



Analysis of Insurance Customer Factors to Renewal Using Hybrid AHP-FTOPSIS

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ABSTRACT

Human life is full of uncertainties that have enormous risks. Insurance is one way that can help humans reduce this risk. The human need for insurance causes competition among insurance companies in Indonesia to be very competitive. Competition between insurance companies is influenced by several factors, one of the factors is having customers who do insurance renewals. This study aims to determine the factors that influence customers to renew using the Analytical Hierarchy Process (AHP) method and to rank customers' favorite insurance using the Fuzzy Technique for Order Preference by Similarity to Ideal Solution (FTOPSIS) method. The results of the analysis using this method concluded that the main factors that influence customers in making renewals are features with sub-criteria for health protection needs. Meanwhile, the customer's favorite insurance ratings for extending are Takafullink Salam Cendikia with a closeness coefficient of 0.645, Takaful Al-Khairat with a value of 0.563, Takaful Dana Pendidikan with a value of 0.552, and Takafullink Salam with a value of 0.341.

Keywords: Insurance; Renewal; AHP; FTOPSIS

INTRODUCTION

Human life is full of elements of uncertainty that have enormous risks, such as accidents and death. Humans need a guarantee or a method to reduce this risk which we usually call insurance. The human need for insurance causes the competition of insurance companies in Indonesia to be very competitive. The biggest factor for an insurance company to be competitive is a customer who carries out a renewal. Each customer has its own criteria which are the determining factors for a customer to renew.

The Decision Support System (DSS) is specific information that is intended to assist management in making decisions related to semi-structured issues. DSS aims to assist decision makers in establishing an unstructured decision. Unstructured decisions have vague problems, and it's difficult to find solutions. Decision support systems are basically designed to support every stage of decision making, namely identifying problems, selecting relevant data, determining approaches, and evaluating alternative choices. In 2018, [1] conducted research on how to improve consumer satisfaction

learning (LBB) in Malang using the DANP-TOPSIS method. Identifying important human error factors in emergency departments in Taiwan using HFACS, AHP, and FTOPSIS by [2]. [3] conducted research on the selection of favorite banks using the AHP and TOPSIS methods. [4] discusses the selection of the best health applications and features that affect the AHP and FTOPSIS methods. Comparison on of ANP and AHP methods studied by [5]. [6] conducted reseacrh comparison between TOPSIS and SAW. [7]discusses decision making using hybrid AHP-TOPSIS. Hybrid Fuzzy AHP-TOPSIS researched by [8]. [9] researched decision making using hybrid AHP-TOPSIS. Comparison beetwen SAW, AHP, and TOPSIS researched by [10]. [11] conducted research on the comparison between SAW method and AHP method. Integrated ANP and TOPSIS Method for suplier performace assesment researched by [12]. [13] reasearched evaluation of smart and sustainable cities with ANP and TOPSIS method. [14] conducted research hybrid AHP-TOPSIS method under spherical fuzzy sets for system selection. Hybrid AHP-TOPSIS for selecting supplier in construction supply chain researched by [15]. This study aims to determine the factors that most influence insurance customers to renew and obtain favorite insurance alternatives by combining the AHP and FTOPSIS methods. The combination of the AHP and FTOPSIS methods is to obtain the criteria weights using the AHP method, then the FTOPSIS method uses the criteria weights that have been obtained by the AHP method to obtain the best alternative.

METHODS

Analytical Hierarchy Process (AHP) Method.

AHP is a decision-making process with compilation of functional hierarchies with the main input being human [16]. AHP requires ideas from individuals and groups by obtaining their respective assumptions and obtaining the desired solutions. These ideas are used to determine criteria that can solve a problem. In this research, AHP method is used to determine criterion weight to be used in the FTOPSIS method. According [16] there are general measures of AHP Method consists of seven steps.

