

## MODEL SWOT-AHP-TOPSIS FOR UNIVERSITY DEVELOPMENT STRATEGY

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**ABSTRACT**– Universities face challenges to always improve themselves in order to make themselves the best universities. Therefore, every university needs to do an analysis of Strengths, Weaknesses, Opportunities, and Threats (SWOT) so that they can formulate strategies that are in accordance with the situation of the university. The results of the SWOT analysis which are then included in the TOWS Analysis Matrix will be an alternative strategy that can be considered for developing the university. However, due to limitations in implementing the alternatives referred to, it is necessary to apply a priority scale. This study aims to propose a SWOT-AHP-TOPSIS model so that it can help universities in determining which alternative strategic priorities will be chosen to be implemented in stages. The working method of this model is to first apply the Analytical Hierarchy Process (AHP) to obtain priority weights for each alternative for SO, WO, ST, and WT. Then the decision regarding which strategy to choose will be based on the TOPSIS method which is based on the choice on the closest distance to the Positive Ideal Solution and the farthest distance to the Negative Ideal Solution. This model will be applied at Universitas IBBI to determine the most suitable university development strategy. The novelty of this research is that there is no research that directly discusses SWOT analysis in university development and also strategies based on the TOWS Analysis Matrix and each of these strategies will be determined which one is the priority. The results of the study show that the most important thing to develop higher education based on the application of the model is to strengthen the network of cooperation with industry as graduates of users and also high schools as providers of prospective students.

**KEY WORDS** : SWOT, TOWS, AHP, TOPSIS

### 1. INTRODUCTION

Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis that was popularized by Andrews[1] is a type of contextual analysis which states that the strategic development will be based on internal conditions and capabilities which include strategies, strengths, and effects together with external conditions which include opportunities and threats[2]. SWOT Analysis has been widely recognized as a tool for analyzing and reflecting on the situation of each institution and can also be used as a tool in decision making[3].

Types of alternative strategies that can be obtained through a SWOT with the TOWS Analysis Matrix are: SO (Strengths - Opportunities), ST (Strengths - Threats), WO (Weaknesses - Opportunities) and WT (Weaknesses - Threats)[4]. Although, a SWOT analysis can produce

alternative strategies that can be implemented, of course, implementing these strategies simultaneously will be difficult. Therefore, it is necessary to determine which alternative strategies will be executed in stages first. Therefore, it is necessary to determine the rank or priority weight of each alternative strategy[5].

The Analytical Hierarchy Process (AHP), which was first introduced by Saaty[6], is a decision-making tool that provides the ability to rank a number of preferences so that it offers convenience in determining the weight of an alternative or criterion[7]. The use of SWOT-AHP has been carried out by a number of researchers because it allows for the determination of the weight or priority scale of the alternative strategies based on the assessment of a number of experts in the form of a pairwise comparison matrix[8].

The first stage of the SWOT-AHP is problem analysis to obtain the SWOT factor. After the SWOT factor exists,

an alternative strategy will be generated based on the TOWS Analysis Matrix. Then based on the existing alternative strategies, the expert will be involved to provide an assessment in the form of a pairwise comparison matrix using Saaty's Scale which has a value range of 1-9[9].

TOPSIS analysis needs to be applied to measure alternatives or indicators that are in accordance with the alternative criteria or strategies where it is strived to have the closest distance to the positive ideal solution and the farthest distance to the negative ideal solution[10]. Positive ideal solution states the greatest efficiency and smallest cost. The negative ideal solution states the smallest efficiency and the largest cost[11].

Each university needs to do a SWOT analysis to measure themselves and define relevant steps to support university development[12]. After knowing the existing SWOT indicators, each university needs to determine strategic alternatives and then measure the ability of each alternative strategy to be achieved by the indicator of each SWOT Factors[13]. As for measuring the weight of each alternative strategy, it can be done using a method that combines AHP and TOPSIS[14].

