Decision Support System Promotion of Structural Position Improvement of Civil Sevants Using Fuzzy Umano

Odi Anggreawan Widodo[1], Nur Hazimah Syani Harahap[2], Alamsyah[3], Much Aziz Muslim[4], Yosza Dasril[5]
[1,2,3]Computer Science Department, Mathematics and Natural Science Faculty, Semarang State University
[4,5]Faculty of Technology Management and Business, Universiti Tun Hussein Onn Malaysia (UTHM), Batu Pahat, Johor, Malaysia
* Corresponding Author

ARTICLE INFO

Article history:

Received July 28, 2021
Revised August 28, 2021
Accepted September 28, 2021

Keywords:

Fuzzy Umano;
Structural Position;
Decision Support System.

ABSTRACT

Promotion of structural promotion is an activity to improve the performance, productivity, and professionalism of employees in the work. Structural positions are positions related to task, authority, and responsibility to a government agency. As an effort to create a qualified government institution, every 4 years General and Legal Affairs Bureau of Semarang State University conducts promotional activities of structural upgrading. Mechanism of choosing the desired employee criteria, sometimes the leadership of BUHK UNNES less know the value of actual employee competence. This creates disgust by various employee information from ambiguous data. To solve the problem, need to apply fuzzy database technique. Fuzzy database used to process ambiguous data is Fuzzy Umano. Fuzzy Umano is used to find the posibility value of data that is ambiguous by expressing it using the possibility distribution. The purpose of this research is to design and apply Fuzzy Umano method on decision support system of promotion promotion promotion of civil servant position, and to know result of implementation of Fuzzy Umano method. The results obtained are a decision support system with category input in accordance with the wishes that have the output of a recommendation of Civil Servants who deserve to be promoted with the value of fire strenght. Civil Servants with fire strength value above 3 which will be recommended for promotion of structural promotion.

Cite Article:

Odi Anggreawan Widodo[1], Nur Hazimah Syani Harahap[2], Alamsyah[3], Much Aziz Muslim[4], Yosza Dasril, "Decision Support System Promotion of Structural Position Improvement of Civil Sevants Using Fuzzy Umano" *Indonesian Community on Optimization and Computer Application*, vol. 1, no. 1, pp. xx-xx, 2022, doi: .

1. INTRODUCTION

Promotion of structural promotion is an activity to improve the performance, productivity, and professionalism of employees in the work. Structural positions are positions related to position, task, authority, and responsibility to a government agency. Structural positions are managerial positions within the organizational structure whose rank of rank is determined by the echelon level [1]. Decision Support System is the process of making decisions by choosing actions between alternatives to solve a problem or some problem. Decision support system as a system that may support the performance of a manager or group of managers in solving semi-structured problems by providing information or recommendations against certain [2]. Decision support system is an interactive information system that provides information, modeling and employee data module [3]. The application of decision support systems is widely used in various fields as it is built to support solutions to problems and evaluate opportunities [4].

The background of this research is the decision making mechanism The promotion of structural promotion in the General Bureau of Law and Personnel is generally done with consideration of the criteria of good employees before determining the recommendation of promotion of structural positions. In choosing the desired employee criteria, sometimes the leader BUHK UNNES is less aware of the value of actual employee competence. The disguise from the consideration of BUHK leader's criterion UNNES can be poured in fuzzy logic concept by using database capable of handling vague criteria. In fuzzy database there are 2 kinds of models, namely model Tahani and Umano. In the Umano Model fuzzy database, the ambiguous data are expressed using positivity distribrances. Positive distribution is the attribute value of a relational model [5]. This performance assessment has become a common thing done by various agencies, both private and domestic. Nevertheless, performance appraisal remains an important issue considering that through employee performance appraisal results can be known information that can be used in the employee development process [6]. The system is required to address ambiguous, inaccurate, and disguised issues that can give appropriate and appropriate decision-making considerations.

In this research, apply fuzzy database technique. The fuzzy database technique used to process ambiguous data is Fuzzy Umano. Fuzzy Umano is used to find the value of the posibility of data that is ambiguous by expressing it using the possibility distribution. The expression on the distribution of posibility is some part that if the data of ambiguity has uncertain value how much its value as it does not know then the value is expressed to be unknown, if the ambiguous data must have no value or empty it is expressed to be undefined, and if the ambiguous data has more value of one value is then formulated with expression of the possibility. Having obtained the value of posibility, then conducted a search that produces Civil Servants with the most recommended value of the greatest value.