1. Defining the problem and determining the desired solution then arranging hierarchy of the problems by setting goals which are the overall system goals at the top level.
2. Determine the priority of the elements.
 - a. Making pair comparasons by comparing elements in pairs according to given criteria.
 - b. The pairwise comparison matrix is filled using numbers to represent the relative importance of one element to another. The pairwise comparison matrix entry is the result of a questionnaire converted using Table 1.
3. Synthesis

Considerations for pairwise comparisons are synthesized to obtain overall priority.

 - a. Sum each column on the matrix.
 - b. Divide each value from the column by the total column obtain a normalized matrix.
 - c. Sum each row and divide by the number of elements to get the average value.
4. Measure consistency.
 - a. Multiplies each value in the first column by the relative priority of the first element, the value in the second column by the relative priority if the second element, and so on.
 - b. Adding each row, the result divided by the corresponding relative priority element.

c. Adding the results above for the elements that exist, called λ_{maks}

5. Calculating the Consistency Index (CI)

$$CI = \frac{\lambda_{maks} - n}{n - 1} \tag{1}$$

n = number of elements

6. Calculating the Consistency Ratio (CR)

$$CR = \frac{CI}{IR} \tag{2}$$

Where IR is Index Random Consistency contained in Table 2

7. Check hierarchy consistency, the consistency ratio must be less or equal to 0.1. The calculation result can be declared correct.

Table 1. AHP rating scale

Difference	-8	-7	-6	-5	-4	-3	-2	-1	0
AHP Scale	9	8	7	6	5	4	3	2	1

Source : [16]

Table 2. Index Random Consistency

Matrix Size	IR Value
1,2	0.00
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49
11	1.51

Source : [16]

Fuzzy Technique for Order Preferences by Similarity to Ideal Solution (FTOPSIS) Method.

The FTOPSIS Method is a development of the TOPSIS (Technique for Order Preference by Similarity to Ideal Solution). TOPSIS Method first introduced by Yoon and Hwang in 1981. The TOPSIS Method has a weakness, when the decision maker has difficulty determining a value. Therefore, it is necessary to provide an assessment in the form of intervals such as applying fuzzy logic. Fuzzy numbers, linguistic values and membership function shown in the Figure 1 and Table 3. In this research, FTOPSIS method is used to rank the alternatives.

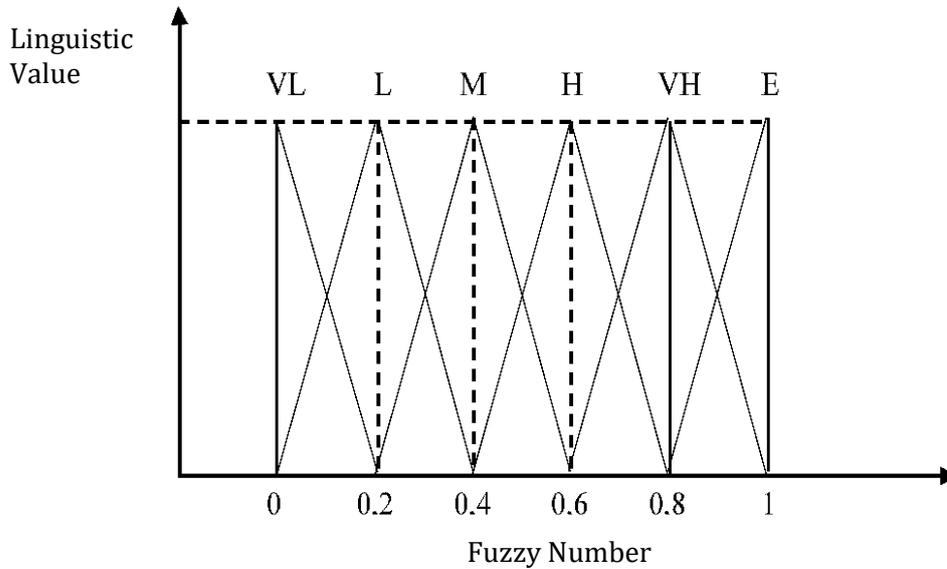


Figure 1. Fuzzy numbers and linguistic

Table 3. The membership function of linguistic value

Linguistic Value	Fuzzy Number
Very low (VL)	(0, 0, 0.2)
Low (L)	(0, 0.2, 0.4)
Medium (M)	(0.2, 0.4, 0.6)
High (H)	(0.4, 0.6, 0.8)
Very High (VH)	(0.6, 0.8, 1)
Excellent (E)	(0.8, 1, 1)

