YPBM University Tourism Building Location Selection with a Combination of Cut off Point and AHP Topsis Method

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YPBM UNIVERSITY TOURISM BUILDING LOCATION SELECTION WITH A COMBINATION OF CUT OFF POINT AND AHP TOPSIS METHOD

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ABSTRACT

YPBM University is a private high educational institution located both in Jakarta and Serpong, Tangerang. Currently, the University is planning to establish a new campus devoted to hospitality and hotelier majors. The objective of this research is to analyze the determination of the location decided to build the new campus to make sure that the decision is improve. Criteria selection was conducted by using cut off point method, meanwhile alternative location selection evaluation was conducted by using AHP and TOPSIS methods. The valuation was conducted by Board of Directors, Rector, Vice Rector, Rectorate Daily Executor, and a number of directors. Cut off point calculation produced 5 (five) highest criteria namely accessibility, environment, expansion, competition, and building cost. AHP TOPSIS measurement result produced an alternative location preferences namely Batam with a value of 0.6047, Yogyakarta with a value of 0.4453, and Bali with a value of 0.3667. Based on that, the recommended location is in Batam City with the highest preference value.

Keywords: decision analysis, location selection, cut off point, AHP, Topsis.

Introduction

YPBM University is a private high educational institution located both in Jakarta and Serpong, Tangerang. Currently, the University is planning to establish a new campus devoted to hospitality and hotelier majors. The decision to open a new campus is intended to attract more potential students who want to learn things related to tourism and hospitality. Location selection is intended to avoid negative impacts as much as possible and to achieve location with the highest positive impact. A location is a key factor that would determine the sustainability of a company in a long-term. By choosing a strategic location, Means that the investment and operational costs will be minimized in the long-term and short-term, and will increase the level of competitiveness in company [1].

The objective of this research is to determine the most strategic location to build new campus for YPBM University. The construction of a building with the wrong location will cause several problems, such as less developed business, low interests of prospective students which leads to inability to achieve the predetermined target. Therefore, it is important to determine an accurate location taking into account these factors. According to [2] several factors that determines location decision for a business unit are: access, traffic, parking space, visibility, expansion, environment, competition, government regulation, customer location, source of materials, source of labor, water, transportation, electricity, industrial waste disposal, employee, and factory facility. Based on a research by [3], location determination is taken based on several criteria, one of them is the most efficient cost level to build the facility.

The determination of location decision in this research is implemented by using Cut Off Point, AHP and TOPSIS methods. On Cut Off Point, the questionnaires that filled with several criteria are distributed to a number of respondents to filter and obtain the required determining criteria [4]. From several criteria mentioned in the previous researches, there are several usable criteria as references on YPBM University new campus location determination. These criteria is summarized by using Cut Off Point method. AHP is one of the best way to produce a decision on a complex criteria structure in various levels [5]. AHP is a method to solve a complex multi-criteria problem into a hierarchical form [6], [7], [8]. AHP method cannot be effectively used when there is a lot of criteria and alternative method. To handle the weakness, another type of decision making method such as TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) is

required [9]. AHP method is used to put value on every criteria and test their consistency, because AHP is fitted with eigen vector which is utilized to prioritize every criteria based on their location determination criteria values namely accessibility, visibility, expansion, environment, competition, and government regulation, meanwhile TOPSIS method is used to sort the location decision result. The concept of TOPSIS method is to choose the closest alternative to positive ideal solution, and the furthest alternative to negative ideal solution [11].

