COMPARISON OF SOFT MULTISET METHOD AND TOPSIS IN SUPPLIER SELECTION

Ayeng Mapatda Putri

Universitas Komputer Indonesia
JL. Dipatiukur No 112-114, Bandung INDONESIA
E-mail : ayengmp@gmail.com

ABSTRACT

Soft Multiset is a new method that developed to solve problems in decision making. This method is used to solve problem of Group Decision Making. TOPSIS is a method that also can be used in Group Decision Making by combining TOPSIS with weighted method. In this research will use Entropy weighting method. This study will compare Soft Multiset and TOPSIS to determine which method that can produce a decision which is same/approaching decision maker's decision.

In decision making process, Soft Multiset method can process a lot of object of decision. All the assessment of the alternatives will be put into one set and further processed to produce decision. In TOPSIS method, the assessment of alternatives will be processed using Entropy weighting method with the aim to accommodate the values of some decision makers to produce one value. Then that value will be processed by using TOPSIS method to obtain the result of decision.

Based on the results of a comparison of Soft Multiset and TOPSIS method, the obtained accuracy/similarity of the decision for Soft Multiset method reaches 80% and TOPSIS method has an accuracy of 60%.

Keywords : Soft Multiset, TOPSIS, Entropy, supplier, Group Decision Making

1. PREMILINARY

Decision Support System (DSS) is one branch of science on a Field of Artificial Intelligence Which is Part of Computer Based Information Systems. One of decision-support method that newly-developed is Soft MULTISET method. Soft multiset method was first introduced in 2011. Soft multiset method is a method that is able to resolve a case that has many objects and many decision maker. Research on how to use Soft multiset in decision support performed by Shawkat Alkhazaleh and Abdul Razak Salleh for The First Time By testing the use of Soft MULTISET in elections of cars, houses and hotels [1], wherein the data used by the researchers are still using dummy data. In this study proved that Soft MULTISET can be used in decision support problem. Subsequent research conducted by Khaleed Alhazaymeh and Nasruddin Hassan in case of site selection, machinery, and truck [2]. From these two studies concluded that Soft MULTISET able to produce a decision or choose an alternative from a number of alternatives. But in research that has been described previously, is still a way of using Soft multiset. by using dummy data as the media to explain the use of Soft MULTISET in decision support problem resolution. There is no research that implements Soft MULTISET on real cases. It is not known accuracy or similarity of the decisions of the methods Soft MULTISET with the decision decision maker.

One method that is often used in decision support system is a TOPSIS method. Research into the use TOPSIS has been done. As research conducted by Agung Pramudhita N., et al by applying TOPSIS in case the placement of employees [3]. From these studies, the result accuracy achieved from the use of TOPSIS in case the placement of employees is 85%. Rifqi Abdillah also use TOPSIS in the case of municipal elections grade performing at the level of accuracy obtained by 83% [4]. TOPSIS method was also applied to the case of determining the passing grade and the money base by Mulyono Hendro Hartanto, et al with accuracy the value reached 86% [5]. Of all the research that has been mentioned earlier, it can be concluded that the TOPSIS have a pretty good degree of accuracy. TOPSIS can also be used in the case of group decision with TOPSIS combining with other methods, such as research conducted by Indira Kusuma Ward [6] and Khorotun Nisak [7] which combines TOPSIS with Entropy in the case of raw material supplier selection. Dwi Andharini Cahyani also using TOPSIS and entropy in group decision for the case of the selection of suppliers of Madura batik [8]

Based on the previous explanations, so in this study will be a comparison between Soft multiset which is a new method of SPK with TOPSIS which is a method that has been commonly used in the SPK. So later known which method has good accuracy or similarity of results in accordance with the decision maker. Cases are used in testing the accuracy of this method is the supplier selection in the group decision. To compare the accuracy of the two methods, it is necessary to do some research, so

in this study title "Soft Multiset Comparison And Topsis Method In Case Of Supplier Selection".