The study [7] suggests to represent the fuzzy inaccuracy and fuzzy data of fuzzy sets, where fuzzy data represent fuzzy relationships whose membership values and attribute values can be a possibility distribution, where the uncertainty of attribute values is indicated by the distribution of the posibility and its relation to the membership level. Research [8] explains that both the fuzzy set and possibility distribution are defined as the mapping of the universe written to the unit interval (0, 1). However, the semantics of (0, 1) may differ between the two. And research [9] suggests that which can represent hierarchical data whose attribute values can be a distribution of posibility with a certainty factor and confronted with the degree of relationship of possibility distribution.

The problem in this research is how to design and apply Fuzzy Umano method on decision support system of promotion of structural position of Civil Servant in BUHK UNNES environment?

The purpose of this research is to design and apply Fuzzy Umano method on decision support system of recommendation of promotion of structural position of Civil Servant using Fuzzy Umano in BUHK UNNES environment which result show Civil Servant that is feasible to be promoted to increase its structural position with result of overall criteria that have been inputted.

2. METHODS

The step in the preliminary study is to find a complete picture of the implementation of Fuzzy Umano to solve the problem of Civil Servant data which is ambiguous in getting the recommendation of promotion promotion of civil servant position in Public Bureau of Law And Personnel of Universitas Negeri Semarang. Fuzzy Umano is used to change ambiguous data by expressing it using a possibility distribution. Positive distribution process produces a data that can be determined its value of posibility. The value of the equality is equal to the fuzzy membership degree so that the fire strength value can be known after the query process is performed. The research variables used consist of four criteria, namely education, class / rank, competency, and age.

Planning stage is the first stage in the system that includes the stage of system analysis and system requirements specification, this stage intends to identify and evaluate the problems and needs needed, this stage includes the analysis of hardware requirements, software requirements analysis, user needs analysis and process requirements analysis [10].

This research also utilizes the possibility distribution to model information knowledge. In this model, the information that can not be applied can be modeled by the distribution posibility about a particular domain, where each domain value has a possibility equal to 0. That is, if D is the universe discourse A(x), and πA(x) (d) indicates the possibility that A(x) takes the value d ∈ U, then for the unknown and applicable values, the following representation is used:

$$\text{Unknown} = \pi_{A(x)}(\mathrm{d}) = 1 \; \forall \; \mathrm{d} \in \mathrm{D} \quad (1)$$

The nonapplicable values have a special case of possibility distribution named undefined, which is represented as:

$$\text{Undefined} = \mathrm{P}_{A(x)}(\mathrm{d}) = 0 \; \forall \; \mathrm{d} \in \mathrm{D} \tag{2}$$

To represent a situation in which a lack of information is applicable or nonapplicable, a special value called Null is used as follows:

$$Null = \{1 \,/\, Unknown, 1 \,/\, Undefined\} \tag{3}$$

For the remaining cases of imprecise information, a similar model to the preceding one is adopted. Besides, every instance of a relation in this model has a possibility distribution associated with it in the [0, 1] interval, thus indicating the membership degree of that particular instance to such a relation. In other words, a fuzzy relation R, with m attributes, is defined as the following membership function:

$$\mu_R : P(U1) \times P(U2) \times \ldots \times P(U_m) \rightarrow P([0,1]) \tag{4}$$

where the $\times$ symbol denotes the Cartesian product, P(Uj) with j = 1, 2, ..., m is the collection of all the possibility distributions in the discourse universe Uj of the j-th R attribute.

The function mR associates a P([0, 1]) value to every instance of the relation R, which corresponds to all the possibility distributions in the [0, 1] interval; this shall be considered as an R membership degree of such an instance.