Source : [3]

General measurer of FTOPSIS Method consists of 9 steps.

1. Assesing criteria and alternatives

Assumed that there are m alternatives $A = \{A_1, A_2, A_3, \dots, A_m\}$ that will be evaluated against n criteria $C = \{C_1, C_2, C_3, \dots, C_n\}$. The weight of each criterion is denoted by W_i with $i = 1, 2, 3, \dots, n$. The ranking of the fuzzy criteria value of each decision D_k with $k = 1, 2, 3, \dots, K$ for each alternative A_j with $j = 1, 2, 3, \dots, m$ against the criterion C_i with $i = 1, 2, 3, \dots, n$ denoted by \tilde{R}_k with $k = 1, 2, 3, \dots, K$ with the membership function $\mu_R(x)$.

2. Calculate the comparison value of each criterion and alternatives

The fuzzy values for each decision maker are presented as fuzzy triangle $\tilde{R}_k = a_k, b_k, c_k, k = 1, 2, 3, \dots, K$. The value of the fuzzy ratio is given by $\tilde{R} = a, b, c, k = 1, 2, 3, \dots, K$, with

$$a = \min_k \{a_k\} \quad , \quad b = \frac{1}{K} \sum_{k=1}^K b_k \quad , \quad c = \max_k \{c_k\} \tag{3}$$

Fuzzy weight ratio $\tilde{w}_j = w_{j1}, w_{j2}, w_{j3}$ with :

$$w_{ji} = \min_k \{w_{jk1}\}, w_{j2} = \frac{1}{k} \sum_{k=1}^K w_{jk2}, w_{j3} = \max_k \{w_{jk3}\} \quad (4)$$

3. Make a decision matrix

Creating a decision matrix (D_k) that is appropriate for the alternatives to be evaluated based on the following defined criteria :

$$\tilde{D} = \begin{matrix} & C_1 & C_2 & \dots & C_n \\ A_1 & \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \end{bmatrix} \\ A_2 & \begin{bmatrix} x_{21} & x_{22} & \dots & x_{2n} \end{bmatrix} \\ \vdots & \begin{bmatrix} \vdots & \vdots & \ddots & \vdots \end{bmatrix} \\ A_m & \begin{bmatrix} x_{m1} & x_{m2} & \dots & x_{mn} \end{bmatrix} \end{matrix}$$

With x_{ij} states the performance of the calculation for i alternatives against the j criterion.

4. Normalize the fuzzy decision matrix

Normalize the data using a linear scale transformation, the normalized matrix is defined by

$$\tilde{R} = [\tilde{r}_{ij}]_{m \times n}, i = 1, 2, 3, \dots, m; j = 1, 2, 3, \dots, n \quad (5)$$

with

$$\tilde{r}_{ij} = \left(\frac{a_{ij}}{c_j^+}, \frac{b_{ij}}{c_j^+}, \frac{c_{ij}}{c_j^+} \right) \text{ dan } c_j^+ = c_{ij} \quad (6)$$

$$\tilde{r}_{ij} = \left(\frac{a_j^-}{c_{ij}}, \frac{a_j^-}{b_{ij}}, \frac{a_j^-}{a_{ij}} \right) \text{ dan } a_j^- = a_{ij} \quad (7)$$