2. ANALYSIS

This research will be conducted comparison Soft MULTISET and TOPSIS in Group Decision Making. Cases are used to test these two methods is the supplier selection, where there are 5 types of supplier used is a supplier of plastic, cardboard, metal, medipart, and LEDs that the evaluation was done by 4 decision maker. There are 13 criteria considered in the selection of suppliers. Details of the selection criteria can be seen in Table 1

Tabel 1. Supplier Criteria

No	Kriteria
1	Deserving price and quality of goods
2	The ability to provide a certain amount of discount on bookings
3	Conformity of goods with established specifications
4	Provision of goods without defects
5	The ability to deliver consistent quality
6	The ability to deliver the goods in accordance with the agreed date
7	The ability in handling transportation system
8	Accuracy and Relevance in the number of shipments
9	Compliance contents
10	Ease of contact
11	The ability to provide information in a clear and easy to understand
12	Free in response to customer demand
13	Quick response in resolving customer complaints

The rating assessment of each alternative on each criterion assessed by 1 to 5 are

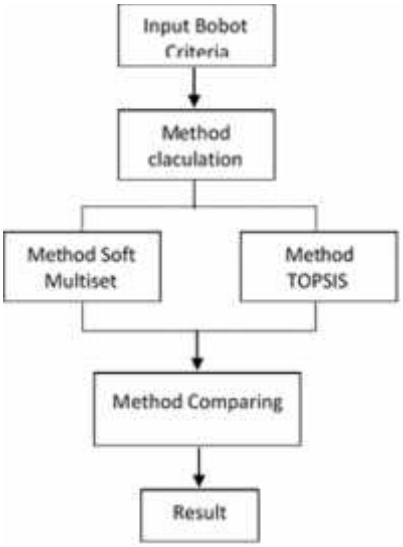
1 = Very Bad
2 = Poor
3 = Enough
4 = Good
5 = Very good.

The decision-maker will also give weight to the interest rate criterion assessed with grades 1 to 5 are

1 = Not important
2 = Less important
3 = Quite important
4 = Important
5 = Very important.

3. ANALYSIS METHODE

The stages for the analysis method on the supplier selection decision support can be seen in Figure 1



Picture 1. Method Analysis

3.1 Soft Multiset Method

In the decision, Soft MULTISET can process many objects. To determine the best alternative MULTISET Soft will choose the alternative that has the highest score. The calculation process decision support using Soft MULTISET are as follows:

1. Make Soft MULTISET set by the following equation

$$U = \prod_{i=1}^{n} P(U_i), \quad E = \prod_{i=1}^{n} E_U \quad , dan\ A \subseteq E \qquad (1)$$

n = number of universe set of alternative
P(Ui) = Power set of alternative
EUi = set of criteria related to the universe set

2. Perform union operations on a set of soft multiset alternatives.
3. The results of the union of the decision maker votes stored in tables resultant.
4. Create a comparison table for soft multiset resultant value based on the table. Comparison table is square table in which the number of rows and columns together. Rows and columns are labeled the same in accordance with the object name or an alternative set of rules. Cij comparison table contents obtained from the number of parameters or criteria that xi membership value greater than or equal to the membership value xj

5. Calculate the value ri using the following equation

$$r_i = \sum_{j=1}^{n} c_{ij} \quad (2)$$

j = number of objects (column)
c_{ij} = weight value of the comparison table

6. Calculate the value tj using the following equation

$$t_j = \sum_{i=1}^{n} c_{ij} \quad (3)$$

i = number of objects (rows)
c_{ij} = weight value of the comparison table

7. Calculate the value of Si by using the following equation

$$S_i = r_i - t_j \quad (4)$$

r_i = sum value line
t_j = number of column values

8. Use the returned result set union operation to the calculation of the previous object and change the values of other objects set to 0 if the value of alternative results in the previous process is not the maximum value. If the value of the previous alternative is the maximum value, the value of the other objects are not replaced

9. Perform steps 4 to 7, in accordance with the number of objects owned by the case

3.2 Entropy and TOPSIS Method

TOPSIS method for weighting process will use entropy method for TOPSIS method is only able to process weight rating of one person the decision maker. The weight that was entered by the decision makers will be processed using Entropy method. The purpose of using Entropy method in the calculation of the weight that is to accommodate the assessment of some of the decision makers.

