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A HYBRID Approach in Determining Location of Stand Establishment at Batik Hatta Semarang

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Abstrak

Kota Semarang merupakan salah satu tempat dimana terdapat berbagai jenis usaha. Salah satunya adalah Butik Batik Hatta, sebuah usaha kecil menengah binaan Bank Jateng yang bergelut secara spesifik dalam dunia kesenian batik. Usaha ini mengembangkan dan mempertahankan eksistensinya dengan cara mengikuti berbagai pameran di beberapa pusat perbelanjaan sebagai media promosi produk. Untuk meminimalisir terjadinya kerugian, maka dibutuhkan perhitungan yang akurat dalam menghasilkan keputusan penentuan pendirian lokasi stand ditinjau dari segi biaya sewa, lokasi, tata letak, laba,dan keamanan. Namun penghitungan tersebut masih dilakukan secara manual sehingga dianggap tidak efisien waktu serta rentan terhadap kekeliruan. Sehingga dibuatlah suatu Sistem Pendukung Keputusan (SPK) untuk membantu mendapatkan rekomendasi lokasi pendirian stand terbaik pada Butik Batik Hatta. Metode yang digunakan dalam penelitian ini adalah Metode HYBRID MCDM AHP-TOPSIS. Penelitian ini telah melalui proses validasi menggunakan perbandingan data actual dan diperoleh nilai sebesar 0.90 pada Koefisien Korelasi Spearman. Berdasarkan hasil tersebut, metode HYBRID MCDM AHP-TOPSIS dapat digunakan dalam menentukan lokasi pendirian stand pada Butik Batik Hatta.

Kata kunci*— HYBRID, AHP, TOPSIS, SPK, Lokasi Pendirian Stand*

Abstract

Semarang has various types of business. One of them is Batik Hatta Boutique, a small and medium business under the guidance of the Bank of Central Java that deals specifically in the world of batik art. This business develops and maintains its existence by participating in various exhibitions in several shopping centers as a media product promotion. To minimize losses, it needs accurate calculation in making decision of determining the location of establishment. It is reviewed by rental cost, location, layout, profit, and security. However, that calculation is still manual so it is inefficient and susceptible to error. Therefore, Decision Support System (DSS) is made to help in getting recommended location of best establishment at the Butik Batik Hatta. The method used in this research is the HYBRID MCDM AHP-TOPSIS Method. Validation process of this research has been done by using comparison of actual data and its result is 0.90 in the Sparman Correlation Coefficient. The conclusion is that the AHP-TOPSIS HYBRID MCDM method can be used in determining the location of establishment stand at the Batik Hatta Boutique.

Keywords— *HYBRID, AHP, TOPSIS, DSS, Location of Stand Establishment*

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1. INTRODUCTION

Batik is a typical art that is very closely related to the valuable cultural values of Indonesian [1]. Batik has existed since the beginning of the 19th century which is still growing and has been known on the international scene, and it has officially held the title Masterpieces of the Oral and Intangible Heritage of Humanity by UNESCO in 2009 [2].

One of the businesses that are focusing on batik craft is Batik Hatta Boutique, an UKM fostered by the Bank of Central Java, located in Semarang. The problems that often faced by batik crafts in Semarang are the whereabouts of the unknown batik as well as marketing constraints. To develop and maintain this business, Batik Hatta Boutique certainly needs media or intermediaries to market its various products. One of them is taking part in exhibitions at various events which is held by several Malls in Semarang. Many competitors are also become part of the exhibitors, and among competitors must be scramble to get the location of the establishment which can support their profits and minimize their losses.

During this time, the election of business location is still one of important decision. It is classified as a long-term decision for a company, because it can determine success and failure of a business in the future [3]. So this company requires various considerations in determining the location to set up an exhibition stand. This becames a problem and triggering Batik Hatta Boutique to determine the best location to set up an exhibition stand by selecting strictly and accurately at several locations. It is still done manually and requires observation that must be done regularly besides it will take a long time. Some decision-makers have many roles in conducting this research. It will become increasingly difficult because every decision-maker has different criterias and alternatives. Thus, from various observations and deliberation, accurate criterias have been obtained to determine location of stand establishment at Batik Hatta Boutique, namely rental costs, location, layout, profit, and security.