(6) benefit criteria, (7) cost criteria

5. Calculate the normalized matrix weights

The normalized matrix weight \tilde{V} is calculated by multiplying the weight \tilde{w}_i of the evaluated criterion by the normalized decision matrix \tilde{r}_{ij}

$$\tilde{V} = [\tilde{v}_{ij}]_{n \times j}, i = 1, 2, 3, \dots, m; j = 1, 2, 3, \dots, n \quad (8)$$

with $\tilde{v}_{ij} = \tilde{w}_i \times \tilde{r}_{ij}$

6. Calculate the value of Fuzzy Positive Ideal Solution (FPIS) and Fuzzy Negative Ideal Solution (FNIS)

$$A^+ = \{(v_{ij} | j \in J), (v_{ij} | j \in J'), i = 1, 2, \dots, m\} \\ = (\tilde{v}_1^+, \tilde{v}_2^+, \tilde{v}_3^+, \dots, \tilde{v}_n^+) \quad (9)$$

$$A^- = \{(v_{ij} | j \in J), (v_{ij} | j \in J'), i = 1, 2, \dots, m\} \\ = (\tilde{v}_1^-, \tilde{v}_2^-, \tilde{v}_3^-, \dots, \tilde{v}_n^-) \quad (10)$$

With $j = 1, 2, 3, \dots, n$ and J is the set of benefit criteria. $J' = \{j = 1, 2, 3, \dots, n$ and J' is the set of cost criteria.

7. Calculate the distance for each alternatives from FPIS and FNIS

If there is \tilde{v}_1 and \tilde{v}_2 is two fuzzy triangular numbers, defined as $\tilde{v}_1 = (a_1, b_1, c_1)$ and $\tilde{v}_2 = (a_2, b_2, c_3)$ then the distance $[d(\tilde{v}_1, \tilde{v}_2)]$ between \tilde{v}_1 and \tilde{v}_2 can be calculated by

$$d(\tilde{v}_1 \tilde{v}_2) = \sqrt{\frac{1}{3} [(a_1 - a_2)^2 + (b_1 - b_2)^2 + (c_1 - c_2)^2]} \tag{11}$$

Distance (D_j^+, D_j^-) of each weighted alternative ($i = 1, 2, 3, \dots, m$) from FPIS and FNIS can be calculated by

$$D_j^+ = \sum_{i=1}^n d(\tilde{v}_{ij}, \tilde{v}_i^+) \quad , j = 1, 2, \dots, J, \tag{12}$$

$$D_j^- = \sum_{i=1}^n d(\tilde{v}_{ij}, \tilde{v}_i^-) \quad , j = 1, 2, \dots, J. \tag{13}$$

8. Calculate the closeness coefficient value

The *Closeness Coefficient* (CC_i) represents the distance between FPIS(A^+) and FNIS (A^-) simultaneously for each alternative, the *Closeness Coefficient* (CC_i) can be calculated by

$$CC_i = \frac{D_j^-}{D_j^+ + D_j^-} \quad , j = 1, 2, 3, \dots, J \tag{14}$$

With $0 < CC_i < 1$

9. Sort alternative

Each alternative is sorted according to the decreasing *Closeness Coefficient* (CC_i) value. The best alternatives is the *Closeness Coefficient* (CC_i) value is close to FPIS and far from FNIS.

RESULTS AND DISCUSSION

Analytical Hierarchy Process (AHP) Method.

The first step in the AHP Method is arrangement the hierarchichal structure. The hierarchical structure in this study consists of 4 levels, the first level is the goal, namely to determine the favorite type of insurance. The second level is the elaboration of the main aspects that influence the objectives, namely the criteria. The third level is the aspects that influence the criteria, namely sub-criteria. The fourth level or the lowest level is the level that consists of alternatives. The structure of the hierarchical system in this study can be seen in Figure 2. Then, we determine the priority of the elements by create formation of Pairwise Comparison Matrix between sub-criteria and create weight matrix between sub-criteria based on the results of the questionnaire. Next step is calculate *CR* value. The five criteria have a $CR < 0,1$, it can be concluded that the pairwise comparison matrix between these subcriteria is consistent. The most influential criterion in choosing the customer's favorite insurance for renewal in company A is the insurance feature with the subcriteria for the need for health protection having a weight value of 0.800. Table 5 shows the evaluation result and final ranking of criterion.