Research Methodology

This research is divided into four main stages which are criteria and alternative identification, criteria determination with Cut Off Point method, and decision alternative evaluation with Fuzzy AHP TOPSIS and Priority Analysis methods. The research methodology flow diagram is pictured in the following Figure 1.
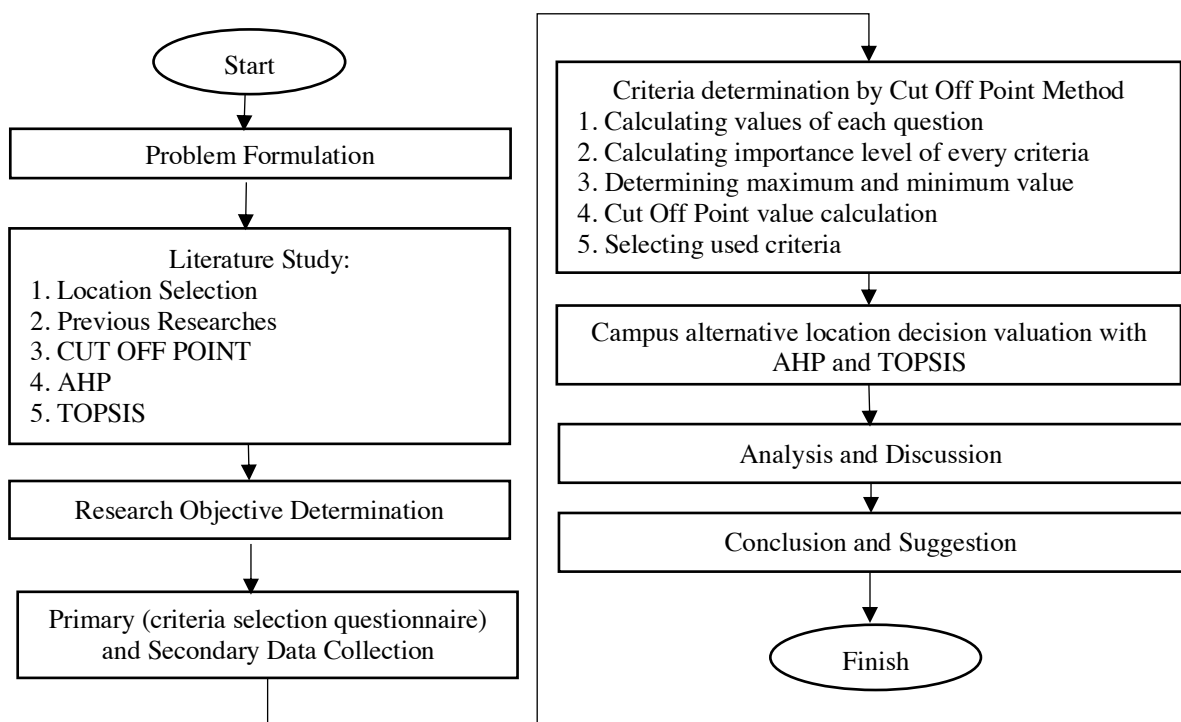

Figure 1. Research Methodology

Cut Off Point method is utilized to ensure requirement level of certain criteria. Questionnaire filled with numbers of criteria are distributed to every determined respondent. Important element are given a score of 3 points, medium 2 points, and less important is 1 point [12].

The steps of AHP method application are [9]:
1. Defining the problem and constructing a hierarchical structure
2. Evaluating the criteria and alternatives using a scale of 1-9.
3. Determine the priority weight or eigen vector value for each element.
4. Determine logical consistency by calculating the Consistency Index and Consistency Ratio values. CR <0.1 indicates consistency.

The next step is to determine the value of each criteria, and produce a normalized decision. After that, we determine the alternative range and the preference value of each alternative [13].

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Performance rank of each alternative can be measured by using formula 1 [13].

$$Rij = \frac{xij}{\sqrt{\sum_{i}^{m}=1 x^2 ij}} \qquad (1)$$

Building positive A+ and negative A- matrix solutions with normalized rank value by using formula 2 [13].

$$y_{ij} = W_{ij} r_{ij} \qquad (2)$$

Identifying positive and negative ideal solutions can be conducted by using formula 3 and 4 [13].

$$A^+ = y_1^+ , \ y_2^+ , \dots, y_n^+ \qquad (3)$$
$$A^- = y_1^- , \ y_2^- , \dots, y_n^- \qquad (4)$$

The distance with positive ideal solution can be measured by using formula 5 [13].

$$D_i^+ = \sqrt{\sum_{j=1}^{n} (y_j^+ - y_{ij})^2} \qquad (5)$$

The distance with negative ideal solution can be measured by using formula 5 [13].

$$D_i^- = \sqrt{\sum_{j=1}^{n}(y_j^- - y_{ij})^2} \qquad (6)$$

The preference value of each alternative is measured by using formula 7 [13].

$$V_i = \frac{D_i^-}{D_i^- + D_i^+} \qquad (7)$$

This research was conducted in YPBM University, Northern Jakarta through interview and questionnaire distribution to a number of parties such as Board of Directors, Rector, Vice Rector, Rectorate Daily Executor, and a number of directors. Besides that, we also conducted observation and evaluation on locations used as alternative.