Table 1. Representation Umano-Fukami Model

Information	Umano-Fukami Model
The precise data is known and this is crisp: c	$\pi_{A(x)}(d) = \{1/c\}$
Unknown but applicable	Unknown (Equation 1)
Not applicable or nonsense	Undefined (Equation 2)
Total ignorance	Null (Equation 3)
Range [m,n]	$\pi_{A(x)}(d) = 1$ if $d \in [m, n] \subseteq D$ $\pi_{A(x)}(d) = 0$ in other case
The information available is a possibility distribution μ_a	$\pi_{A(x)}(d) = \mu a(d) \; \forall \; d \in D$
The possibility that it may not be applicable is λ and, in case it is applicable the data is μ_a	Without representation

Finally, in the query process, expressed either in fuzzy or precise terms, the model solves the query problem by dividing the set of instances involved in the relation into three subsets, where the first subset contains the instances completely satisfying the query, the second subset groups those instances that might satisfy the query, and the third subset consists of those instances that do not satisfy the query. The information as well as the representation of this model are shown in Table 1 [11].

Fuzzy Umano is used to alter the data of Civil Servants who are ambiguous by expressing using the possibility distribution. The expression on the distribution of posibility is some part that if the data of ambiguity has uncertain value how much its value as it does not know then the value is expressed to be unknown, if ambiguous data must not have value or empty then expressed to be undefined, and if ambiguous data have more value of one value is then formulated with expression of posibility, eg Taro has age {36,38} p indicating that taro has age 36 or 38.

The next step, the process is to determine the value of each ambiguous data that has been expressed using the distribution of posibility. Data with unknown value, then the value of posibility for data that is unknown value is 1. Data with undefined value, then the value of posibility for data that is undefined value is 0. For data that has value more than 1 value, then determined the value of possibility distribution {36 /0.8,38/0.6} means Taro has a life of 36 with a 0.6, or Taro has a 38 with 0.8. So it can be concluded that based on the comparison of the value of possibility, taro has age 38 is greater than age 36. Positive value represents the value of fuzzy membership degree. Having known the value of the posibility of each ambiguous data, the fuzzy query process is performed by forming the fuzzy set. The next step, determine the value of the degree of membership of each variable with the existing attributes. As a result, the inference output of each rule is given explicitly (crisp) based on α-predicate (fire strength). The end result is obtained by using weighted averages. Finding fire strength value by mnghitung total average value of degree of

membership in the set in question. With the value of fire strength output yield recommendation promotion promotion of structural positions Civil Servants who are in the top 3 of the fuzzy query results.

3. RESULTS AND DISCUSSION

30 data obtained in the General Bureau of Legal and Personnel are Civil Servant data about age, education, competence, and class of space. From 30 data of Civil Servant obtained, there are 7 data that is ambiguous that is on criteria of competence as shown in Table 2.

Table 2. Ambiguous Data

Employee Code	Age	Education	Competence	Room Class
P0007	52	S1	Unknown	III/c
P0014	33	S1		III/b
P0015	45	S1	90 atau 94	III/d
P0017	47	S1	Unknown	III/b
P0027	36	S1		III/a
P0028	31	S1	Unknown	III/b
P0029	30	S1	88 atau 95	III/a

The first step in Fuzzy Umano is to change the ambiguous data obtained in Table 2 by expressing it using the possibility distribution. The expression on the distribution of posibility is some part that if the data of ambiguity has uncertain value how much its value as it does not know then the value is expressed to be unknown, if the ambiguous data must have no value or empty it is expressed to be undefined, and if the ambiguous data has more value of one value is then formulated with expression of posibility, eg Taro has age {36,38} p which indicates that taro has age 36 or 38. The result of the expressing process using the posibility distribution obtained can be seen in Table 3.

Table 3. Results of Expressing Process Using Possibility Distribution

Employee Code	Age	Education	Competence	Room Class
P0007	52	S1	Unknown	III/c
P0014	33	S1	Undefined	III/b
P0015	45	S1	{90,94}p	III/d
P0017	47	S1	Unknown	III/b
P0027	36	S1	Undefined	III/a
P0028	31	S1	Unknown	III/b
P0029	30	S1	{88,95}p	III/a

3.1. Pseudocode and Fuzzy Umano Algorithm

Ambiguous Handling Algorithm on Fuzzy Umano
For each criterion value of each alternative, do:

```
if ( value = 'undefined' ){
        return fuzzy = 0;
}else if ( value = 'unknown' ){
        return fuzzy = 1;
}else if ( value based on two or more posibility) {
        take the value of each value;
        compare the posibility, take the largest;
        return fuzzy = biggest posibility;
}else{
        return fuzzy = (min criterion values) / (max value criterion-value minimum criterion)
}
```

The above pseudocode can be explained using the algorithm as in Table 4.