This study aims to propose a SWOT-AHP-TOPSIS model, so that it can help universities in determining which alternative strategic priorities will be chosen to be implemented in stages. The working method of this model is to first apply the Analytical Hierarchy Process (AHP) to obtain priority weights for each alternative for SO, WO, ST, and WT. Then the decision regarding which strategy to choose will be based on the TOPSIS method which is based on the choice on the closest distance to the Positive Ideal Solution and the farthest distance to the Negative Ideal Solution. The novelty of this research is that there is no research that directly discusses SWOT analysis in university development and also strategies based on the TOWS Analysis Matrix and each of these strategies will be determined which one is the priority.

## 2. RESEARCH METHOD

Model SWOT-AHP-TOPSIS For University Development Strategy will be proposed in this study.

### 2.1. Method

This model will be applied at Universitas IBBI to determine the most suitable university development strategy. The research stages can be seen in Figure 1.

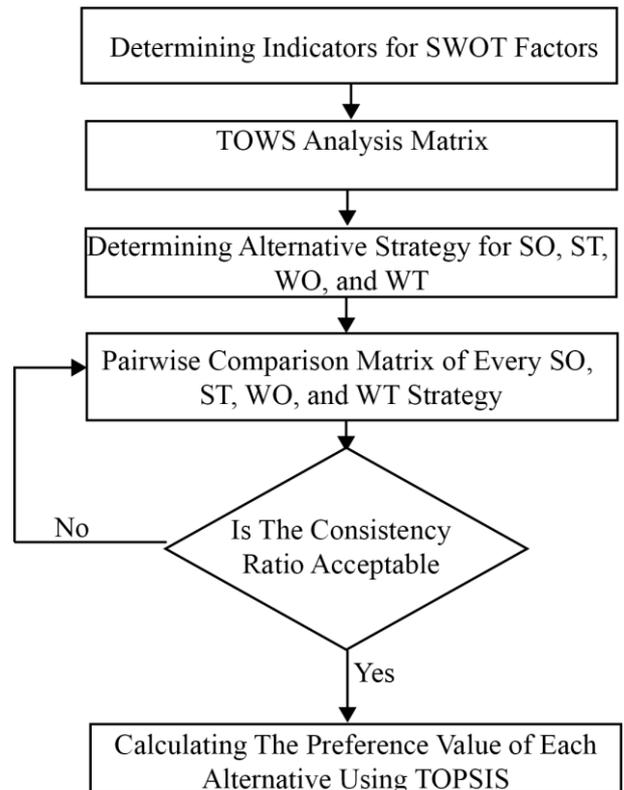


Figure 1. Research method

Based on Figure 1, it can be seen that the process begins with determining the indicators for the factors in SWOT, and then after obtaining the SWOT Factors, the process will continue with the formation of the TOWS Analysis Matrix. Based on the TOWS Analysis Matrix, strategies for SO, ST, WO, and WT will be obtained. After having strategies for SO, ST, WO, and WT, the next step is to form a pairwise comparison matrix for each strategy. Then after that, based on the pairwise comparison matrix, the weights for each TOWS strategy will be obtained using the AHP method. Then it will be determined which alternative strategy is the best using the TOPSIS method.

### 2.2. SWOT

SWOT analysis is basically carried out based on an analysis of internal factors and external factors. Internal factors consist of: Strengths and Weaknesses. The internal factors consist of: Opportunities and Threats. These factors can be seen in Figure 2[15]. This is an example of the equation.

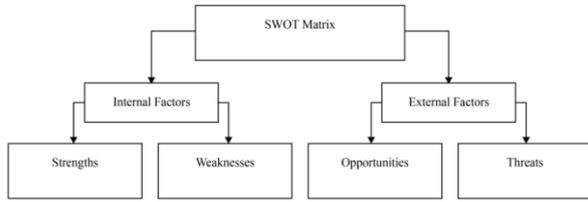


Figure 2. SWOT analysis

Finally, through the TOWS Analysis matrix, the four strategies (SO, ST, WO, and WT) can be obtained, as can be seen in Table 1[16].

Table 1. Tows analysis matrix

		Internal Factors	
		Strengths (S)	Weaknesses (W)
External Factors	Opportunities (O)	SO Strategy	WO Strategy
	Threats (T)	ST Strategy	WT Strategy

Based on Table I, it can be seen that each strategy can be explained as follows[17].