Results and Discussion
Criteria Determination with Cut Off Point Method
The location of YPBM University new branch is determined by using a number of criteria which is placed in the questionnaire such as building cost (BC), facility (FC), Accessibility (AS), Visibility (VS), Expansion (EX), Environment (EN), Competitor (CP), and Government Regulation (GR). These criteria were chosen based on references taken from a number of literatures regarding location selection and also a product of brainstorming effort performed by a number of Deans and Directors in YPBM University. The pre-determined alternative of locations were Batam, Yogyakarta, and Bali. However, not every criteria are usable to help determine the location. Selection of factors importance were obtained from questionnaire results, including factors obtained from problem analysis and requirements [14].
After obtaining questionnaire result from all respondents, every criteria were sorted from the highest to the lowest, to obtain the average importance level of every existing element. The obtained results were processed with Cut Off Point method. The average importance level analysis result can be seen in the following Table 1.

$$HM = (7 \times 3)+(2 \times 2) + (1 \times 1) = 26$$
$$Mean = 26 / 10 = 2{,}6$$

Table 1. The Average Factors Importance Level

No	Factors	Very Important	Important	Less Important	Respondents	Total	Average
1	**AS**	**7**	**2**	**1**	**10**	**26**	**2.6**
2	VS	3	5	2	10	21	2.1
3	GR	5	3	2	10	23	2.3
4	**EN**	**8**	**2**	**0**	**10**	**28**	**2.8**
5	**EX**	**7**	**2**	**1**	**10**	**26**	**2.6**
6	**CP**	**6**	**4**	**0**	**10**	**26**	**2.6**
7	**BC**	**10**	**0**	**0**	**10**	**30**	**3**
8	FC	3	5	2	10	21	2.1

Criteria factors that possess value under the Cut Off Point, will not be included in AHP method calculation. Based on the analysis result in Table 1, the maximum average score is 3, meanwhile the minimum average score is 2.1. Based on that, the natural Cut Off Point value is as follows:

$$NCOP = (Max.Score + Min.Score)/2$$
Cut-off point $= (3 + 2{,}1) / 2 = 2{,}55$

Based on that, the criteria with average score under 2.55 will not be used in AHP method calculation. Meanwhile the criteria that passess Cut Off Point calculation that can be continued to be utilized in AHP method calculation are accessibility, environment, expansion, competitor, and building cost. The selected alternatives are Batam, Yogyakarta, and Bali.

The Evaluation of Criteria and Alternatives with AHP-TOPSIS Methods

Decision making on predetermined alternatives by using AHP method was conducted through questionnaire distribution to obtain priority levels of each criteria. Table 2 shows the questionnaire result levelling with Geometric Mean.

Table 2. Questionnaire Levelling Results

No	Criteria	Expert					Geomean	Criteria
		1	2	3	4	5		
1	AS	5	0,1429	0,3333	5	0,3333	0,8312	LK
2	AS	3	5	5	7	2	4,0201	EK
3	AS	0,3333	0,3333	0,1429	0,3333	0,2	0,2540	PC
4	AS	0,125	0,1111	0,1111	0,1429	0,1111	0,1196	BP
5	EN	3	3	3	3	1	2,4082	EK
6	EN	0,3333	0,3333	3	5	0,2	0,8027	PC
7	EN	0,125	0,2	0,3333	0,14286	0,1429	0,1762	BP
8	EX	0,1429	3	0,2	0,2	3	0,5524	PC
9	EX	0,2	0,1111	0,1429	0,1111	0,125	0,1345	BP
10	CP	0,3333	0,1429	3	0,2	0,1111	0,3165	BP

