Test Results

Delay is the delay time of a packet caused by the transmission process from one point to another which is the destination [14]. Delay (Latency) testing aims to determine the time needed for data to travel the distance from origin to destination. Delay itself can be affected by distance, physical media, congestion or also long processing time [11]. Testing is done using wireshark software and sample packages that have been taken. Then the packet is filtered by typing ip.dst==172.20.10.3 on wireshark which is ESP32's ip. After filtering it will look like Fig. 16.

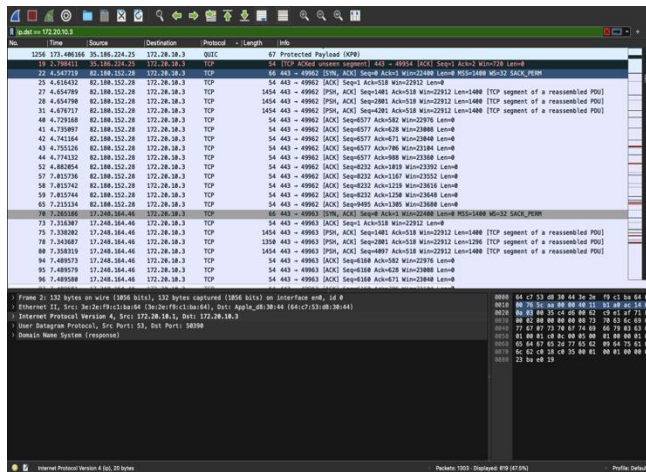


Figure 16. Packages that have been filtered to calculate the average delay

After filtering then selecting the Statistics menu and clicking the Capture File Properties option as shown below:

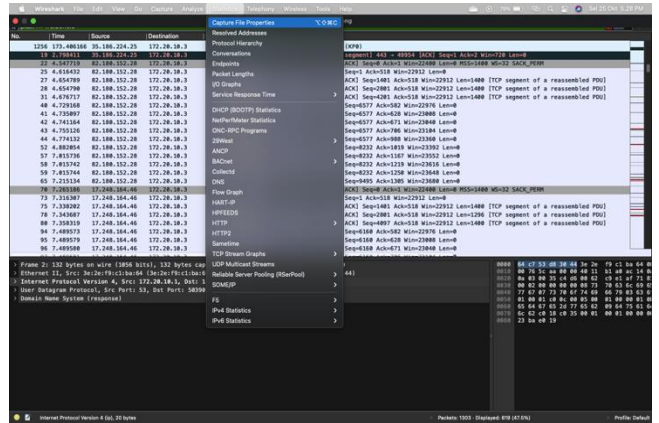


Figure 17. Menu statistics and capture file properties

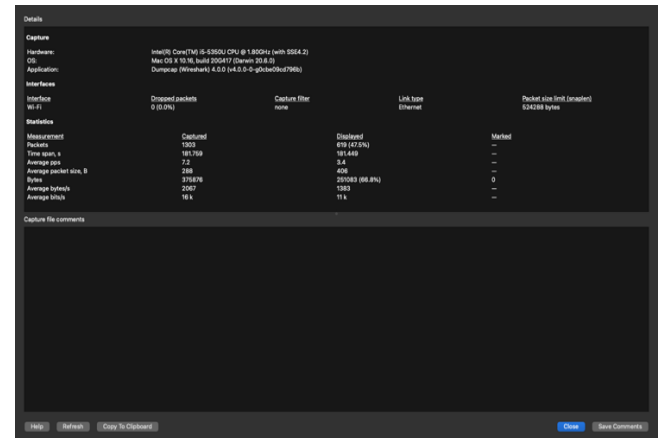


Figure 18. Package details menu that has been filtered to calculate the average delay

From Fig. 18 it can be seen that the Total Delay of the filtered packets can be seen in the Time Span, s-Displayed details of 181,449 and for the Total Packages Received in the Packets-Displayed details, there are 619 (47.5%). Then to calculate the Average Delay you can use the following equation [15]:

$$Average\ Delay = \frac{(Total\ Delay)}{(Total\ Packet\ Received)} \tag{21}$$

$$= \frac{181,449}{619}$$

$$= 0,29313247sec$$

$$= 293ms$$

From the results of these calculations, it is obtained that the average delay that occurs is 293ms. Based on the results of the calculations that have been done, it can be concluded that the quality of the network used is in the good latency category because it is <300 ms.

IV. CONCLUSION

Based on the description above it can be concluded as follows: based on the results of the Black Box Testing Evaluation previously carried out, the Decision Support System for Hiring New Employees at Bangraden Foods Using the Web-Based Fuzzy Tsukamoto Method has web system

performance that runs 100% smoothly for all functions and features in the system. Based on the results of system testing that was carried out on 5 prospective employees, the system detected that 2 prospective employees had passed with a 'pass' decision because they reached an average score of 75 according to the Bangraden HRD food provisions and 3 prospective employees 'did not pass' because their scores were below average company requirements. Apart from that, in the Quality of Services test which previously obtained a Throughput of 16 Kb/s, it was included in the 'Bad' category because the value was less than 25 Kb/s and the index was 1. Packet Loss of 0.273594% was included in the 'Very Good' category because the value was less than 1% and the index is 4. The delay of 293ms is included in the Goods category because the value ranges between 150-300ms and the index is 3. In this case, create a 'Decision Support System for Accepting New Employees at Bangraden Foods Using the Web-Based Fuzzy Tsukamoto Method' based on design and the results of tests that have been carried out previously, Bangraden Foods management can use them to provide recommendations regarding the recruitment of prospective new employees to help make employee recruitment decisions, so that Bangraden Foods management no longer accepts employees manually.