1. SO: The good use of opportunities through existing strengths.
2. ST: The good use of strengths to eliminate or reduce the impact of threats.
3. WO: Taking into account weaknesses to obtain the benefits of opportunities.
4. WT: Seeking to reduce the impact of threats by considering weaknesses.

### 2.3 AHP

The stages of the AHP method are as follows[3].

1. Form a pairwise comparison matrix

Pairwise comparison matrix can be seen in Equation 1.

$$A = (a_{ij})n \times n = \begin{bmatrix} 1 & \frac{W_1}{W_2} & \dots & \frac{W_1}{W_n} \\ \frac{W_2}{W_1} & 1 & \dots & \frac{W_2}{W_n} \\ \vdots & \vdots & \dots & \vdots \\ \frac{W_n}{W_1} & \frac{W_n}{W_2} & \dots & 1 \end{bmatrix} \quad (1)$$

2. Calculating the normalized element

The normalized element can be seen in Equation 2.

$$w_{ij} = \frac{a_{ij}}{\sum_{i=1}^n a_{ij}} \quad (2)$$

The weight of each element can be calculating using principal Eigen Vector that can be seen in Equation 3.

$$Weight\ of\ Alternative\ i = \frac{\sum_{j=1}^n w_{ij}}{n} \quad (3)$$

3. Calculating the  $\lambda_{max}$

$\lambda_{max}$  is the principal eigen value of the matrix X and can be calculated using Equation 4.

$$\lambda_{max} = \left[ \sum_{i=1}^n a_{i1} \dots \sum_{i=1}^n a_{in} \right] x \begin{bmatrix} e_1 \\ \vdots \\ e_n \end{bmatrix} \quad (4)$$

4. Calculating the Consistency Ratio

The process of calculating consistency ratio begin with determining the consistency index that can be calculating using Equation 5.

$$Consistency\ Index\ (CI) = \frac{(\lambda_{max} - n)}{(n - 1)} \quad (5)$$

And Consistency Ratio (CR) can be calculating using Equation 6.

$$Consistency\ Ratio\ (CR) = \frac{Consistency\ Index\ (CI)}{Random\ Index\ (RI)} \quad (6)$$

Random index can be calculating using Table II.

Table 2. Random index

n	RI
1	0.00
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

The consistency ratio is acceptable if less than 10% (0.1).

### 2.4 Topsis

The stages of the TOPSIS method are as follows[18].

1. Construct the normalized decision matrix

Normalized decision matrix can be determined using Equation 7.

$$X = \begin{pmatrix} x_{1,1} & x_{1,2} & \dots & x_{1,m} \\ x_{2,1} & x_{2,2} & \dots & x_{2,m} \\ \vdots & \vdots & \ddots & \vdots \\ x_{n,1} & x_{n,2} & \dots & x_{n,m} \end{pmatrix} \quad (7)$$

2. Calculating distance

Calculating distance according to column vector using the cosine distance measure that can be calculated using Equation 8.

$$Z_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^n x_{ij}^2}} \quad (8)$$

3. Identification the positive optimal solution  $Z^+$  and the negative worst solution  $Z^-$   
Positive optimal solution  $Z^+$  can be calculating using Equation 9.

$$Z^+ = \begin{pmatrix} \max(z_{1,1}, z_{2,1}, \dots, z_{n,1}) \\ \max(z_{1,2}, z_{2,2}, \dots, z_{n,2}) \\ \vdots \\ \max(z_{1,m}, z_{2,m}, \dots, z_{n,m}) \end{pmatrix} \quad (9)$$

and negative worst solution  $Z^-$  can be calculating using Equation 10.

$$Z^- = \begin{pmatrix} \min(z_{1,1}, z_{2,1}, \dots, z_{n,1}) \\ \min(z_{1,2}, z_{2,2}, \dots, z_{n,2}) \\ \vdots \\ \min(z_{1,m}, z_{2,m}, \dots, z_{n,m}) \end{pmatrix} \quad (10)$$

4. Calculating the separation distance  
The separation distance can be calculating using Equation 11 and 12.

$$D_i^+ = \sqrt{\sum_{j=1}^m w_j (Z_j^+ - z_{i,j})^2} \quad (11)$$

$$D_i^- = \sqrt{\sum_{j=1}^m w_j (Z_j^- - z_{i,j})^2} \quad (12)$$

5. Calculating the Relative Closeness Coefficient  
Relative Closeness Coefficient can be calculating using Equation 13.

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

This research will propose Model SWOT-AHP-TOPSIS For University Development Strategy.