The consistency ratio calculation result shows a value of less than 0.1 (0.0892) which means that the calculation can be continued. Figure 3 shows the resulted hierarchical structure of alternative values calculation on each criteria.
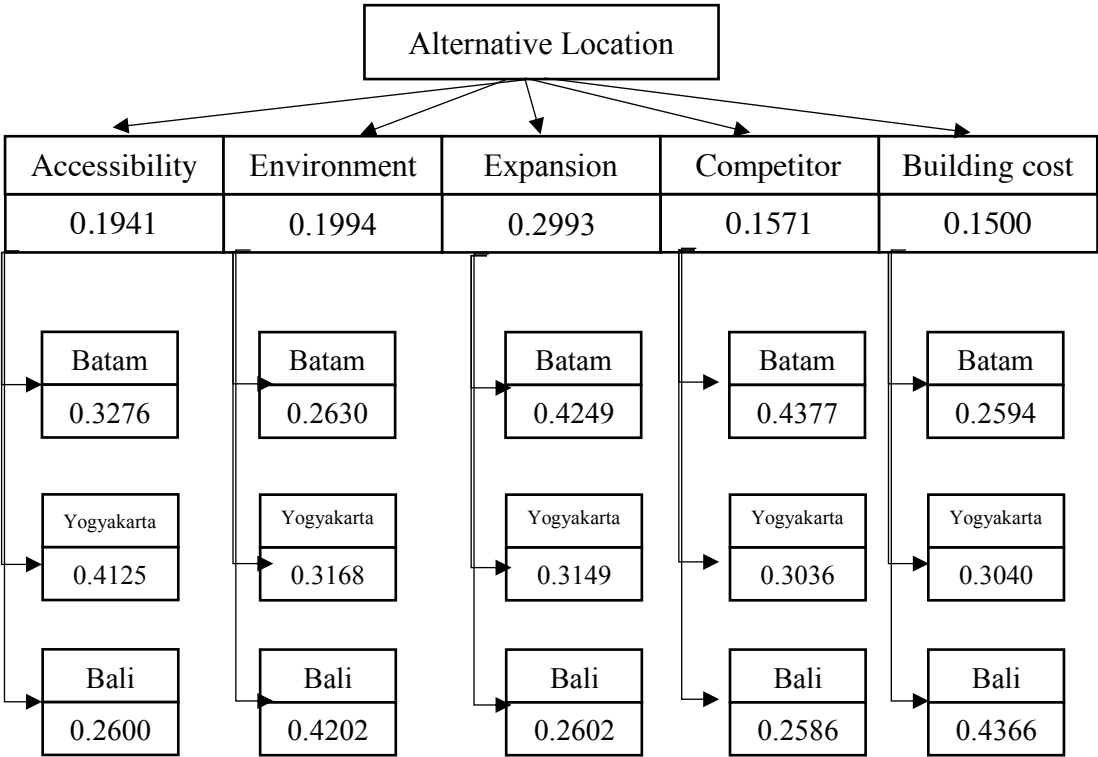

Figure 3. Hierarchical Structure of Alternative Values for All Criteria

The last step is to conduct alternative location ranking based on normalized eigen vector. The following values are obtained from eigen vector calculation as previously mentioned. Based on the calculation, Batam City produces the highest value of 0.3509 compared to the other alternatives which are Yogyakarta (0.3308) and Bali (0.3183).

After using AHP method, we obtain the value of all criteria, which further analyzed with TOPSIS method by producing alternative compatibility ranking of the alternatives against the criteria. The criteria valuation is sorted from lowest (1), low (2), medium (3), high (4) and highest (5). The following Table 3 shows tha alternative compatibility ranking against the criteria.

Table 3. Alternative Compatibility Ranking Against Criteria

Alternative	Criteria				
	AS	EN	EX	CP	BC
Batam	3	2	5	5	2
Yogyakarta	4	3	3	3	3
Bali	2	4	2	2	5

After producing compatibility rank, the next step is to calculate r_{ij} and to produce normalized decision matrix with the following formula 1.

$$r_{11} = \frac{3}{\sqrt{3^2+4^2+2^2}} = 0,5570$$

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Normalized decision matrix:

$$R = \begin{matrix} 0.5570 & 0.3713 & 0.8111 & 0.8111 & 0.3244 \\ 0.7427 & 0.5570 & 0.4866 & 0.4866 & 0.4866 \\ 0.3713 & 0.7427 & 0.3244 & 0.3244 & 0.8111 \end{matrix}$$

The calculated normalized decision matrix values (Y), are calculated by multiplying normalized decision matrix (R) with the predetermined values of each criteria (W) = 0.1941 ; 0.1994 ; 0.2993 ; 0.1571 ; 0.1500 with the following formula 2.

$$Y = \begin{matrix} 0,7509 & 0,5142 & 1,6857 & 0,8851 & 0,3380 \\ 1,0012 & 0,7714 & 1,0113 & 0,5310 & 0,5070 \\ 0,5005 & 1,0286 & 0,6742 & 0,3540 & 0,8451 \end{matrix}$$

Table 4. Distance between Alternative Value to Ideal Solution Alternatives

	Positive Ideal Solution Distance		Negative Ideal Solution Distance	
Batam	D1	0,7645	D1	1,1695
Yogyakarta	D2	0,8722	D2	0,7002
Bali	D3	1,2473	D3	0,7223

After obtaining the distance value of ideal solution alternative as illustrated in Table 4 by using Formula 5 and 6, we can use formula 7 to determine which alternative will be chosen as the final decision.

Based on the alternative preference value calculation to determine the location of new campus for YPBM University, we obtained the location with the highest value which is Batam City with a value of 0.6047, followed by Yogyakarta with a value of 0.4453 and Bali with a value of 0.3667. The highest preference value determines the chosen alternative location which is Batam.

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