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Product Selection Decision Support System Insurance For Prospective Customers using AHP and TOPSIS

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ABSTRACT

In determining the insurance product common problems faced by insurance agents and prospective customers, namely the length of the process of determining customers' products and a lack of understanding of the products offered. It required a system that could be used by an insurance agent in the product selection process in accordance with the criteria of the prospective customer. This study aimed to design a decision support system for the selection of insurance products by using AHP and TOPSIS. The system is built to produce perangkingan insurance products according to the criteria of the prospective customer, ie, age, income, purpose, sex, smoking, and menika status. CMS system accuracy testing is done by comparing the output of the system by manual calculation process which is known there are differences in the results.

1. Introduction

Insurance is a willingness to establish small losses which is certainly as a replacement or substitution of large losses that have not occurred. From the definition of this insurance can be concluded that the insurance is a term used to refer to actions, systems or business where financial protection (indemnity) to life, property, health, etc.[1],

At this time the growth of the insurance business so rapidly evolving. With so many programs being offered would be an Pull for prospective customers who want to use the insurance. Insurance products are offered also vary ranging from life insurance, health, education until unjangan days old. The purpose of insurance programs for each prospective customer must be different too.

PT. Prudential is an insurance company established in 1995, Prudential is part of Prudential plc, a leading financial services group in the UK. PT Pridential have thousands of marketers and 8 branch offices in Jakarta area. In determining the insurance product common problems faced by the prospective customer. [2].

The problem that occurs is a lack of understanding of the customers towards the products offered. It required an application decision support system that can facilitate customers to obtain information on the products offered using AHP (Analytical Hierarchy Process) and TOPSIS (Technique for Order Performance of Similarity to Ideal Solution).

AHP *(Analytical Hierarchy Process)*is one method that various decision support systems have been widely applied in the industry basically refers to the evaluation of the assessment of a number of criteria, to evaluate a number of criteria that is used AHP were able to approach the assessment criteria of qualitative and quantitative criteria [3]. While the method Technique for Order Performance of Similarity to Ideal Solution (TOPSIS) using the principle that the alternatives selected must have the longest distance (farthest) from the negative ideal solution from a geometrical point by using the relative

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proximity of an alternative. Then, possessed TOPSIS approach is simple but systematic procedure in the calculation,

In some studies that have been conducted by researchers write in journals or scientific papers on the use of Decision Support System (DSS) on the electoral system is [5], concluded that in order to be able to process the data assessment more objective it is necessary to build a decision support system that can determine who is entitled to receive the award, while eliminating manual calculation then made computerized and help with semi structured repetitive routine problems, but it still required human judgment in the application of the solution. [6] states that the best electoral calculation results using both methods deliver the best outcome. The purpose of this research was made to help PT.

The purpose of this study was to provide information to prospective customers about the insurance products that best based on AHP and TOPSIS and provide decision support for the selection of insurance products.

2. Research methods

The data collection was done by interview to gather the necessary data and reviewed the literature to support the retrieval of research results.

Each step in the research can be described as follows:

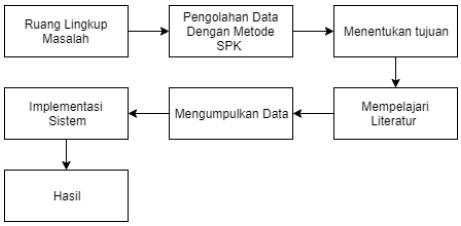

Fig 1, Process Flow Research

A. Decision Support System

Decision Support System Decision support system is a computer-based system that is able to solve management problems in generating the best alternatives to support the decision taken by the decision makers[7],

B. *Analytical Hierarchy Process*

*Analytical Hierarchy Process*is a decision support models developed by Thomas L. Saaty. This decision support models will describe the multi-factor problem or a complex multiple criteria into a hierarchy. According to Saaty, hierarchy is defined as a representation of a complex problem in a structure multi level where the first level is the goal, which was followed by the level of factors, criteria, sub-criteria, and so on down to the last level of the alternative[8], With a hierarchy, a complex problem can be decomposed into groups of the group who then arranged into a form of hierarchy so that the problem will appear more structured and systematic.

This study uses six criteria used for the assessment are: Age (C1), jobs (C2), income (C3), gender (C4), smoking (C5) and marital status (C6).