### 3.1. Determining Indicators for SWOT Factors

The indicators of each SWOT factor are as follows.

1. Strengths  
Indicators for strengths as follows.
  - a. There is full support for educational foundations in university development (S1).
  - b. Operational networks and partnerships have been established, particularly with industry and high schools (S2).
  - c. Most of the human resources are still young with adequate quality (S3).
  - d. The university has been around for a long time and is well known to the public (S4).
2. Weaknesses  
Indicators for Weaknesses as follows.
  - a. The use of information technology is still inadequate (W1).
  - b. The existing cooperation is still not optimal (W2).
  - c. Funds for lecturers' further studies are still limited (W3).
3. Opportunities  
Indicators for opportunities as follows.
  - a. There are still many high school graduates (O1).
  - b. Universities can accommodate students who study while working (O2).
  - c. A network of partners who are willing to help develop the university (O3).
4. Threats  
Indicators for threats as follows.
  - a. Most of the lecturers are still young, so the opportunity to become civil servants is still open (T1).
  - b. State Universities open various admission classes for students with middle and upper economic abilities (T2).

### 3.2. TOWS Analysis Matrix

TOWS Analysis Matrix can be seen in Table III. Based on Table III, it can be seen that interacting external factors and internal factors will produce SO, WO, ST, and WT Strategy.

## 3. RESULT AND DISCUSSION

Table 3. TOWS Analysis matrix for the model

		Internal Factors	
		Strengths (S) (S1, S2, S3, S4)	Weaknesses (W) (W1, W2, W3)
External Factors	Opportunities (O) (O1, O2, O3)	SO Strategy	WO Strategy
	Threats (T) (T1, T2)	ST Strategy	WT Strategy

3.3 Determining Alternative Strategy for SO, ST, WO, and WT

Based on the TOWS Analysis Matrix, a number of alternative strategies that can be obtained are as follows.

1. SO Strategy

The SO Strategy obtained is as follows.

- a. Empowering apprenticeship programs and curriculum preparation by involving partners and stakeholders (A1).
- b. Involving lecturers in providing knowledge sharing to high school students (A2).

2. ST Strategy

The ST Strategy obtained is as follows.

- a. Providing scholarships for young lecturers to continue their education (A3).
- b. Universities need to budget more for promotional costs for print and electronic media (A4).

3. WO Strategy

The WO Strategy obtained is as follows.

- a. Exploring cooperation opportunities with partners through career development and student entrepreneurship efforts (A5).
- b. Increasing the use of information technology and social media as promotional media for high school students (A6).

4. WT Strategy

The WT Strategy obtained is as follows.

- a. Cooperating with similar study programs with both public and private universities (A7).
- b. Providing further study funds for young lecturers (A8).

3.4 Pairwise Comparison Matrix for Every SO, ST, WO, and WT Alternative Strategy

Pairwise Comparison Matrix for SO, ST, WO, and WT can be seen in Table 4.

Table 4. Expert Opinion

	A1	A2	A3	A4	A5	A6	A7	A8
A1	1	2	2	1/2	1/2	2	3	2
A2	1/2	1	2	1/2	1/2	1	2	1
A3	1/2	1/2	1	1	1/3	1	2	1/2
A4	2	2	1	1	1	3	4	2
A5	2	2	3	1	1	3	4	3
A6	1/2	1	1	1/3	1/3	1	2	1
A7	1/3	1/2	1/2	1/4	1/4	1/2	1	1/2
A8	1/2	1	2	1/2	1/3	1	2	1