3.2.1 Entropy Method

Entropy method is a method that can be used to determine a weight on the criterion with the highest value variation will get the highest weight. Entropy method can be used to calculate the weight in the decision-making group (Group Decision Making).

The steps of weighting by using entropy method is as follows:

1. All decision makers must provide a value that indicates the importance of a particular criterion to decision making. Each decision makers should assess based on their preference of each.
2. Subtract each of those numbers to the ideal value, the reduction results declared by k_{ij}.
3. For each value (k_{ij}) for a total value in all criteria

$$aij = \frac{k_{ij}}{\sum_{i=1}^{m}\sum_{i=1}^{n} k_{ij}} \quad (5)$$

m = number of decision makers
n = number of criteria
k_{ij} = the value of the initial data normalization

4. Calculate the entropy values for each criterion with the following equation

$$Ej = \left[\frac{-1}{\ln(m)}\right]\sum_{i=1}^{n}\left[a_{ij}\ \ln(a_{ij})\right] \quad (6)$$

m = number of decision makers
n = number of decision makers
a_{ij} = Value matrix calculations
E_j = Value of entropy

5. Calculate the dispersion of each criterion with the following formula

$$D_j = 1 - E_j \quad (7)$$

Ej = value calculation of entropy
Dj = value Dispersion

6. Since the assumed total weight is 1, then to get the weight of each criterion, the dispersion value should be normalized in advance, so that

$$Wj = \frac{D_j}{\sum D_j} \quad (8)$$

Dj = disperse calculation results

3.2.2 TOPSIS Methode

After getting the weight values of entropy for supplier selection criteria and the assessment of each supplier, then the next will be calculated using TOPSIS method for ranking the supplier to obtain the best suppliers based on the calculation of the highest value.

TOPSIS method in the calculation procedure of decision support are as follows:

1. Build a decision matrix
   The decision matrix m X refers to the alternatives that will be evaluated based on the n criteria. The decision matrix X can be seen as follows

$$X = \begin{array}{c} \\ a_1 \\ a_2 \\ a_3 \\ \vdots \\ a_m \end{array} \begin{array}{c} \begin{array}{cccccc} x_1 & x_2 & x_3 & . & . & x_n \end{array} \\ \begin{bmatrix} x_{11} & x_{12} & x_{13} & . & . & x_{1n} \\ x_{21} & x_{22} & x_{23} & . & . & x_{2n} \\ x_{31} & x_{32} & x_{33} & . & . & x_{3n} \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ x_{m1} & x_{m2} & x_{m3} & . & . & x_{mn} \end{bmatrix} \end{array}$$

a_i = alternatives might
x_j = attributes where alternative performance

measure

x_{ij} = ai alternative performance with reference attributes xj

2. Build a normalized decision matrix. The equation used to transform each element x_{ij} is

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \quad (9)$$

With i = 1, 2, 3, ..., m; and j = 1, 2, 3, ..., n;

rij = elements of the normalized decision matrix R

xij = elements of the decision matrix X

3. Make a decision matrix is normalized weighted. With a weight $w_j = (w_1, w_2, w_3, ..., w_n)$, where wj is the weight of criteria j $\sum_{j=1}^{n} w_j = 1$ and then normalizing weight matrix Y is

$$y_{ij} = w_j r_{ij} \quad (10)$$

With i = 1, 2, 3, ..., m; and j = 1, 2, 3, ..., n;