Step - step of AHP are as follows [9]:

1) Summing up the values of each column in the matrix.
2) Dividing each column with a total value of the column in question to obtain a normalization matrix using Equation 1, which states pairwise comparison matrix, the matrix a row i and j column in a matrix.

$$\sum_{j=1}^{n} a_{ij} = 1 \quad \text{.....(1)}$$

3) Summing up the values of each matrix and dividing by the number of elements to obtain an average value using Equation 2, where n specifies the number of criteria and average wi-th row.

$$wi = \frac{1}{n}\sum_{j=1}^{n} a_{ij} \quad \text{.....(2)}$$

After performing the steps above, next is the measure of consistency with the following steps:

1) Multiplying the value in the first column with the first element relative priority.
2) Summing each row.
3) Divide the results summation line with the relative priority elements.

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4) Summing up the results of the division on the number of elements present. The result is called λ max.
5) Calculating Consistency Index (CI) using the formula:

$$CI = \frac{\lambda \max - n}{n-1} \quad \text{..... (3)}$$

Where :
n = number of elements

6) Calculating the ratio Consistency / Consistency Ratio (CR) using the formula:

$$CR = \frac{CI}{RI} \quad \text{..... (4)}$$

Where :
CR = Consistency Ratio
CI = Consistency Index
RI = Random Index

7) Consistency checking hierarchy, the data is said to be true if it has the consistency ratio value less than or equal to 0.1.

In general decision-making with AHP is based in the table below:

Table1,
Value index random consistency ratio

n	1	2	3	4	5	6	7	8
RI	0	0	0:58	0.90	1:12	1:24	1:32	1:41
n	9	10	11	12	13	14	15	
RI	1:45	1:49	1:52	1:53	1:56	1:57	1:58	

Where in RI or random index value, can check the consistency of the hierarchy. If the value is more than 10%, then the judgment must be corrected data assessment. However, if the ratio Consistency (CI / CR) is less than or equal to 0.1, the final result can be declared true.

C. *Technique for Order of Similiarity to Ideal Solution*

Technique for Order Performance of Similarity to Ideal Solution (TOPSIS) is one of multiple criteria decision support system. TOPSIS had the principle that the chosen alternative should have the shortest distance from the positive ideal solution and has the furthest distance from the negative ideal solution from the standpoint of geometric use Euclidean distance (the distance between two points) to determine the relative proximity of an alternative.Basic principle of TOPSIS method is the chosen alternative should have the shortest distance from the ideal completion farthest distance from the positive and negative ideal completion [10],TOPSIS method has the following advantages:

1) TOPSIS method is one method that is simple and rational concepts are easy to understand.
2) TOPSIS method is able to measure the relative performance in forming a simple mathematical form [11].

Stages TOPSIS method:

a) Make a decision matrix that is normalized.
b) Make a decision matrix that is normalized weighted.
c) Determining the ideal solution matrix of positive and negative ideal solution matrix.
d) Determine the distance between the value of each alternative with a matrix of positive and negative ideal solution.
e) Determining the value of preference for each alternative [11].

TOPSIS require performance ratings of each alternative on each criterion Ci Ai normalized, namely: The steps of the algorithm of TOPSIS method is:

a) Determining normalizing the decision matrix. Rij normalized value is calculated using the formula:

$$\boldsymbol{R_{ij}} = \frac{X_{ij}}{\sum_{i=1}^{m} X_{ij}^2} \quad \text{..... .. (5)}$$

Information:
i = 1,2, ..., m
j = 1,2, ..., n

b) Determining the weight normalized decision matrix. Yij normalized weight values as follows:

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$y_{ij} = w_{ij} r_{ij}$ ..... (6)

Information:
i = 1,2, ..., m
j = 1,2, ..., n

A + = (y1 + y2 + ..., yj +)
A- = (y1-, Y2-axes, ..., yj-) ..... (7)

with:

$$yj + = \begin{cases} i \text{ max } yij, jika\ j = keuntunngan \\ i \text{ min } yij, jika\ j = biaya \end{cases}$$

$$yj- = \begin{cases} i \text{ max } yij, jika\ j = keuntunngan \\ i \text{ min } yij, jika\ j = biaya \end{cases}$$ ..... (8)

c) Specifies the alternative value of the matrix within the ideal solution is positive (+) and negative ideal solution matrix (di-), distance ideal solution is positive (+)

$$at + = \sqrt{\sum_{j=1}^{m} (yij - yj +)^2}$$

$$in- = \sqrt{\sum_{j=1}^{m} (yij - yj -)^2}$$ ..... (9)

