DECISION SUPPORT SYSTEM OF REWARDING ON LECTURER PERFORMANCE USING FUZZY TSUKAMOTO METHOD CASE STUDY AT MATARAM UNIVERSITY OF TECHNOLOGY

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Abstract—*To prepare quality and character human resources, Mataram Technological University strives to provide the best in carrying out the tridharma activities of higher education, one of which is by giving rewards in the hope that morale and loyalty can continue to be improved. However, the gift-giving system that the Mataram Technological University has implemented has not been able to bring about change because the gift-giving system is incorrect. The applied reward-giving assessment system only refers to the assessment without paying attention to other criteria in the tridharma of higher education. Such as the implementation of learning, Research, and community service. Therefore, to overcome this problem, a decision support information system for awarding lecturer performance is needed, which is built using the fuzzy Tsukamoto method by considering several criteria such as Presence, Research Results, and Community Service Results. Lecturer Performance Index in carrying out the learning process. With this decision support system, the implementation of the Tridharma carried out by lecturers can continue to monitor the system and improve the quality and accreditation of study programs and universities.*

Keywords: *Decision Support System, Fuzzy, Tsukamoto, Monitoring, Reward.*

Abstrak—Untuk mempersiapkan sumber daya manusia yang bermutu dan berkarekter, Universitas Teknologi Mataram terus berupaya memberikan yang terbaik dalam melaksanakan kegiatan tridharma perguruan tinggi salah satunya adalah dengan cara memberikan reward dengan harapan semangat kerja dan loyalitas dosen terus dapat ditingkatkan. Namun sistem pemberian reward yang selama ini diterapkan oleh Universitas Teknologi Mataram belum mampu membawa perubahan, dikarenakan sistem pemberian reward yang belum tetap, hal ini disebabkan karena sistem penilian pemberian reward yang diterapkan masih mengacu pada penilaian presensi semata tanpa memperhatikan kriteria-kriteria lain dalam pelaksanaan tridarma perguruan tinggi seperti pelaksanaan pembelajaran, penelitian dan pengabdian pada masyarakat. Oleh karena itu, untuk mengatasi permasalahan tersebut diperlukan sebuah sistem informasi pendukung keputusan pemberian reward terhadap kinerja dosen yang dibangun menggunakan metode fuzzy tsukamoto dengan memperhatikan beberapa kriteria-kriteria seperti Presensi, Hasil Penelitian dan Hasil Pengabdian pada Masyarakat, serta Indeks Prestasi Kinerja Dosen dalam melaksanakan proses pembelajaran. Sehingga dengan adanya sistem pendukung keputusan ini, pelaksanaan tridharma yang dilakukan oleh dosen dapat terus dimonitoring secara tersistem dan terus dapat ditingkatkan demi perbaikan mutu dan akreditasi program studi serta perguruan tinggi.

Kata Kunci*: Sistem Pendukung Keputusan, Fuzzy, Tsukamoto, Monitoring, Reward.*

INTRODUCTION

Mataram University of Technology (UTM) is one of the private universities located in Mataram City. To improve work performance and the quality of higher education, UTM always provides motivation and support to its lecturers in carrying out the tridharma activities of higher education. One form of this support is the provision of rewards.

The Rewards are awards given to employees or employees after doing work (Warnars & Adyana, 2021). The reward can also be interpreted as a form of appreciation or remuneration for services given because someone has made excellence, achievements contributed to, or succeeded in carrying out the tasks that have been given

(Rahman, Nurjanah, & Mukhlis, 2020). In addition, rewards are one way to improve work performance and motivate lecturers to create job satisfaction in higher education (Erlangga & Dharmawan, 2018). However, the provision of rewards that UTM has implemented has not been able to bring about change because the reward assessment system only refers to attendance assessment alone without paying attention to other essential criteria in the implementation of the tridharma of higher education such as the implementation of learning, Research, and community service. Therefore, to overcome these problems, a decision support information system for giving rewards to lecturer performance is needed, which is built using the fuzzy Tsukamoto method by taking into account several criteria such as Presence, Research Results, and Results of Community Service, as well as the Lecturer Performance Achievement Index in carrying out the process. Learning. The Fuzzy Tsukamoto method is a method that has tolerance for data and is very flexible. The advantage of the Tsukamoto method is that it is intuitive and can provide responses based on information that is qualitative, inaccurate, and ambiguous (Sari & Mahmudy, 2015).