This research is focuses on Decision Support System in Determining Location of Stand Establishment at Batik Hatta Boutique. To get an accurate decision, the researcher used the HYBRID MCDM AHP-TOPSIS crossing method. AHP Method used by A. Gnanavelbabu and P. Arunagiri [4] that produces a waiting time as the final result with a value 0.3083, and the other research was done by Hillerman et al [5] produces the most important characteristic, the provider billing characteristics, with a value of 0.614. For TOPSIS Method used by Wang et al [6] produces that 12 symbiotic technologies are selected to apply in the case iron and steel enterprise under 3 types of preferences, and research was done by Kannan et al [7] obtained that L9 was chosen as selected method.

Other SPK methods used in research such as [8] which used the ARAS method for Digital Supply Chain (DSC) , and COPRAS in [9] for Selection of Mango Seeds. As previous researchers who used the comparison of the HYBRID method between AHP-TOPSIS by Iswari et al who obtained 91% using Hamming Distance Incompatibility in The implementation of the AHP-TOPSIS method in the selection of outstanding students [10] , Pirnanda et al [11] which uses 5 respondents and produces the highest value of 0.90 in the third respondent, Muhsen et al [12] Which results in energy cost savings for customers with a maximum value of 44%, and Nadda [13] which use 9 alternatives and get the maximum combination of optimal process parameters in the first alternative. From some of these researches, it can be concluded that comparison of the HYBRID method between AHP-TOPSIS is the right method for done this research in determining the establishment of location of stand at the Batik Hatta Boutique.

1.1 Decision Support System (DSS)

Decision Support System (DSS) is a model that can be used in helping the decision-making process for company as solving a problem [14]. Decision Support Systems provides a knowledge, modelling form, and data processing tools that can be used to support better decision making in various situations [15].

2. METHODS

2.1 Problem Analysis

This research was focuses on decision-making in determining location of the stand establishment at Batik Hatta Boutique. To support this research, some accurate basics are needed, as (1) Accurate data and information from each decision-maker regarding the location that will be target of location of the stand establishment; (2) Some decision-makers have different criterias and alternatives, so they will be pursed to get the right decision regarding to erection of location of the stand establishment; (3) If there is an error in recommendation of location of the stand establishment, Batik Hatta Boutique will probably suffer losses; (4) Selection of location of the stand establishment is still done manually. Thus, we need a system to simplify and improve time efficiencies in making decisions regarding to location of the stand establishment at Batik Hatta Boutique. In designing and building this system, researchers use the AHP-TOPSIS HYBRID MCDM Method.

AHP method is chosen because it can solve problems on smaller elements so that decision-makers can focus on the problem under study [4]. This method is used in the process of determining the weights of criterion and alternative. TOPSIS method has concept as alternative which has the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution is the chosen alternative [13]. Used in the ranking process to get the right recommendations.

2.2 System Overview

In this research, will be built a system that can recommend the location of the stand establishment is advantageous for Batik Hatta Boutique owners. This system is created by involvement of business owner and decision-makers in terms of determining criterias and alternatives. The assessment of several criterias that have been set is as follows:

1. The criteria for rental costs are obtained from observations in terms of rental costs per night in several shopping centers and are estimated to have various benefits for business owner.
2. Location criteria get an assessment in the form of (a) Locations that can be easily accessed in their transportation. (b) Distance from the city center. (c) Facilities for stand tenants.
3. Layout criteria are assessed in the form of (a) Position of the slot stand. (b) Access to enter the slot stand.
4. Assessment of profit criteria obtained from the increase in income per day.
5. Security can be assessed from (a) Monitoring the stand area in each shift (morning, afternoon, evening, night). (b) Involvement of security in guarding loading activities to the stand-location.

2.3 Analytical Hierarchy Process (AHP)

AHP method is an MCDM type of decision-making method which as whole breaks down various unstructured components, then arranged in the form of a hierarchy to give value to the consideration of each important variable. The highest variable will be the selected result from the calculation of this method. For solving the problems using this method should refer to the following steps [16]:

1. Making hierarchy is the process of analyzing problems into a hierarchical structure.
2. Comparative judgment is an assessment of the relative importance of two elements that will produce an alternative paired comparison matrix for each criterion. This stage uses the importance preference scale shown in table 1.