Based on Table IV, calculating normalized element using Equation 2 as follows.

$$\left( \begin{aligned}
 w_1 &= \frac{0.13 + 0.2 + 0.16 + 0.1 + 0.12 + 0.16 + 0.15 + 0.18}{8} = 0.15 \\
 w_2 &= \frac{0.08 + 0.1 + 0.16 + 0.1 + 0.12 + 0.08 + 0.1 + 0.09}{8} = 0.1 \\
 w_3 &= \frac{0.07 + 0.05 + 0.08 + 0.2 + 0.07 + 0.08 + 0.1 + 0.04}{8} = 0.09 \\
 w_4 &= \frac{0.26 + 0.2 + 0.08 + 0.2 + 0.24 + 0.24 + 0.2 + 0.18}{8} = 0.2 \\
 w_5 &= \frac{0.26 + 0.2 + 0.24 + 0.2 + 0.24 + 0.24 + 0.2 + 0.27}{8} = 0.23 \\
 w_6 &= \frac{0.07 + 0.1 + 0.08 + 0.06 + 0.07 + 0.08 + 0.1 + 0.09}{8} = 0.08 \\
 w_7 &= \frac{0.05 + 0.05 + 0.04 + 0.05 + 0.06 + 0.04 + 0.05 + 0.04}{8} = 0.05 \\
 w_8 &= \frac{0.07 + 0.1 + 0.16 + 0.1 + 0.07 + 0.08 + 0.1 + 0.09}{8} = 0.09
 \end{aligned} \right)$$

For calculating the weight of alternative can be using Equation 3 as follows.

$$\left( \begin{aligned}
 w_1 &= \frac{0.13 + 0.2 + 0.16 + 0.1 + 0.12 + 0.16 + 0.15 + 0.18}{8} = 0.15 \\
 w_2 &= \frac{0.08 + 0.1 + 0.16 + 0.1 + 0.12 + 0.08 + 0.1 + 0.09}{8} = 0.1 \\
 w_3 &= \frac{0.07 + 0.05 + 0.08 + 0.2 + 0.07 + 0.08 + 0.1 + 0.04}{8} = 0.09 \\
 w_4 &= \frac{0.26 + 0.2 + 0.08 + 0.2 + 0.24 + 0.24 + 0.2 + 0.18}{8} = 0.2 \\
 w_5 &= \frac{0.26 + 0.2 + 0.24 + 0.2 + 0.24 + 0.24 + 0.2 + 0.27}{8} = 0.23 \\
 w_6 &= \frac{0.07 + 0.1 + 0.08 + 0.06 + 0.07 + 0.08 + 0.1 + 0.09}{8} = 0.08 \\
 w_7 &= \frac{0.05 + 0.05 + 0.04 + 0.05 + 0.06 + 0.04 + 0.05 + 0.04}{8} = 0.05 \\
 w_8 &= \frac{0.07 + 0.1 + 0.16 + 0.1 + 0.07 + 0.08 + 0.1 + 0.09}{8} = 0.09
 \end{aligned} \right)$$

The consistency ratio according to Equation 4-6 can be assuming in the acceptable range.

3.5 Normalized Decision Matrix of each to Equation 4-6 can be assuming in the acceptable range

Assuming that expert giving an assessment for each SWOT factors in every alternative strategy as in Table V.

Table 5. Expert opinion for each SWOT factors in alternative strategy

	A1	A2	A3	A4	A5	A6	A7	A8
S1	4	4	5	4	3	3	5	4
S2	5	4	4	4	5	4	3	4
S3	2	2	3	3	3	4	3	4
S4	4	5	2	3	4	3	4	5
W1	3	2	3	2	3	4	3	3
W2	2	3	4	3	2	3	4	3
W3	3	4	2	3	3	2	3	2
O1	3	4	5	3	4	5	3	4
O2	4	2	3	4	3	5	4	4
O3	3	4	5	4	3	4	4	5
T1	2	3	2	3	3	2	3	2
T2	3	3	3	3	2	3	3	4

And the normalized decision matrix for each alternative can be calculated as follows.