The decision support system is an interactive information system that provides information, modeling, and data manipulation. It was first introduced in the early 1970s by Michael S. Scott Morton with the terms Decision Management System. The concept of decision support is characterized by a computer-based interactive system that helps decision-making and utilizes data and models to solve problems that are not structured (Yani & Darmawan, 2015).

In our lives, sometimes we are faced with the problem of probability or estimation of the mapping of input and output relationships based on less or uncertain data. For this reason, a decision support system is needed to provide information, guide, predict and direct information users to make better decisions (Simargolang & Tamba, 2019). Fuzzy logic is suitable for solving this problem. Fuzzy logic is a "counting" methodology with a linguistic variable as a substitute for counting with numbers (Wiguna & Hanny, 2015). Fuzzy logic maps the problem from the input to the expected output. In the fuzzy set, the membership value lies in the range of 0 to 1 (Setiawan, Yanto, & Yasdomi, 2018)

The Tsukamoto method is an extension of monotonous reasoning. In the Tsukamoto method, every consequence of the IF-THEN rule must be represented by a fuzzy set with a boring membership function. As a result, the inference output of each control is given in a crisp (crisp) based on fire strength (Silaban, 2021).

In previous studies, there have been many studies that have discussed the awarding of these rewards, including Research conducted by Erlangga 2018 this study only resulted in calculation techniques that are poured into Microsoft Excel. No information system has been produced (Erlangga & Dharmawan, 2018). At the same time, this Research will make a decision-support information system that can provide faster and more accurate decision-making results.

Subsequent Research conducted by Darsono Nababan and Robbi Rahim in 2018, entitled the decision support system for employee bonus awards, with the topics method, was carried out in 2018. In this study, there were differences in the criteria and research methods used (Nababan & Rahim, 2018). Trysha Novelita Saragih's Research entitled "Decision Support System for Giving Rewards to Employees Using the Preference Selection Index Method" in 2019 aims to obtain the weight of employee criteria using the preference selection index method (Saragih, 2019). Lukman Adyana's Research, Harco Leslie Hendric Spits Warnars, and this Research is entitled "Decision Support System for Determining Teacher Rewards Recipients With the Weighted Product (WP) Method" in 2021. In this study, the methods and criteria are different from the Research to be carried out, and the resulting system is still desktop-based and not yet online (Warnars & Adyana, 2021).

From all this Research that has been carried out, it can be concluded that there are differences or updates from the resulting Research, which are related to the methods used. The tsukamoto method can provide the best alternative from a number of predetermined alternatives (Mutaqin & Wulandari, 2022). In addition, the information system that will be generated will run online to provide convenience and be accessed from anywhere, while previous studies only produced desktop-based applications and were not user-friendly. The purpose of this Research is to design and produce a decision support system in giving rewards to lecturers' performance using the fuzzy Tsukamoto method, which is given at the end of each semester quickly and precisely. So that with this decision support system, the implementation of the tridharma carried out by lecturers can continue to be improved and monitored systematically to improve the quality and accreditation of study programs and universities.

MATERIALS AND METHODS

The software development method used in this Research is to apply the prototype method, which is carried out in three stages: gathering

requirements and designing and evaluating prototypes (Maulida, 2022).

1. Gathering Needs

At this stage of gathering needs, this is done by looking for problems and root causes related to the technique of giving rewards to lecturers that have been applied to the Mataram Technological University campus. The problem is related to the criteria for providing tips that are not right, which is only based on attendance results without looking at other measures so. With this needs analysis, it is necessary to add several criteria in determining the reward system, such as attendance, the performance index of lecturers in the implementation of learning, research results, and PkM results.