Table 1 Importance Preference Scale [17]

Numerical Rating	1	3	5	7	9	2,4,6,8
Interpretation Preference	Equal	Moderate	Strong	Very Strong	Absolute	Intermediate

3. After determining the comparison matrix, proceed with finding the priority weight value. The method of determining priority weights can be calculated in three ways, as:
   a. Add the pairwise comparison matrix.
   $$\sum_i^n a_{ij} \text{ ; i,j = 1,2,…,n.} \quad (1)$$
   b. Divide each value of the column by the total column to obtain matrix normalization.
   $$a_{ij=\frac{a_{ij}}{\sum_{i=1}^n a_{ij}}} \text{ ; i,j = 1,2,…,n.} \quad (2)$$
   c. Add the results of the normalization matrix and divide by the number of elements to produce priority weights.
   $$w_i^T = \frac{\sum_{j=1}^n a_{ij}}{n} \text{; i,j = 1,2,…,n.} \quad (3)$$
4. Determine Consistency.
   a. Calculate the value of λ_{max}.
   $$\lambda_{max} = \frac{1}{n}\sum_{i=1}^n \frac{(Aw^T)}{w_i^T} \quad (4)$$
   n is the number of a matrix, A is a pairwise comparison matrix, and w ^ T is the priority weight (eigenvalue)
   b. Calculate Consistency Index (CI).
   $$CI = \frac{\lambda_{max} - n}{n-1} \quad (5)$$
   c. Calculate Consistency Ratio (CR).
   $$CR = \frac{CI}{RI} \quad (6)$$

   If the result of CR ≤ 0.1 then the pairwise comparison matrix is consistent. But if the result of CR > 0.1 then the value is not consistent or must be repeated [18] List of Random Consistency Index (IR) is shown in Table 2.

Table 2 List of Random Consistency Index [17]

n	1	2	3	4	5	6	7	8	9	10
Nilai IR	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

5. Calculate Rank
   Ranking can be determined by multiplying the results of the alternative eigenvalue with the results of the criteria eigenvalue

2.4 Technique For Others Reference by Similarity to Ideal Solution (TOPSIS)

TOPSIS is a DSS method that is used to select alternatives that exist by determining the closest distance to the positive ideal solution and the farthest distance from the negative ideal solution. The steps to complete the calculation are as follows [19]:

a. Calculate a normalized matrix.
$$r_{ij} = \frac{x_{ij}}{\sum_i^n x^2 ij} \quad (7)$$
ij = 1,2,…,n. r_{ij} is normalized matrix, and x_{ij} is weight of criteria.

b. Calculating the weight normalized matrix obtained from the multiplication between the normalized matrix and weight, where the weight is taken from the calculation results on AHP.
$$y_{ij} = w_j r_{ij} \quad (8)$$

c. Determine the positive ideal solution matrix and the negative ideal solution obtained from the weighted normalized value. Before calculating, it must be determined first which elements are the benefits and costs
$$A^+ = (y_1^+, y_2^+, y_3^+, \dots, y_n^+) \quad (9)$$

$$A^- = (y_1^-, y_2^-, y_3^-, \dots, y_3^-) \quad (10)$$

Where $y_j^+ = \begin{bmatrix} max_i y_{ij}; & if\ j\ is\ benefit \\ min_i y_{ij}; & if\ j\ is\ cost \end{bmatrix}$

$y_j^- = \begin{bmatrix} min_i y_{ij;} & if\ j\ is\ benefit \\ max_i y_{ij}; & if\ j\ is\ cost \end{bmatrix}$

d. Calculate the distance of alternative values with a positive ideal solution matrix and a negative ideal solution matrix.