yij = elements of the normalized weighted decision matrix Y

wj = weight of criteria j

rij = elements of the normalized decision matrix R

4. Determine the ideal solution matrix and the negative ideal solution matrix. Positive ideal solution denoted A +, while the negative ideal solution denoted A-. Here is the equation of A + and A-

$$A^+ = \{(\max y_{ij} | j \in J), (\min y_{ij} | j \in J'), i = 1,2,3 \dots m\} = (y_1^+, y_2^+, y_3^+, \dots, y_n^+)$$

$$A^- = \{(\min y_{ij} | j \in J), (\max y_{ij} | j \in J'), i = 1,2,3 \dots m\} = (y_1^-, y_2^-, \dots, y_n^-)$$

y_{ij} = normalized weighted matrix [i][j]

A^+ = positive ideal solution matrix element

A^- = negative ideal solution matrix element

5. Determine the distance between the value of each alternative with the ideal solution matrix positive and negative ideal matrix

a. The distance between the alternative Ai with a positive ideal solution formulated as

$$D_i^+ = \sqrt{\sum_{j=1}^{m} (y_i^+ - y_{ij})^2} \quad (11)$$

Di^+ = Ai alternative distance with a positive ideal solution

y^+ = positive ideal solution

y_{ij} = normalized weighted matrix

b. The distance between the alternative Ai with negative ideal solution formulated as

$$D_i^- = \sqrt{\sum_{j=1}^{m} (y_{ij} - y_i^-)^2} \quad (12)$$

Di^- = distance Ai alternative solutions ideal negative

y^- = negative ideal solution

y_{ij} = normalized weighted matrix

6. Calculating the proximity to the positive ideal solution. The proximity of each alternative against the ideal solution is calculated based on the formula

$$V_i = \frac{D_i^-}{D_i^- + D_i^+} \quad (13)$$

V_i = Proximity of each alternative to the solution ideal

D_i^+ = Distance Ai alternative to ideal solution positive

D_i^- = Distance Ai alternative to ideal solution negative

7. Alternatives which have a value of closeness to the positive ideal solution (Vi), the highest is the best alternative based on the calculation TOPSIS

4. DISCUSSION

The result of decisions made by the decision maker 4 for 5 object types are as follows supplier

Tabel 2. Decision's of Decision Maker

Supplier Plastik	Supplier Karton	Supplier Media Part	Supplier Metal	Supplier LED
PT. Sefong	PT. AMB	PT. Best Print	PT. Techno	PT. Solidlite

By using the Soft MULTISET, it will get the final results of calculations for supplier such as Table 3

Tabel 3. Calculation Soft Multiset Method

	ri	tj	Si
Supplier Plastik			
Hymold	215	198	17
Daiho	156	258	-102
Sefong	250	146	104
APB	184	246	-62
Giken	225	182	43

	ri	tj	Si
Supplier Karton			
AMB	152	110	42
Cheng Heng	136	138	-2
Interpack	116	156	-40
Supplier Media Part			
Prima	134	144	-10
Nissho	137	147	-10
Best Print	150	130	20
Supplier Metal			
Techno	153	151	2
Tokyo Byokane	145	155	-10
Endela	156	148	8
Supplier LED			
Sharp	181	204	-23
Everlight	197	194	3
Solidlite	206	192	14
ROHM	201	195	6

By using TOPSIS, it will get the final results of calculations for supplier such as Table 4

Tabel 4. Calculation of Metode Soft Multiset

Supplier Plastik	
Hymold	0,4867
Daiho	0,5043
Sefong	0,4733
Supplier Plastik	
APB	0,4954
Giken	0,5343
Supplier Karton	
AMB	0,3885
Cheng Heng	0,5818
Interpack	0,6070
Supplier Media Part	
Prima	0,4534
Nissho	0,4262
Best Print	0,5566
Supplier Metal	
Techno	0,5475
Tokyo Byokane	0,4675
Endela	0,4019
Supplier LED	
Sharp	0,5183
Everlight	0,4811
Solidlite	0,5193
ROHM	0,4543