To determine the level of data consistency, we calculate the *CR* value. First, calculate the value of λ_{maks} then calculate the *CI* using equation (1). λ_{maks} is obtained by adding the vp_n results for the elements that exist and each number of subcriteria is the value of n used. Table 5 shows the vp_n results. Using the *CI* value that has been obtained, calculate the *CR* value using equation (2). If the $CR < 0,1$ the research can be continued. Table 4

shows the *CR* value. It is shown that the five criteria have a *CR* value of less than 0,1 which means that the data for the five criteria are consistent. So, research can be continued.

Table 4. *CR* value

Criteria	<i>CR</i> value
Company Image	0,068
Agent	0,034
Insurance Features	0,064
Claim	0,020
Income	0,055

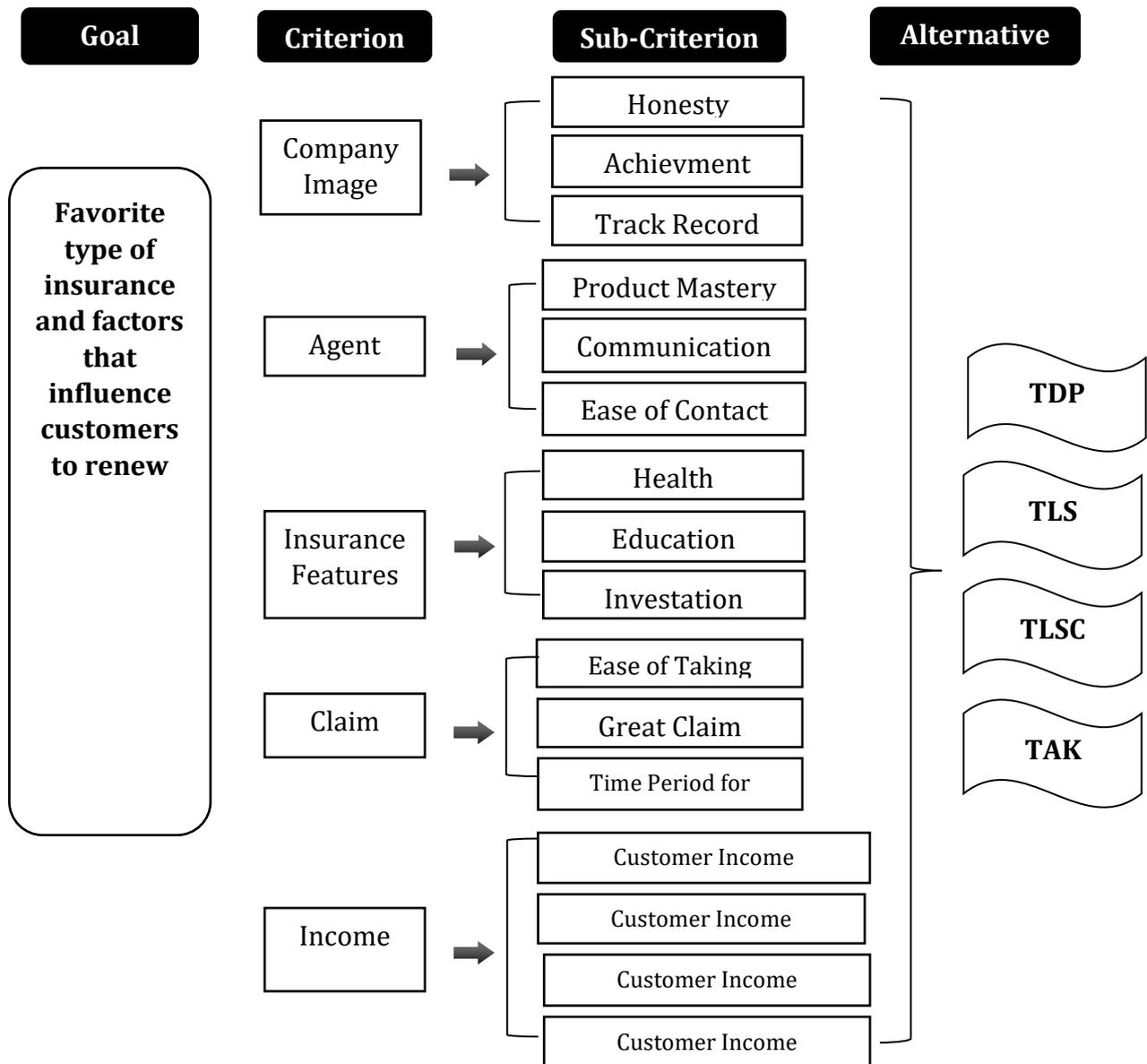


Figure 2. Hierarchical System

Table 5. AHP Method Result

Subcriteria	vp_n (Priority Vector)
Honesty	0.639
Achievment	0.087

Track Record	0.274
Product Mastery	0.343
Subcriteria	vp_n (Priority Vector)
Communication	0.575
Ease of Contact	0.082
Health	0.800
Education	0.124
Investation	0.075
Ease of Taking Claims	0.123
Great Claim	0.557
Time Perios for Claiming	0.320
Customer Income (<Rp. 2,5 million /month)	0.055
Customer Income (Rp. 2,5 – 4,9 million /month)	0.156
Customer Income (Rp. 5,0 – 7,5 million/month)	0.545
Customer Income (>Rp. 7,5 million/month)	0.244

Afterward, we analyze the best alternative in FTOPSIS Methods. The weights of criteria to be used in evaluation process are calculated by using AHP Method combined with the scores from the expert questionnaire. Table 6 shows the data from the expert questionnaire.