Where :
yj + = element of positive ideal solution matrix
yj- = elements of the negative ideal solution matrix

d) Determining the value of preferences (vi) for each alternative. Proximity preference value is an alternative to an ideal solution.

$$v_i = \frac{di^-}{di^- + di^+}$$ ..... (10)

Where:
The + = distance between the alternative values to i with positive ideal solution.
di- = distance between the alternative values to i with negative ideal solution.
vi = preference value that indicates an alternative to i, ci larger value indicates an alternative priorities.

3. Results and Discussion

3.1. Discussion

The counting process of recommendation mirrorles camera with AHP-TOPSIS method begins with providing an assessment. Rated "Absolute more important" are given priority 9, the value of "It's More Important" will be given priority 7, the value "More Important" priority 5, the value of "Enough is important" priority 3, and the value "Equally Important" will be given first priority.

The first step in the form of tables form a pairwise comparison matrix (pairwise comparison value) which can be seen in the following table:

Table 2.
Pairwise comparisons decision matrix table 1

Criteria	C1	C2	C3	C4	C5	C6
C1	1	1	3	5	7	9
C2	1	1	1	3	5	7
C3	0.33	1	1	9	1	3
C4	0.2	0.33	0.11	1	5	7
C5	0.14	0.2	1	0.2	1	9
C6	0.11	0.14	0.33	0.14	0.11	1

Information:
C1 = Age
C2 = Jobs
C3 = Revenue
C4 = Gender

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C5 = Smoking
C6 = Status Married

The second step to change the pairwise comparison matrix to form decimals and the sum of each column that can be seen in Table 3, in the calculation of the writer uses two decimal places.

Table 3.
Pairwise comparisons decision matrix table 2

Criteria	C1	C2	C3	C4	C5	C6
C1	1.00	1.00	3.00	5.00	7.00	9.00
C2	1.00	1.00	1.00	3.00	5.00	7.00
C3	0.33	1.00	1.00	9.00	1.00	3.00
C4	0.20	0.33	0.11	1.00	5.00	7.00
C5	0.14	0.20	1.00	0.20	1.00	9.00
C6	0.11	0.14	0.33	0.14	0.11	1.00

Matrix above was evaluated and in total each column to get the value of the normalized decision matrix to obtain the results as below:
Column C1 = 1.00 + 1.00 + 0.33 + 0.20 + 0.14 + 0.11 = 2.787

Perform these calculations until the column C6. After a number of columns is determined, the next step is to divide the figures by the number of each column, thus forming a matrix of normalization.
Column C1, C1 line divided by number of column C1 = 1.000 / 2.787 = 0.348

Perform these calculations on whole numbers in Table 3.2. And the results can be seen in the following table:

Table 4
Normalized decision matrix table

Criteria	C1	C2	C3	C4	C5	C6
C1	0.358	0.272	0.465	0.272	.366	0.25
C2	0.358	0.272	0.155	0.163	0.261	0.194
C3	0.119	0.272	0.155	.490	0.052	0.083
C4	0,071	.090	0,017	0,054	.2616	0.194
C5	0.051	0,054	0.155	0,010	.0523	0.25
C6	0,039	0.038	0.051	0.007	0,005	0,027

The next step seeking priority weight scale, by calculating the average line of table 3.2, and the calculation is as follows:
The average line C1 = (0.358 + 0.272 + 0.465 + 0.272 + 0.366 + 0.25) / 6 = 0.33

Perform these calculations until the line C6, and the results can be seen from the table below:

Table 5
Priority weighting matrix table

Criteria	C1	C2	C3	C4	C5	C6
Weight	0.33	0.23	0.19	0.11	0.09	0.02

After her weight value was found ingo to method TOPSIS to rank the election insurance products that suit the needs of the user.