Based on predetermined criteria, data processing uses the Tsukamoto fuzzy method. Four stages are carried out in data processing using the Tsukamoto undefined method, namely the formation of fuzzy sets, Fuzzification, Inferencing (Base Rule), and Defuzzification (Satria & Sibarani, 2020).

a. Formation of a Fuzzy Set

A fuzzy set is a group that represents a specific condition in an undefined variable (Finding-tutor, Dia, Mustika, Ginardi, & Fatichah, 2017). Fuzzy sets based on variables or criteria that have been determined in this study see table 1 below.

Table 1. Fuzzy Set

No	Variable	Set
1	Lecturer Performance Achievement Index	Good
		Not Good
2	Lecturer Presence	Diligent
		Less Diligent
3	Research Result	There is
		there isn't any
4	Devotion Result	There is
		there isn't any
5	Reward	Could
		Can Not

b. Fuzzification

Fuzzification is the stage of mapping the input value in the form of crisp data, which is converted into the state of fuzzy input values in membership degrees or truth levels (Ragestu & Sibarani, 2020). The degree of membership of the fuzzy set can be seen in table 2 below:

Table 2. Membership Degree

No	Variable	Set	Membership Degree
1	Lecturer Performance Achievement Index	Good	3-4
		Not Good	1-3
2	Lecturer Presence	Diligent	75-100
		Less Diligent	1-75
3	Research Result	There is	1
		there isn't any	0
4	Devotion Result	There is	1
		there isn't any	0
5	Reward	Could	75-100
		Can Not	1-75

To determine the degree of membership of each variable using the degree of membership of the descending and ascending liner as follows:

$$\mu\ UP\ (x)\begin{cases}0; & x \le \alpha\\ \frac{(x-\alpha)}{(b-\alpha)}; & \alpha \le x \le b\\ 1; & x \ge b\end{cases} \quad \text{..... (1)}$$

$$\mu\ Dwon\ (x)\begin{cases}1; & x \le \alpha\\ \frac{(b-x)}{(b-\alpha)}; & \alpha \le x \le b\\ 0; & x \ge b\end{cases} \quad \text{..... (2)}$$

1) Degree of Lecturer Performance Achievement Index membership

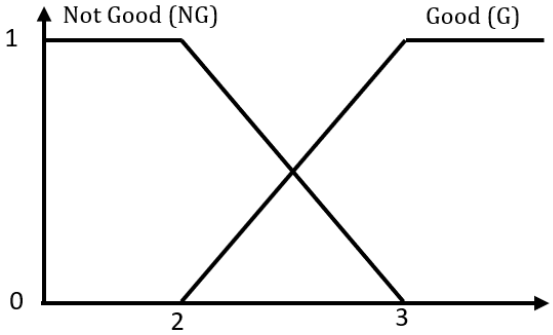

Figure 1. Representation of the degree of membership in the Lecturer Performance Index

$$\mu G\ (x)\begin{cases}0; & x \le 3\\ \frac{(x-3)}{(4-3)}; & 3 \le x \le 4.\\ 1; & x \ge 4\end{cases} \quad \text{..... (3)}$$

$$\mu NG\ (x)\begin{cases}1; & x \le 1\\ \frac{(3-x)}{(3-1)}; & 1 \le x \le 3\\ 0; & x \ge 3\end{cases} \quad \text{..... (4)}$$

2) Lecturer Presence membership degree

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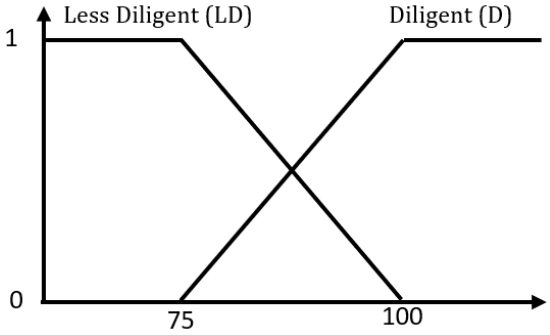