Table 6. Data from the expert questionnaire

	TDP	TLS	TLSC	TAK
Honesty	H	VH	M	H
Achievment	VH	VH	H	M
Track Record	M	H	VH	L
Product Mastery	L	VH	M	M
Communication	H	L	VH	H
Ease of Contact	M	L	L	M
Health	H	H	VH	E
Education	E	VH	H	H
Investation	H	VH	E	H
Ease of Taking Claims	VH	H	H	VH
Great Claim	M	L	VH	H
Time Period for Claiming	VH	H	VH	H
Customer Income (<Rp. 2,5 million /month)	H	VH	M	M
Customer Income (Rp. 2,5 – 4,9 million /month)	H	H	H	M
Customer Income (Rp. 5,0 – 7,5 million/month)	H	M	VH	VH
Customer Income (>Rp. 7,5 million/month)	H	H	M	H

Then the next step is calculating the weight of the alternative matrix. Table 7 shown the multiplication results of the expert questionnaire values that have been converted based on table 3 with the priority vector value vp_n . For example, criteria Honesty on Alternative TDP is H then convert the value to fuzzy number based on Table 3 which is (0.4, 0.6, 0.8). Then do fuzzy multiplication with the value of the priority vector vp_n . which is 0.639. After we get the multipclication of the priority vectors and the expert quuestionner, we calculate the FPIS and FNIS values, then we use these values to calculate the FPIS and FNIS distances using equation (12) and (13). Table 8 shows the value of the FPIS and FNIS distance. After calculating the distance between FPIS and FNIS, we calculate CC_i value using equation (14). Table 9 shows the results of calculating the CC_i value.

Depends of the CC_i value in Table 9 the alternatives ranking in FTOPSIS method, The first order is the TLSC alternative, the second is the TAK alternative, the third is the TDP alternative, and the last order is the TLS alternative.