Table 4. Fuzzy Umano Algorithm

Step	Explanation
if (nilai = 'undefined'){ return fuzzy = 0;	Conditions where the criterion value on the alternative is not known to have a value or not.

}	Eg: An employee is not known whether or not has a competency score

else if (nilai = 'unknown'){
return fuzzy = 1;
}
	The condition where the criterion value on the alternative has been known to have the value but the exact value is not known.
	For example: An employee has a value of competence but not known how much its value.

else if (value based on two or more posibility){
take the value of each value;
compare the posibility, take the largest;
return fuzzy = biggest posibility;
}
	The conditions by which the criterion value on alternatives have two or more possibilities with their respective posibility.
	For example: An employee has an age value between 35 or 36.

else {
return fuzzy = (min value criteria) / (max value criteria-value minimum criterion)
}
	Fuzzy value is taken for normal conditions.

The next step, the process is to determine the value of each ambiguous data that has been expressed using the distribution of posibility. Based on Table 3, data that are ambiguous are only available on competency criteria data.

Data on competency criteria with unknown value apply equation (1), then the value of posibility for data that is unknown value is 1. Employee with employee code P0007, P0017, and P0028 on criteria of competence with unknown value, hence have value of posibility 1.

The data with the undefined value applies equation (2), then the value of the posibility for the data that is undefined value is 0. Employee with employee code P0014, and P0027 with undefined competence value, hence has a value of 0.

For data with values greater than 1, the value of the possibility distribution is supplied. For example, {36 / 0.8,38 / 0.6} means Taro has a life of 36 with a 0.6, or Taro has a 38 with 0.8. It can be concluded that based on the comparison of the value of possibility, taro has age 38 greater than the age of 36. Employee with employee code P0015, and P0029 has competence value more than one value which has been expressed using possibility distribution that is {90,94} p, and { 88,95} p then given the value of posibility suppose {96 / 1,90 / 0.6}, and {88 / 0.3,95 / 1}. Then it can be concluded that employees with employee code P0015 has a competence value 90 with a value greater than the value of the competence of 96, and employees with employee code P0029 has a competence value 95 with a value greater than the value of competence value 88. Positive value has been obtained then the value of degree fuzzy membership is known. The value of the equality is equal to the degree of membership because the value of possibility is at intervals between 0 and 1. The possibility value represents the degree of fuzzy membership.

Having known the value of the posibility of each ambiguous data, the fuzzy query process is performed by forming the fuzzy set. According to the data obtained in this study, the set of fuzzy formed each variable as follows:

The age variable of Civil Servants formed two fuzzy sets with linguistic variables that are young, and old. The fuzzy set for age variables:

Young = 30 to 45

Old = 45 to 60

Next With the graph the membership function will appear as in Figure 1.

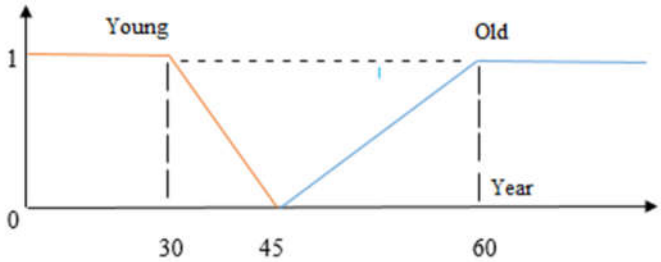

Fig. 1. Variable Graph Display Age

According to Figure 1. then the membership function for the age variable can be formulated as follows:

$$\mu_{young}\,[\mathrm{x}] = \begin{cases} 0; & \mathrm{x} \le 30 \\ (45 - \mathrm{x})/(45 - 30); & 30 \le \mathrm{x} \le 45 \\ 0; & \mathrm{x} \le 45 \end{cases}$$
$$\mu_{old}\,[x] = \begin{cases} 1; & x \le 45 \\ (x - 45)/(60 - 45); & 45 \le x \le 60 \\ 1; & x \le 60 \end{cases} \quad (5)$$

Civil Servant Competency Variables form three fuzzy sets with linguistic variables that is young, and old. The fuzzy set for age variables:
Simply = 75 to 85
Good = 85 to 95
With the graph of membership function will appear as in Figure 2.