TOPSIS method based on the concept that the best alternative was selected not only has the shortest distance from the positive ideal solution but it also has the longest distance from the negative ideal solution. The criteria in determining the camera selection are:

1. C1 = Age
2. C2 = Profession
3. C3 = Income
4. C4 =Gender
5. C5 = Smoke
6. C6 = Status Married

The ranking matches each alternative on each criterion assessed by 1 to 5. The following table shows the ranking of the suitability of each alternative on each criterion:

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Table 6
Alternative Matches rankings

Alternative	C1	C2	C3	C4	C5	C6
PRUprime healthcare plus	1	1	1	2	1	1
PRUprime healthcare	2	2	1	1	1	1
PRUearly stage payor	1	2	1	2	1	2
PRUlink term	3	2	2	2	1	1
PRUearly stage crisis cover plus	1	1	1	2	1	1
6 products	1	1	2	1	1	1

Once the match is loaded then the next rankings calculate the normalization matrix using the equation:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{j=1}^{m} x_{ij}\ 2}}$$

r = $\sqrt{1^2 + 2^2 + 1^2 + 3^2 + 1^2 + 1^2}$ = 4,1231
The results of calculation of C1 using the equation above can be seen ditabel 7

Perform these calculations until the line C6, and the results can be seen from the table below:

Table 7
Results Number of Rank Root

Alternative	C1	C2	C3	C4	C5	C6
r	4.1231	3.8730	3.4641	4.2426	2.4495	3,0000

Normalization matrix obtained by dividing the table 6 with table 7 Example calculation is as follows:
Values column line C1 C1 = 1 / 4.1231 = 0, 2425

Table 8
Normalization matrix

Alternative	C1	C2	C3	C4	C5	C6
PRUprime healthcare plus	.2425	.2582	.2887	.4714	.4082	.3333
PRUprime healthcare	.4851	.5164	.2887	.2357	.4082	.3333
PRUearly stage payor	.2425	.5164	.2887	.4714	.4082	.6667
PRUlink term	.7276	.5164	.5774	.4714	.4082	.3333
PRUearly stage crisis cover plus	.2425	.2582	.2887	.4714	.4082	.3333
6 products	.2425	.2582	.5774	.2357	.4082	.3333

Once the matrix is normalized so the next step is the manufacture of matrix normalized weighted. Weighted normalized decision matrix derived from matrix multiplication which has been normalized by the weight of preference. Example calculation of the normalized weighted matrix:
C1 value in table 8 multiplied by the row in table 5
= 0.2425 x 3.33 = 0.0800

Perform calculations throughout the entire value, and the result is as follows:

Table 9
Weighted normalized matrix

Alternative	C1	C2	C3	C4	C5	C6
PRUprime healthcare plus	.0800	.0594	.0548	.0519	.0367	.0067
PRUprime healthcare	.1601	.1188	.0548	.0259	.0367	.0067
PRUearly stage payor	.0800	.1188	.0548	.0519	.0367	0.0133
PRUlink term	.2401	.1188	.1097	.0519	.0367	.0067
PRUearly stage crisis cover plus	.0800	.0594	.0548	.0519	.0367	.0067
6 products	.0800	.0594	.1097	.0259	.0367	.0067

From the matrix above then proceed with the determination of the positive and negative ideal solution. Before calculating the positive and negative ideal solution should look for maximum and minimum values of each column first.

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Table 10
Weighted normalized matrix

Alternative	C1	C2	C3	C4	C5	C6
PRUprime healthcare plus	.0800	.0594	.0548	.0519	.0367	.0067
PRUprime healthcare	.1601	.1188	.0548	.0259	.0367	.0067
PRUearly stage payor	.0800	.1188	.0548	.0519	.0367	0.0133
PRUlink term	.2401	.1188	.1097	.0519	.0367	.0067
PRUearly stage crisis cover plus	.0800	.0594	.0548	.0519	.0367	.0067
6 products	.0800	.0594	.1097	.0259	.0367	.0067
Max	.2401	.1188	.1097	.0519	.0367	0.0133
Min	.0800	.0594	.0548	.0259	.0367	.0067

$$\text{D Positive} = \sqrt{\begin{matrix}((0{,}0800-0{,}2401)^2+(0{,}0594-0{,}1188)^2+\\(0{,}0548-0{,}1097)^2+(0{,}0519-0{,}0519)^2+\\(0{,}0367-0{,}0367)^2+(0{,}0067-0{,}0133)^2\end{matrix}}$$
$$= .1794$$

$$\text{D Negative} = \sqrt{\begin{matrix}((0{,}0800-0{,}0800)^2+(0{,}0594-0{,}0594)^2+\\(0{,}0548-0{,}0548)^2+(0{,}0519-0{,}0259)^2+\\(0{,}0367-0{,}0367)^2+(0{,}0067-0{,}0067)^2\end{matrix}}$$
$$= 0{,}0259$$