$$A1 = \frac{4}{\sqrt{4^2 + 5^2 + 2^2 + 4^2 + 3^2 + 2^2 + 3^2 + 4^2 + 3^2 + 2^2 + 3^2}} = \frac{4}{\sqrt{130}} = 11.4$$

$$p_{11} = \frac{4}{11.4} = 0.35$$

$$p_{21} = \frac{5}{11.4} = 0.44$$

$$p_{31} = \frac{2}{11.4} = 0.18$$

$$p_{41} = \frac{4}{11.4} = 0.35$$

$$p_{51} = \frac{3}{11.4} = 0.26$$

$$p_{61} = \frac{4}{11.4} = 0.18$$

$$p_{71} = \frac{3}{11.4} = 0.26$$

$$p_{81} = \frac{3}{11.4} = 0.26$$

$$p_{91} = \frac{4}{11.4} = 0.35$$

$$p_{101} = \frac{3}{11.4} = 0.26$$

$$p_{111} = \frac{2}{11.4} = 0.18$$

$$p_{121} = \frac{3}{11.4} = 0.26$$

The same process can be done for A2 until A8, so we can obtain the normalized decision matrix as follows

$$X = \begin{pmatrix} 0.35 & 0.33 & 0.4 & 0.35 & 0.27 & 0.24 & 0.41 & 0.31 \\ 0.44 & 0.33 & 0.32 & 0.35 & 0.44 & 0.32 & 0.24 & 0.31 \\ 0.18 & 0.16 & 0.24 & 0.26 & 0.27 & 0.32 & 0.24 & 0.31 \\ 0.35 & 0.42 & 0.16 & 0.26 & 0.35 & 0.24 & 0.32 & 0.38 \\ 0.26 & 0.16 & 0.24 & 0.17 & 0.27 & 0.32 & 0.24 & 0.23 \\ 0.18 & 0.25 & 0.32 & 0.26 & 0.18 & 0.24 & 0.32 & 0.23 \\ 0.26 & 0.33 & 0.16 & 0.26 & 0.27 & 0.16 & 0.24 & 0.15 \\ 0.26 & 0.33 & 0.4 & 0.26 & 0.35 & 0.39 & 0.24 & 0.31 \\ 0.35 & 0.16 & 0.24 & 0.35 & 0.27 & 0.39 & 0.32 & 0.31 \\ 0.26 & 0.33 & 0.4 & 0.35 & 0.27 & 0.32 & 0.32 & 0.38 \\ 0.18 & 0.25 & 0.16 & 0.26 & 0.27 & 0.16 & 0.24 & 0.15 \\ 0.26 & 0.25 & 0.24 & 0.26 & 0.18 & 0.24 & 0.24 & 0.31 \end{pmatrix}$$

### 3.6 Determining the weight of normalized decision matrix

The weight of normalized decision matrix can be calculated as follows.