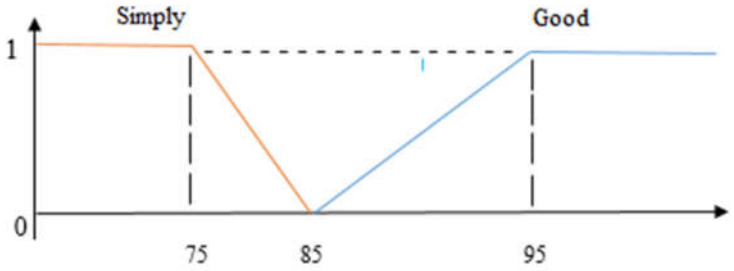

Fig. 2. Competency Variable Graph Display

According to Figure 2. then the membership function for the age variable can be formulated as follows:

$$\mu_{\text{simply}}\,[x] = \begin{cases} 0; & x \le 75 \\ (85 - x)/(85-75); & 75 \le x \le 85 \\ 1; & x \le 85 \end{cases}$$
$$\mu_{\text{good}}\,[x] = \begin{cases} 0; & x \le 85 \\ (85 - x)/(85-75); & 85 \le x \le 95 \\ 1; & x \end{cases} \quad (6)$$

Next calculate the degree of membership of each variable performed to be able to determine the value of fire strength in the next step. Here's the calculation of the degree of membership of each variable;
Degrees Membership of the age variable is calculated from a defined membership function. In Table 5 is the result of the calculation of membership functions.

Table 5. Degree of Membership Variable Age

Employee Code	Age	Degree of Membership Young	Old
P0001	56	0	0,733333333
P0002	57	0	0,8
P0003	54	0	0,6
P0004	60	0	1
:	:	:	:
P0030	48	0	0,2

The degree of membership of a competency variable is calculated from a defined membership function. Table 6 is the result of calculating the membership function.

Table 6. Degree of Membership Variable Competence

Employee Code	Competence	Degree of Membership Simply	Good

P0001	89	0	0,4
P0002	82	0,3	0
P0003	93	0	0,8
P0004	80	0,5	0
:	:	:	:
P0030	90	0	0,5

The last step is the query process. The query process is done by entering the category of recommendation criteria for promotion of structural positions such as age, education, competence, and Room Class. Inputan done by the user to find the desired employee in accordance with the desired criteria. Suppose the user wants to find employees who have a young age with the last education S1 has a very good competency value that is in the classroom III / d, then from 30 data, employees with employee code P0002, P0007, and P0015 by calculating fire strength as an example degree of membership Civil Servant with employee code P0002 is

Age 57 years = 0.8
Education S1 = 1
Competency score 82 = 0
Room Class III / d = 1

Calculate fire strength as follows:

$$\alpha - \text{predicate} = \frac{\text{the total number of degrees of membership}}{\text{the sum of all variables}}$$

$$\alpha - \text{predicate} = \frac{0{,}8 + 1 + 0 + 1}{4} = 0{,}7 \quad (7)$$

Civil Servants who have the highest fire strength value of the top three which means that employees are eligible for recommended promotion of structural promotion. Fire strength calculation results can be seen in Table 7.

Table 7. Fire Strength Calculation Result

Employee Code	Degree of Membership				
	Age	Education	Competence	Room Class	Fire Strength
	Old	S1	Good	III/d	
P0002	0,8	1	0	1	0,7
P0006	0,866666667	1	0,5	0	0,591666667
P0007	0,466666667	1	1	1	0,866666667
P0012	0,333333333	1	1	0	0,583333333
P0015	0	1	1	1	0,75
P0030	0,2	1	0,5	0	0,425

Civil Servant with employee code P0007 with Fire Strength 0,866666667, P0015 with Fire Strength 0,75, and P0002 with Fire Strength 0,7 value which is feasible for recommended promotion of structural increase in BUHK UNNES environment