Perform calculations throughout the entire value, and the result is as follows:

Table 11
Alternative D + and D-

Alternative	D +	D-
PRUprime healthcare plus	.1794	.0259
PRUprime healthcare	.1006	.1304
PRUearly stage payor	.1692	.1030
PRUlink term	.0066	.1903
PRUearly stage crisis cover plus	.1794	.0842
6 products	.1728	.0842

The next is to calculate the final value or preference (vi) for each alternative using the following equation:

$$v_i = \frac{di^-}{di^- + di^+}$$

$$\text{The final value} = \frac{0{,}0259}{0{,}0259 + 0{,}1794} = 0{,}126$$

Perform calculations throughout the entire value, and the result is as follows:

Table 12
The final result

Alternative	Score	Rank
PRUprime healthcare plus	0.126	6
PRUprime healthcare	0,564	2
PRUearly stage payor	0.378	3
PRUlink term	0.966	1
PRUearly crisis stage	0.319	5
6 products	0.327	4

So from the value obtained alternative values PRUlink term is the largest value, so PRUlink term selected as the best insurance product selection.

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Next calculate the level of accuracy in the application of the manual calculation is done by dividing the calculation in applications with manual calculations, as shown in Table 14 below:

Table 13
The calculation of the value of the accuracy of the application and the user

Product	Application	manual	Percentage
PRUprime healthcare plus	0130	0.126	103.1746032
PRUprime healthcare	0495	0,564	87.76595745
PRUearly stage payor	0282	0.378	74.6031746
PRUlink term	0950	0.966	98.3436853
PRUearly stage crisis cover plus	0130	0.319	40.7523511
6 products	0245	0.327	74.9235474

The above table is the result of accurate value comparison between an application and its manual count results are not much different percentages, the results of which have been found to have been quite accurate.

3.2. result

a. System implementation

a) Login page

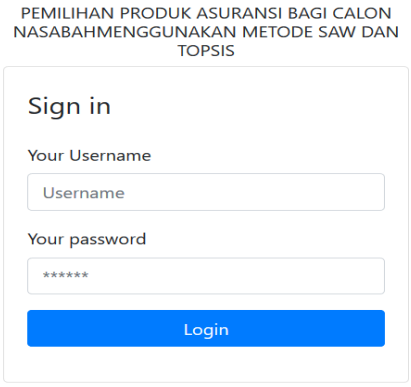

Figure 1. Login Page Views

Figure 1 is a display page that contains the login menu. the user must enter the username and password that have been registered. If a valid username and password are entered will open the main menu page.

b) Insurance Product Pages

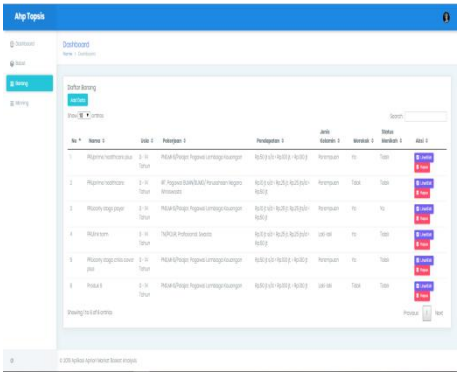

Figure 2. Insurance Products Page Views

Figure 2 is an insurance product that serves the page to add, edit, and delete data insurance products.

c) SPK page

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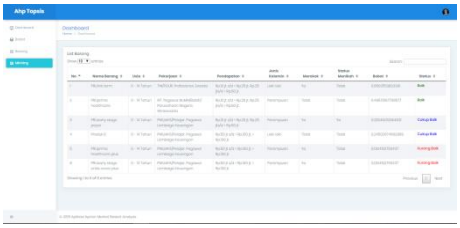

Figure 3. Display Page SPK

Figure 3 is a functioning mining page to see the results of a decision support system in choosing an insurance product.

4. Conclusion

a. Based on test results using manual calculation and application in terms PRUlink find get that top ranking position so that it can be summed up as the best insurance products, with a percentage of 98.343%.
b. Based on the results of prospective customers at the recommended to choose an insurance product with the highest percentage calculation.

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