1. The weight of normalized decision matrix for Alternative Strategy 1 (A1)

$$U_{11} = 0.15 * 0.35 = 0.053$$

$$U_{21} = 0.15 * 0.44 = 0.066$$

$$U_{31} = 0.15 * 0.18 = 0.027$$

$$U_{41} = 0.15 * 0.35 = 0.053$$

$$U_{51} = 0.15 * 0.26 = 0.039$$

$$U_{61} = 0.15 * 0.18 = 0.027$$

$$U_{71} = 0.15 * 0.26 = 0.039$$

$$U_{81} = 0.15 * 0.26 = 0.039$$

$$U_{91} = 0.15 * 0.35 = 0.053$$

$$U_{101} = 0.15 * 0.26 = 0.039$$

$$U_{111} = 0.15 * 0.18 = 0.027$$

$$U_{121} = 0.15 * 0.26 = 0.039$$

2. The weight of normalized decision matrix for Alternative Strategy 2 (A2) until A8

The same calculation can be done for A2 until A8

3. The matrix that contain the weight of normalized decision matrix as follows.

$$U = \begin{pmatrix} 0.053 & 0.033 & 0.036 & 0.070 & 0.062 & 0.019 & 0.021 & 0.028 \\ 0.066 & 0.033 & 0.029 & 0.070 & 0.101 & 0.026 & 0.012 & 0.028 \\ 0.027 & 0.016 & 0.022 & 0.052 & 0.062 & 0.026 & 0.012 & 0.028 \\ 0.053 & 0.042 & 0.015 & 0.052 & 0.081 & 0.019 & 0.016 & 0.034 \\ 0.039 & 0.016 & 0.022 & 0.034 & 0.062 & 0.026 & 0.012 & 0.021 \\ 0.027 & 0.025 & 0.029 & 0.052 & 0.041 & 0.019 & 0.016 & 0.021 \\ 0.039 & 0.033 & 0.014 & 0.052 & 0.062 & 0.013 & 0.012 & 0.014 \\ 0.039 & 0.033 & 0.036 & 0.052 & 0.081 & 0.031 & 0.012 & 0.028 \\ 0.053 & 0.016 & 0.022 & 0.070 & 0.062 & 0.031 & 0.016 & 0.028 \\ 0.039 & 0.033 & 0.036 & 0.070 & 0.062 & 0.026 & 0.016 & 0.034 \\ 0.027 & 0.025 & 0.014 & 0.052 & 0.062 & 0.013 & 0.012 & 0.014 \\ 0.0390001 & 0.025 & 0.022 & 0.052 & 0.041 & 0.019 & 0.012 & 0.028 \end{pmatrix}$$

4. Calculating the positive optimal solution for each Alternative strategy as follows.

$$Z_1^+ = \max\{0.053; 0.066; 0.027; 0.053; 0.039; 0.027; 0.039; 0.039; 0.053; 0.039; 0.027\} = 0.066$$

The same process can be done for  $Z_2^+$  until  $Z_8^+$  so we can obtain as follows.

$$Z_2^+ = 0.042$$

$$Z_3^+ = 0.036$$

$$Z_4^+ = 0.07$$

$$Z_5^+ = 0.101$$

$$Z_6^+ = 0.031$$

$$Z_7^+ = 0.021$$

$$Z_8^+ = 0.034$$

5. Calculating the negative worst solution for each alternative strategy as follows.

$$Z_1^- = \min\{0.053; 0.066; 0.027; 0.053; 0.039; 0.027; 0.039; 0.039; 0.053; 0.039; 0.027\} = 0.027$$

The same process can be done for  $Z_2^-$  until  $Z_8^-$  so we can obtain as follows.

$$\begin{aligned} Z_2^- &= 0.016 \\ Z_3^- &= 0.014 \\ Z_4^- &= 0.034 \\ Z_5^- &= 0.041 \\ Z_6^- &= 0.013 \\ Z_7^- &= 0.012 \\ Z_8^- &= 0.014 \end{aligned}$$

6. Calculating the separation distance of each SWOT Factors to the alternative strategy as follows.

$$\begin{aligned} D_1^+ &= \sqrt{(0.053 - 0.066)^2 + (0.033 - 0.042)^2 + (0.036 - 0.036)^2} \\ &+ \sqrt{(0.070 - 0.07)^2 + (0.062 - 0.101)^2 + (0.019 - 0.031)^2} \\ &+ \sqrt{(0.021 - 0.021)^2 + (0.028 - 0.034)^2} \\ &= 0.044 \end{aligned}$$

$D_2^+$  until  $D_{12}^+$  can be calculating using the same process. So we can obtain as follows.

$$\begin{aligned} D_2^+ &= 0.016 \\ D_3^+ &= 0.066 \\ D_4^+ &= 0.039 \\ D_5^+ &= 0.069 \\ D_6^+ &= 0.079 \\ D_7^+ &= 0.063 \\ D_8^+ &= 0.282 \\ D_9^+ &= 0.284 \\ D_{10}^+ &= 0.234 \\ D_{11}^+ &= 0.07 \\ D_{12}^+ &= 0.074 \end{aligned}$$

$$\begin{aligned} D_1^- &= \sqrt{(0.053 - 0.027)^2 + (0.033 - 0.016)^2 + (0.036 - 0.014)^2} \\ &+ \sqrt{(0.070 - 0.034)^2 + (0.062 - 0.041)^2 + (0.019 - 0.013)^2} \\ &+ \sqrt{(0.021 - 0.012)^2 + (0.028 - 0.014)^2} \\ &= 0.059 \end{aligned}$$