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

$$D_i^- = \sqrt{\sum_{j=1}^{n}(y_{ij} - y_j^+)^2} \quad (12)$$

e. Determine the preference value. The ranking will be obtained from the results of the highest preference value

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

2.5 Context Diagram (CD)

Data Flow Diagrams (DFD) is a model that is depicted in the form of symbols to explain the flow of data or information from a system so that it is easily understood logically and structured. Starting from the highest level of DFD is a context diagram that illustrates the whole system and can only consist of one process. There is one user in this Context Diagram. Users must log in to be able to use the system as a whole. The context diagram of this decision support system is in Figure 1

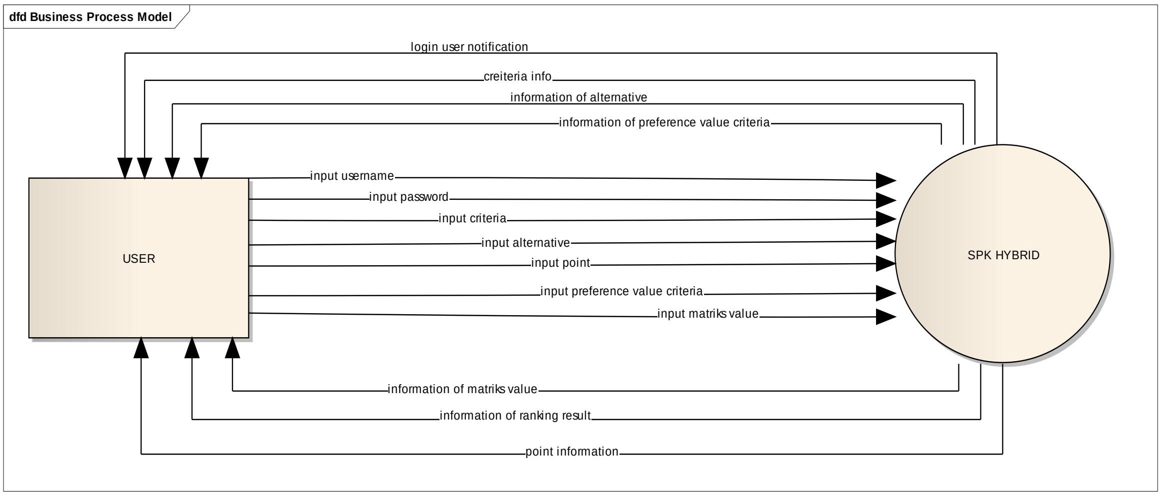


Figure 1 Context Diagram

3. RESULTS AND DISCUSSION

3.1 Testing AHP Calculation

3.1.1 Criteria Inut Processes

First, the users enter the criteria by entering the criteria code and the criteria name to calculate the weight using the AHP method. The input criteria are in Figure 2.

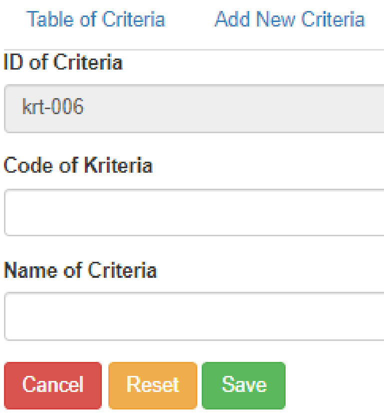


Figure 2 Input of Criteria

Then the results of the input will be saved and then displayed in the criteria table. The user can edit and delete data that has been displayed in the criteria table as shown in Figure 3.

Table of Criteria Add New Criteria

No	ID of Criteria	Code of Criteria	Name of Criteria	OPSI	
1	krt-001	1	LOCATION		
2	krt-002	2	PROFIT		
3	krt-003	3	SECURITY		
4	krt-004	4	RENTAL COSTS		
5	krt-005	5	LAYOUT		

Figure 3 Table of Criteria

3.1.2 Process Input Value of Interest Preference Criteria

Users input preference values according to comparisons of each predetermined criteria. It is an important process because it influences the calculation of criteria weights as shown in Figure 4.

Criteria	LOCATION	PROFIT	SECURITY	RENTAL COSTS	LAYOUT
LOCATION	1	0	0	0	0
PROFIT	5. Strong	1	0	0	0
SECURITY	5. Strong	3. Moderate	1	0	0
RENTAL COSTS	4. Intermediate	2. Intermediate	2. Intermediate	1	0
LAYOUT	5. Strong	2. Intermediate	3. Moderate	2. Intermediate	1

Process

Figure 4 Input Value of Interest Preference Criteria

3.1.3 Calculation Processes of Normalization, Weight, Eigen Value, CI, and CR

After inputting several components of the criteria, the calculation of each criteria will be processed. This calculation results in the normalization of criteria, p.vector, and criteria weight which available in Figure 5.