The results generated by the decision of Soft MULTISET and TOPSIS method can be seen in table 5 and 6

Tabel 5. Decision of Soft Multiset

Supplier Plastik	Supplier Karton	Supplier Media Part	Supplier Metal	Supplier LED
PT. Sefong	PT. AMB	PT. Best Print	PT. Endela	PT. Solidlite

Tabel 6. Decision of Metode TOPSIS

Supplier Plastik	Supplier Karton	Supplier Media Part	Supplier Metal	Supplier LED
PT. Giken	PT. Interpack	PT. Best Print	PT. Techno	PT. Solidlite

5. TEST RESULT

Testing is the phase that has the aim to determine the performance of the method used in the decision support system built by the method of combination Entropy TOPSIS and methods Soft multiset. Performance testing in this research is to measure the similarity decision produced by the method with the resulting decisions by the decision maker.

Percentage similarity Soft Multiset method results can be calculated as follows

$$Kesamaan\ hasil\ Softmultiset = \frac{4}{5}\ x\ 100\% = 80\%$$

Percentage similarity TOPSIS method results can be calculated as follows

$$Kesamaan\ hasil\ TOPSIS = \frac{3}{5}\ x\ 100\% = 60\%$$

6. CLOSING

The conclusion is a summary drawn from the analysis that has been done. While the advice is addressed to users in order to maximize research.

6.1 Conclusion

Based on the results of the implementation and testing methods Soft MULTISET and TOPSIS on decision support for isupplier election case, it can be concluded that the method Soft MULTISET an accuracy / high similarity decisions / approach the decision maker's decision, namely the similarity of the results reached 80%. While the method has an accuracy TOPSIS / similarity decision by 60%

6.2 Suggetion

Of the existing limitations, suggestions for the development of the use of decision support methods in order to become better in the future are as follows:

1. Undertake more research regarding the use of both methods in decision support by implementing these methods in the case and how a different assessment.
2. The amount of data used to test the accuracy of methods of reproduction, both for the types of decisions as well as the number of alternative options.

BIBLIOGRAPHY

[1] Alkhazaleh, Shawkat dan Abdul Razak, "Fuzzy Soft Multiset Theory", *Research Article*, vol. 2012, no. 350603, pp. 1-20, 2012

[2] Alhazaymeh, Khaleed, Nasruddin Hassan. "Vague Soft Multiset Theory", *International Journal of Pure and Applied Mathematics*, vol. 93, no. 4, pp. 511-523. 2014

[3] Agung N. Pramudhita. "Penggunaan Algoritma MCDM dengan metode TOPSIS dalam penempatan karyawan", *Jurnal EECCIS*, vol. 9, no. 1, pp. 91-94.2015

[4] Rachman, Sandy. *Penerapan Metode Topsis Untuk Pemilihan Jurusan Siswa SMA*. Bandung. Skripsi Teknik Informatika Universitas Telkom: tidak diterbitkan. 2016

[5] Suhartanto, Hendro Mulyono, dkk, "Perancangan Model Penentuan Passing Grade dan Uang Pangkal", *Seminar Nasional Teknologi Informasi dan Multimedia*, pp. 73-78. 2015

[6] Wardhani, Indira Kusuma. "Seleksi Supplier Bahan Baku dengan Metode Topsis Fuzzy MADM", *Jurnal Sains dan Seni Pomits*, vol. l1, no. 1, pp. 1-6, 2012

[7] Jamila dan S, Hartati. "Sistem Pendukung Keputusan Pemilihan Subkontrak Menggunakan Metode Entropy dan TOPSIS". *IJCCS*, vol. 5, no. 2, pp. 13-18. 2011

[8] Cahyani, Andharini Dwi, "Aplikasi Sistem Pendukung Keputusan Pemilihan Pemasok Batik Tulis Madura Menggunakan Metode TOPSIS berbasis Entropi", *Seminar Nasional Industrialisasi Madura*, pp.226-269, 2011