Figure 2. Representation of Lecturer Presence Membership Degrees

$$\mu D\ (x)\begin{cases} 0; & x \le 75 \\ \frac{(x-75)}{(100-75)}; & 75 \le x \le 100. \\ 1; & x \ge 100 \end{cases} \quad \text{.....(5)}$$

$$\mu LD\ (x)\begin{cases} 1; & x \le 1 \\ \frac{(75-x)}{(75-1)}; & 1 \le x \le 75 \\ 0; & x \ge 75 \end{cases} \quad \text{.....(6)}$$

3) Membership Degree Research Results

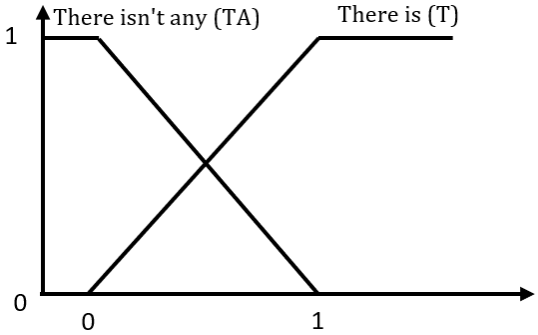

Figure 3. Representation of Membership Degree Research Results

$$\mu T\ (x)\begin{cases} 0; & x \le 0 \\ \frac{(x-0)}{(1-0)}; & 0 \le x \le 1 \\ 1; & x \ge 1 \end{cases} \quad \text{..... (7)}$$

$$\mu TA\ (x)\begin{cases} 1; & x \le 0 \\ \frac{(0-x)}{(1-0)}; & 0 \le x \le 1 \\ 0; & x \ge 1 \end{cases} \quad \text{.....(8)}$$

4) Membership Degrees Outcome of Devotion

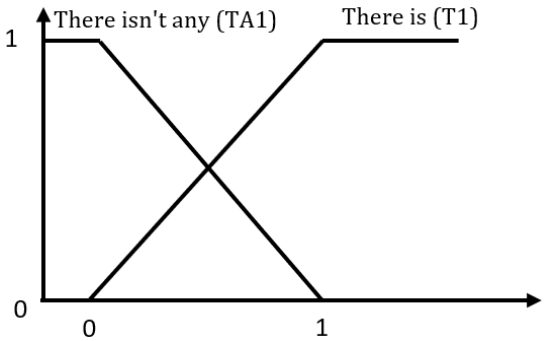

Figure 4. Representation of Degree of Membership Out of Devotion

$$\mu T1\ (x)\begin{cases} 0; & x \le 0 \\ \frac{(x-0)}{(1-0)}; & 0 \le x \le 1 \\ 1; & x \ge 1 \end{cases} \quad \text{.....(9)}$$

$$\mu TA\ (x)\begin{cases} 1; & x \le 0 \\ \frac{(0-x)}{(1-0)}; & 0 \le x \le 1 \\ 0; & x \ge 1 \end{cases} \quad \text{.....(10)}$$

5) Reward membership degrees

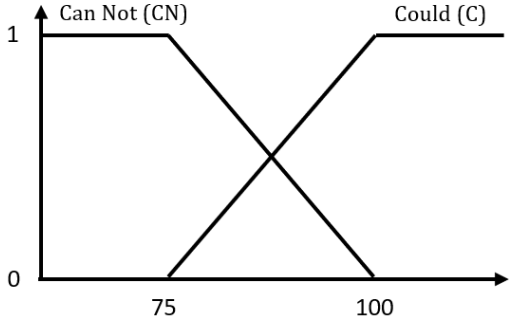

Figure 5. Representation of Reward membership degrees

$$\mu T1(z)\begin{cases} 0; & z \le 75 \\ \frac{(z-75)}{(100-75)}; & 75 \le z \le 100 \\ 1; & z \ge 100 \end{cases} \quad \text{.....(11)}$$

$$\mu TD\ (z)\begin{cases} 1; & z \le 1 \\ \frac{(75-z)}{(75-1)}; & 1 \le z \le 75. \\ 0; & z \ge 75 \end{cases} \quad \text{.....(12)}$$

c. Inferencing (Base Rule)

the next step is to infer or evaluate the rules for Miu that have been obtained using the IF-THEN rule. The powers that have been determined in this Research, using can be seen in the following table:

Table 3. Fuzzy Set Rules

No	Lecturer Performance Achievement Index	Lecturer Presence	Research Result	Devotion Result	Reward
1	Good	Diligent	There is	There is	Could
2	Good	Diligent	There is	there isn't any	Could
3	Good	Diligent	there isn't any	There is	Could
4	Good	Diligent	there isn't any	there isn't any	Can Not
5	Good	Less Diligent	There is	There is	Could

6	Good	Less Diligent	there is not any	There is	Can Not
7	Good	Diligent	There is	there isn't any a	Can Not
8	Not Good	Less Diligent	There is	There is	Can Not
9	Not Good	Less Diligent	There is	There is	Can Not
10	Not Good	Diligent	There is	There is	Can Not

d. Defuzzification

The defuzzification process to determine the fuzzy output in the Tsukamoto method uses the Weight method by dividing the number α*z results by the number in each rule.

$$Z = \frac{(\alpha 1 * z1)+(\alpha 2 * z2)+\cdots+(\alpha 9 * z9)+(\alpha 10 * z10)}{\alpha 1+\alpha 2+\cdots\ldots+\alpha 9+\alpha 10} (13)$$

2. Design

The design stage is to design and create a reward information system.

a. Program Architecture

The program architecture describes the reward information system's appearance or menu structure. The design of the program architecture is as shown in Figure 6 below:

Figure 6. Program Architecture

b. Use Case Diagrams

Display use case diagrams describe the activities or access rights the user can do to the built system. The design of the use case diagram that was made is shown in Figure 7 below:

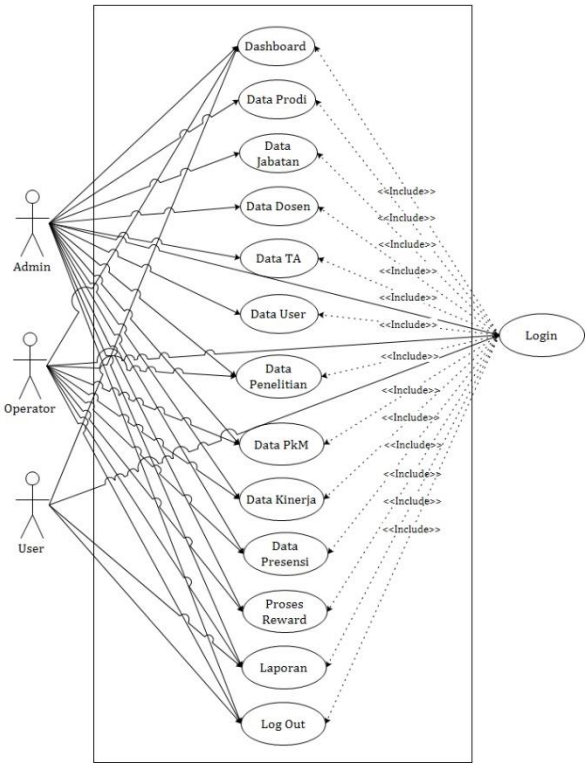

Figure 7. Use Case Diagram

c. ERD

An entity Relationship Diagram (ERD) describes a relationship between one table and other tables in the database. The ERD design for this system is as shown in Figure 8 below:

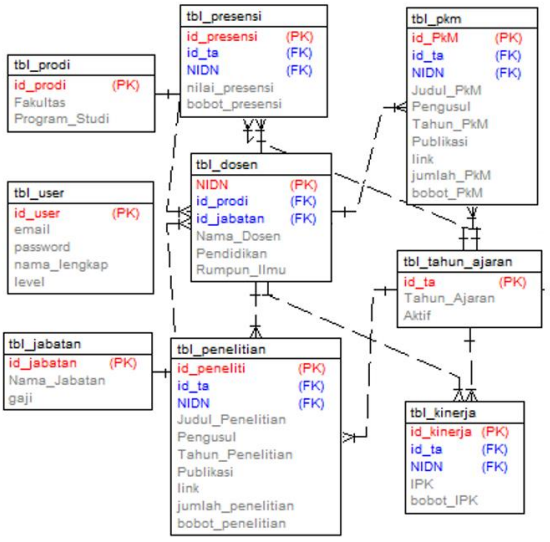

Figure 8. ERD

3. Prototype Evaluation

At the evaluation stage of this prototype, it is carried out using BlackBox testing techniques to find out whether the system that has been built can run well, both in terms of input and output. The display of the prototype evaluation results is shown in table 4 below:

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Table 4. System Test Results

No	Tested module	Testing Scenario	Expected results	Conclusion
1	Login Page	Enter your Email and Password incorrectly	Showing Error Message	Valid
2		Enter Email and Password correctly	Showing Main Page	Valid
3	Main Menu Page	Select Menu and Input Research Data	Displays the input menu and can save research data	Valid
4		Select Menu and Input PkM Data	Displays input menu and can save PkM data	Valid
5		Select Menu and Input Performance Data	Displays input menu and can save performance data	Valid
6		Select Menu and Input Presence Data	Displays the input menu and can save presence data	Valid
7	Reward Process Page	Click Process reward	Show Reward Results	Valid
8	Report Print Page	Click Print Report	Display Reports and can print reward reports	Valid

This table describes the test results of the reward information system so that the system is declared feasible and ready to use.

RESULTS AND DISCUSSION

The following are the steps in solving the problem of giving rewards using the fuzzy Tsukamoto method:

A lecturer X, in the Tridharma of Higher Education, noted that all the criteria as a determinant of awarding the results were as follows:

Lecturer Performance Index = 3.50
Attendance for one semester = 80
Research Result = 1
Devotion Result = 1

Based on the data above, to get the right decision, a calculation step is taken using the Tsukamoto fuzzy method with the following results:

1. Fuzzification

Find the membership of each input variable used:

a. Lecturer Performance Achievement Index

If the value of the lecturer's achievement index = 3.50, then the degree of fuzzy membership in each set is:

Good fuzzy set = 0.50
Poor fuzzy set = 0

b. Lecturer Presence

If the lecturer's presence value = 80, then the degree of fuzzy membership in each set is:

Diligent fuzzy set = 0.2
Fuzzy set less diligent = 0

c. Research result

If the results of the lecturer's research = 1, then the degree of fuzzy membership in each set is:

The fuzzy set exists = 1
The fuzzy set does not exist = 0

d. Devotion Results

If the result of lecturer service = 1, then the degree of fuzzy membership in each set is:

The fuzzy set exists = 1
The fuzzy set does not exist = 0

2. Inference

The application of the MIN implication function to get the smallest value from each fuzzy set in each rule in table 5 below:

Table 5. MIN Implication Function for each rule

No	Lecturer Performance Achievement Index	Lecturer Presence	Research Result	Devotion Result	Reward	αi	zi
1	0,50	0,2	1	1	Could	0,2	80
2	0,50	0,2	1	0	Could	0	75
3	0,50	0,2	0	1	Could	0	75
4	0,50	0,2	0	0	Can Not	0	75
5	0,50	0	1	1	Could	0	75
6	0,50	0	0	1	Can Not	0	75
7	0,50	0,2	1	0	Can Not	0	75
8	0	0	1	1	Can Not	0	75
9	0	0	1	1	Can Not	0	75
10	0	0,2	1	1	Can Not	0	75

3. Defuzzification

The defuzzification process to determine the fuzzy output in the Tsukamoto method uses the weight method by dividing the number α*z results by the number in each direction. The results of the defuzzification as shown in the following calculation process.

$$Z = \frac{(0{,}2*80)+(0*75)+\cdots+(0*75)+(0*75)}{0{,}2+0+\cdots+0+0} \ldots\ldots\ldots\ldots (14)$$

$$z = \frac{16}{0,2} \quad (15)$$

$$z = 80 \quad (16)$$

Based on the calculation results from the defuzzification, lecturer x, with a performance index of 3.50, attendance of 80, research results one and service one, deserves a reward with a score of 80.