REFERENCES

- [1] S. Lena and Sangita, L. "Aplikasi Rekrutmen Karyawan Berbasis Web Menggunakan Framework Laravel," *Jurnal Teknologi Informasi*, vol. 1, 2018.
- [2] D. Pranitasari and K. Khusnul, "Analisis Disiplin Kerja Karyawan," *Jurnal Akuntansi dan Manajemen*, vol. 18, no. 01, pp. 22-38, 2021.
- [3] S. H. Putri and O. Onsardi, "Pengaruh Disiplin Kerja Dan Lingkungan Kerja Terhadap Kinerja Karyawan." *OSF Preprints*, 2020.
- [4] F. Zulfikar, R. Rosnelly, and N.E. Saragih, "Sistem Penunjang Keputusan Kenaikan Jabatan Karyawan Dengan Metode SAW Pada Yayasan Islamic Center Medan," in *Konferensi Nasional Sistem Informasi 2018* pp. 1152-1157, Maret 2018.
- [5] D. Prayetno, M. D. Sinaga, and R.E. Sari, "Sistem Pendukung Keputusan Menentukan Kadar Minyak Mentah Kelapa Sawit Dengan Metode Topsis," in *Seminar Nasional Sistem Informasi dan Teknologi Informasi 2018*, Juli 2018.
- [6] R. Doni, and M. Rahman, "Sistem Monitoring Tanaman Hidroponik Berbasis Iot (Internet of Thing) Menggunakan Nodemcu ESP8266," *J-SAKTI (Jurnal Sains Komputer dan Informatika)*, vol. 4, no. 2, pp. 516-522, 2020.
- [7] H. Setiawan, "Prediksi Kebutuhan Alat Tulis Kantor Dengan Metode Fuzzy Logic Tsukamoto di BPR Dana Mulia Sejahtera," *Jurnal Bangkit Indonesia*, vol. 9, no. 1, pp. 1-5, 2020.
- [8] D. Candra, "Penentuan Performance Sekolah Unggulan Dengan Logika Fuzzy Tsukamoto," *Jurnal Informasi Komputer Logika*, vol. 2, no. 3, 2021.
- [9] H. Fahmi "Analisis Qos (Quality of Service) Pengukuran Delay, Jitter, Packet Lost dan Throughput Untuk Mendapatkan Kualitas Kerja Radio Streaming Yang Baik," *Jurnal Teknologi Informasi Dan Komunikasi*, vol. 7, no. 2, pp. 98-105, 2018.
- [10] N. I. L. Wilaksono, J. Triyono, and C. Iswayudi, "Analisis Perbandingan Kualitas Jaringanmultipleservice Set Identifier dengan Access Point dan Virtual Access Point pada Satu Antarmuka Wireless Mikrotik" (Studi Kasus Pada OSZ STORE Yogyakarta). *Jurnal Jarkom*, vol. 6, no. 1, pp. 42-49, 2018.
- [11] S. W. Pamungkas, and E. Pramono, "Analisis Quality of Service (QoS) Pada Jaringan Hotspot SMA Negeri XYZ," *E-JURNAL JUSITI: Jurnal Sistem Informasi dan Teknologi Informasi*, vol. 7. no. 2, pp. 142-152, 2018.
- [12] A. Yanziah, S. Soim, and M. M. Rose, Analisis jarak jangkauan lora dengan parameter rssi dan packet loss pada area urban," *Jurnal Teknologi Technoscientia*, vol. 13, no. 1, pp. 59-67, 2020.
- [13] M. N. Lestari, P. A. F. Islami, K. M. Moses, and A. P. Wibawa, "Implementasi metode Fuzzy Tsukamoto untuk menentukan hasil tes kesehatan pada penerimaan peserta didik baru di Sekolah Menengah Kejuruan," *Register: Jurnal Ilmiah Teknologi Sistem Informasi*, vol. 4. no. 1, pp. 7-13. 2018.
- [14] A. Budiman, M. F. Duskarnaen, and H. Ajie, "Analisis Quality of Service (Qos) Pada Jaringan Internet Smk Negeri 7 Jakarta," *PINTER: Jurnal Pendidikan Teknik Informatika dan Komputer*, vol. 4, no. 2, pp. 32-36, 2020.
- [15] S. P. Agrianto, P. D. Kusuma, and R. Rumani, "Simulasi dan Analisis Kinerja Qos (quality Of Service) Jaringan Berbasis Simple Network Management Protocol (SNMP)" in *e-Proceeding of Engineering*, 2019.