$D_2^-$  until  $D_{12}^-$  can be calculating using the same process. So we can obtain as follows.

$$\begin{aligned} D_2^- &= 0.085 \\ D_3^- &= 0.035 \\ D_4^- &= 0.061 \\ D_5^- &= 0.029 \\ D_6^- &= 0.034 \\ D_7^- &= 0.035 \\ D_8^- &= 0.3 \\ D_9^- &= 0.3 \\ D_{10}^- &= 0.25 \\ D_{11}^- &= 0.029 \\ D_{12}^- &= 0.029 \end{aligned}$$

7. Calculating the preference value  
The preference value can be calculating using Relative Closeness Coefficient as follows.

$$\begin{aligned} RCC_1(S1) &= \frac{D_1^-}{D_1^- + D_1^+} = \frac{0.059}{0.059 + 0.044} = 0.57 \\ RCC_2(S2) &= \frac{D_2^-}{D_2^- + D_2^+} = \frac{0.085}{0.085 + 0.0216} = 0.79 \\ RCC_3(S3) &= \frac{D_3^-}{D_3^- + D_3^+} = \frac{0.035}{0.035 + 0.066} = 0.35 \\ RCC_4(S4) &= \frac{D_4^-}{D_4^- + D_4^+} = \frac{0.061}{0.061 + 0.039} = 0.61 \\ RCC_5(W1) &= \frac{D_5^-}{D_5^- + D_5^+} = \frac{0.029}{0.029 + 0.069} = 0.3 \\ RCC_6(W2) &= \frac{D_6^-}{D_6^- + D_6^+} = \frac{0.034}{0.034 + 0.079} = 0.31 \\ RCC_7(W3) &= \frac{D_7^-}{D_7^- + D_7^+} = \frac{0.035}{0.035 + 0.063} = 0.36 \\ RCC_8(O1) &= \frac{D_8^-}{D_8^- + D_8^+} = \frac{0.3}{0.3 + 0.282} = 0.52 \\ RCC_9(O2) &= \frac{D_9^-}{D_9^- + D_9^+} = \frac{0.3}{0.3 + 0.284} = 0.51 \\ RCC_{10}(O3) &= \frac{D_{10}^-}{D_{10}^- + D_{10}^+} = \frac{0.25}{0.25 + 0.234} = 0.52 \\ RCC_{11}(T1) &= \frac{D_{11}^-}{D_{11}^- + D_{11}^+} = \frac{0.029}{0.029 + 0.07} = 0.29 \\ RCC_{12}(T2) &= \frac{D_{12}^-}{D_{12}^- + D_{12}^+} = \frac{0.029}{0.029 + 0.074} = 0.28 \end{aligned}$$

According to Relative Closenes Coefficient the  $RCC_2$  (S2) is the best SWOT Factors for be noticed in University Development.

### 3.7 Discussion

Based on the model designed, it can be concluded that the proposed model can put forward the SWOT factor which affects the development of the university. Meanwhile, through the existing SWOT factors, alternative strategies for SO, ST, WO, and WT can be determined. The sequence of SWOT factors in order that affect the alternative strategy is as follows.

$$S2 > S4 > S1 > O3 > O1 > O2 > W3 > S3 > W2 > W1 > T1 > T2$$

Based on the results obtained, it can be stated that it is in accordance with the actual reality.

## 4. CONCLUSION

Based on the research results, it can be found that the proposed model has been able to provide good results of the SWOT analysis which is equipped with the factors in the SWOT analysis that most influence the achievement of the university's development strategy. It can be seen that the AHP method can determine the weight of each alternative strategy well and the TOPSIS method can

determine which factors most influence the achievement of a university development strategy based on positive optimal solutions and negative worst solutions. Further research, it is hoped that it can receive input from experts in the form of linguistic variables so that it will make it easier to provide assessments.

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