4. Program Implementation

The following is the implementation of the program produced in this Research:

a. Lecturer Performance Input Menu

The lecturer performance input menu is used to input the results of the lecturer's performance for one semester, which students have assessed during the learning process. The appearance of the lecturer's performance input form is shown in Figure 9 below.

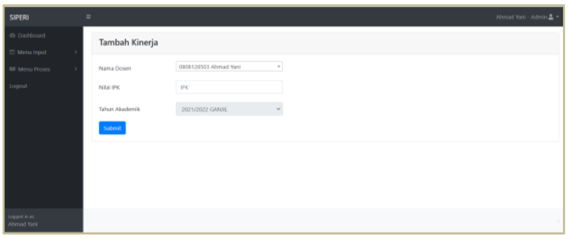

Figure 9. Form for input data on lecturer's performance achievement

b. Research Results Input Menu

Menu for the input of lecturer research results in one semester. The display of the input form of the lecturer's research results is shown in Figure 10 below:

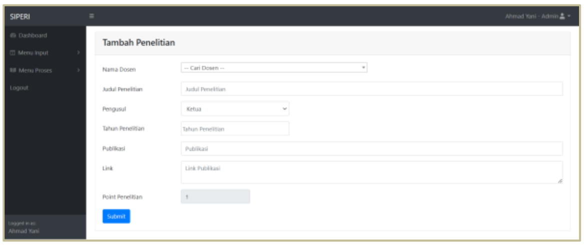

Figure 10. Research Results in Input Form

c. Reward Process Menu

The reward process menu is a menu that is used to validate all the lecturer data that has been inputted earlier. To find out which lecturers can and cannot be rewarded in one semester by, clicking the Reward Process button as shown in Figure 11 below:

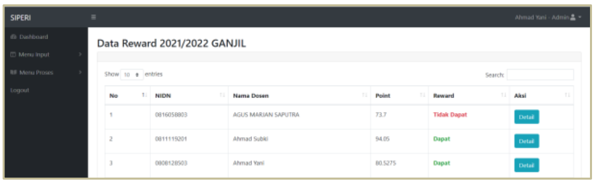

Figure 11. Reward Process

d. Reward Recipient Data Report

The reward recipient data report is used to print all lecturer data that can and cannot be rewarded. The display of the reward receipt report is as shown in Figure 12 below:


LAPORAN DATA PENERIMA REWARD
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No	NIDN	Nama Dosen	Nama Prodi	Nama Jabatan	Point	Reward
1	0816058803	AGUS MARJAN SAPUTRA	D3 Manajemen Administrasi	Asisten Ahli	73.7	Tidak Dapat
2	0811119201	Ahmad Subki	S1 Rakayasa Perangkat Lunak	Lektor	94.05	Dapat
3	0808128503	Ahmad Yani	S1 Teknologi Informasi	Asisten Ahli	80.5275	Dapat

Figure 12. Reward Recipient Data Report

CONCLUSION

Based on the results of the analysis, design, and manufacture of reward information systems using the Tsukamoto fuzzy method, it can be concluded that Tsukamoto's fuzzy logic can be used for the decision-making process in giving rewards to lecturers based on several predetermined criteria, namely the lecturer's performance achievement index, lecturer attendance, the results of Research and the effects of lecturer service carried out for one semester. The results of the calculations entered into the reward information system can be used by higher education leaders to determine who is entitled to get rewards for one semester running. In addition, this reward system can also help higher education leaders monitor higher education tridharma activities carried out by all lecturers so that the purpose of giving rewards is to improve the quality and accreditation of higher education institutions and study programs adequately achieved. Furthermore, if you want to take the same theme in this study, you can add several other criteria or use a different method.

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