Table 7. Multiplication of the priority vectors by the results of the expert questionnaire

	TDP	TLS	TLSC	TAK
Honesty	(0.256,0.384,0.511)	(0.384,0.511,0.639)	(0.128,0.256,0.384)	(0.256,0.384,0.511)
Achievment	(0.052,0.070,0.087)	(0.052,0.070,0.087)	(0.035,0.052,0.070)	(0.017,0.035,0.052)
Track Record	(0.055,0.109,0.164)	(0.109,0.164,0.219)	(0.164,0.219,0.274)	(0,0.055,0.109)
Product Mastery	(0,0.069,0.137)	(0.206,0.274,0.343)	(0.069,0.137,0.206)	(0.069,0.137,0.206)
Communication	(0.230,0.345,0.460)	(0,0.115,0.230)	(0.345,0.460,0.575)	(0.230,0.345,0.460)
Ease of Contact	(0.016,0.033,0.049)	(0,0.016,0.033)	(0,0.016,0.033)	(0.016,0.033,0.049)
Health	(0.320,0.480,0.640)	(0.320,0.480,0.640)	(0.480,0.640,0.800)	(0.640,0.800,0.800)
Education	(0.099,0.124,0.124)	(0.075,0.099,0.124)	(0.050,0.075,0.099)	(0.050,0.075,0.099)
Investation	(0.030,0.045,0.060)	(0.045,0.060,0.075)	(0.060,0.075,0.075)	(0.030,0.045,0.060)
Ease of Taking				
Claims	(0.074,0.098,0.123)	(0.049,0.074,0.098)	(0.049,0.074,0.098)	(0.074,0.098,0.123)
Great Claim	(0.446,0.557,0.557)	(0,0.111,0.223)	(0.334,0.446,0.557)	(0.223,0.334,0.446)
Time Perios for				
Claiming	(0.192,0.256,0.320)	(0.128,0.192,0.256)	(0.192,0.256,0.320)	(0.128,0.192,0.256)
Customer Income				
(<Rp. 2,5 million				
/month)	(0.222,0.033,0.044)	(0.033,0.044,0.055)	(0.011,0.022,0.033)	(0.011,0.022,0.033)
Customer Income				
(Rp. 2,5 – 4,9				
million /month)	(0.062,0.094,0.125)	(0.062,0.094,0.125)	(0.062,0.094,0.125)	(0.031,0.062,0,094)
Customer Income				
(Rp. 5,0 – 7,5				
million/month)	(0.218,0.327,0.436)	(0.109,0.218,0.327)	(0.327,0.436,0.545)	(0.327,0.436,0.545)
Customer Income				
(>Rp. 7,5				
million/month)	(0.098,0.146,0.195)	(0.098,0.146,0.195)	(0.049,0.098,0.146)	(0.098,0.146,0.195)

Table 8. FPIS and FNIS distances.

	TDP	TLS	TLSC	TAK
D_j^+	0.982	1.445	0.787	0.958
D_j^-	1.207	0.748	1.429	1.234

Table 9. CC_i value

Alternative	CC_i
TDP	0.552
TLS	0.341
TLSC	0.645
TAK	0.563

CONCLUSION

The results of data analysis that has been carried out from the combination of the two methods indicate that the most influencing factor for insurance customers to renew at PT Asuransi Takaful Keluarga is the insurance feature, namely the customer's need for health protection with weight value of 0.800. All health insurance companies must have health protection features. So, we see the next order of sub-criteria, honesty with a weighted value of 0.639, agent communication with a weighted value of 0.575, and good claims with a weighted value of 0.557. The sub-criteria that have the highest value

weight are the criteria for company image, agent, and claims. The five criteria have a priority value that is quite close, indicating that the five criteria are mutually sustainable. The order of alternative choices for the customer's favorite insurance who renews at PT. Family Takaful Insurance is Takafulink Salam Scholar, Takaful Al-Khairat, Takaful Fund Education, and Takafulink Salam.

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