4. CONCLUSION

Based on the research that has been done, it can be concluded that in the implementation of Fuzzy Umano on decision support system recommendation promotion of civil servant structural positions can be applied. The process of analyzing ambiguous data is done by expressing it using a possibility distribution. Positive distribution serves to find the value of the posibility of any existing ambiguous data. The value of the possibility is converted to a membership degree. With the degree of membership will get the results of the query as you wish. The search technique recommends promotion of structural promotion using quey fuzzy technique. This technique can search all data from the input of many categories without consuming much time. To determine the recommendation of fuzzy query promotion using fire strength value. Fire strength value obtained from the number of degrees of membership value of all variables divided by the number of variables. The result of the calculation is the value that is at interval 0 and 1. The result of this system is how appropriate Civil Servant is recommended based on four criteria such as age, education, competence, and Group Class by using fire strenth value. From 30 data of Civil Servant is taken 3 best with highest fire

strength value. Any query with different input will produce different outputs. Standard query input that has been set is Civil Servants who have old age, education S1, good competence value, and Group III / d. Civil Servants in this category are eligible to be recommended. Civil Servant with employee code P0007 with Fire Strength 0,866666667, P0015 with Fire Strength 0,75, and P0002 with Fire Strength 0,7 value which is feasible for recommended promotion of structural increase in BUHK UNNES environment

DECLARATION

Author Contribution

The step in the preliminary study is to find a complete picture of the implementation of Fuzzy Umano to solve the problem of Civil Servant data which is ambiguous in getting the recommendation of promotion promotion of civil servant position in Public Bureau of Law And Personnel of Universitas Negeri Semarang.

Funding

Please add: “This research received no external funding” or “This research was funded by NAME OF FUNDER, grant number XXX” and “The APC was funded by XXX”.

Acknowledgments

In this section, you can acknowledge any support given which is not covered by the author con-tribution or funding sections. This may include administrative and technical support, or donations in kind (e.g., materials used for experiments).

Conflict of Interest

Declare conflicts of interest or state “The authors declare no conflict of interest.”

REFERENCES

[1] R. Z. Wijayanto, “Korupsi Mengorupsi Indonesia,” Jakarta: Gramedia Pustaka Utama, 2009.
[2] T. P. Putri and P. H. P. Rosa, “Decision Support System to Choose Digital Single Lens Camera with Simple Additive Weighting Method,” Sci. J. Informatics, vol. 3, no. 2, pp. 167–176, 2016.
[3] S. H. Rukmana, “Sistem pendukung keputusan tender proyek menggunakan metode Benefit Cost Ratio,” JST (Jurnal Sains dan Teknol., vol. 5, no. 2, 2017.
[4] C. A. Josaputri, E. Sugiharti, and R. Arifudin, “Decision Support Systems with AHP and SAW Method for Determination of Cattle with Superior Seeds,” Sci. J. Informatics, vol. 3, no. 2, pp. 119–128, 2016.
[5] S. Kusumadewi and H. Purnomo, “Aplikasi Logika Fuzzy untuk pendukung keputusan,” 2004.
[6] A. Alamsyah and I. H. Muna, “Metode Fuzzy Inference System untuk Penilaian Kinerja Pegawai Perpustakaan dan Pustakawan,” Sci. J. Informatics, vol. 3, no. 1, pp. 88–98, 2016.
[7] M. Umano, T. Imada, I. Hatono, and H. Tamura, “Implementation of SQL-type data manipulation language for fuzzy object-oriented databases,” in Soft Computing in Intelligent Systems and Information Processing. Proceedings of the 1996 Asian Fuzzy Systems Symposium, 1996, pp. 127–132.
[8] M. Umano and S. Fukami, “Fuzzy relational algebra for possibility-distribution-fuzzy-relational model of fuzzy data,” J. Intell. Inf. Syst., vol. 3, no. 1, pp. 7–27, 1994.
[9] Z. M. Ma, L. Yan, and F. Zhang, “Modeling fuzzy information in UML class diagrams and object-oriented database models,” Fuzzy Sets Syst., vol. 186, no. 1, pp. 26–46, 2012.
[10] M. A. MUSLIM and T. R. I. WIDYASTUTI, “COMPARATIVE RESEARCH OF HAAR AND DAUBECHIES WAVELET IN DENOISING DIGITAL IMAGE OF SEMARANG DISTRICT REGION’S MAP,” 2012.
[11] J. Galindo, A. Urrutia, and M. Piattini, “Fuzzy Databases: Modeling, Design and lmplementation. Book the Idea Group Publishing Hershey.” USA, 2006.