Criteria	LOCATION	PROFIT	SECURITY	RENTAL COSTS	LAYOUT	P.Vector	Weight
LOCATION	0.05	0.024	0.031	0.059	0.079	**0.243**	**0.049**
PROFIT	0.25	0.122	0.051	0.118	0.197	0.738	**0.148**
SECURITY	0.25	0.366	0.153	0.118	0.131	1.018	**0.204**
RENTAL COSTS	0.2	0.244	0.306	0.235	0.197	1.182	0.236
LAYOUT	0.25	0.244	0.459	0.471	0.395	1.819	0.364
Total	1	1	1	1	1	5	1

Figure 5 Result of Normalized Matrix, P.Vector, and Weight of Criteria

The result of eigenvalue, CI, and CR are shown in Figure 6.

EIGEN VALUE = 5.451
CI = 0.113
CR = 0.1

Figure 6 Result of Eigenvalue, CI and CR

3.2 Testing Calculation of TOPSIS

3.2.1 Alternative Input Processes

Before performing the overall calculation the user must input the alternatives as shown in Figure 7.

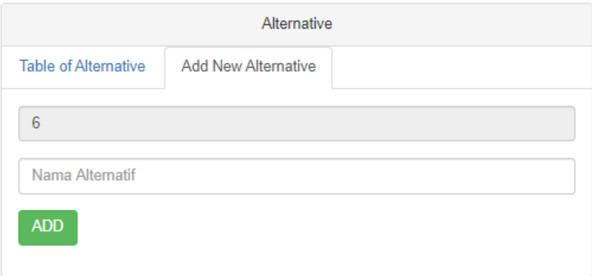


Figure 7 Input of Alternative

The alternative results will be accommodated in the table in Figure 8.

Alternative

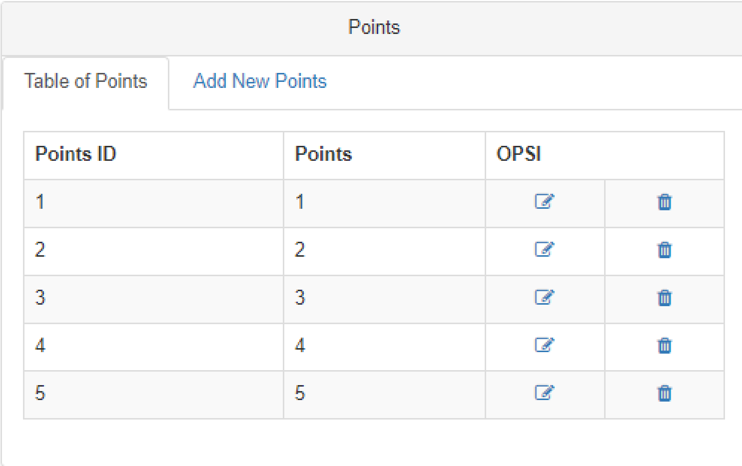
Table of Alternative | Add New Alternative

Alternative ID	Alternative Name	OPSI
1	TRANSMART	
2	JAVA MALL	
3	DP MALL	
4	CITRALAND	
5	PARAGON	

Figure 8 Table of Alternative

3.2.2 Process Input Points

The input point process in this system is filled with a scale of 1-5 used as an assumption for calling the linguistic value used in calculating TOPSIS. Shown in Figure 9.



Points

Table of Points | Add New Points

Points ID	Points	OPSI	
1	1		
2	2		
3	3		
4	4		
5	5		

Figure 9 Table of Points

3.2.3 Matrix Value Input Process

The matrix value input process is carried out to determine alternative criteria according to points illustrating the linguistic scale, as shown in Figure 10.

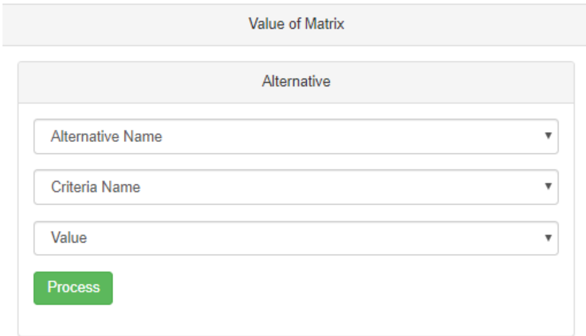


Figure 10 Input of Matrix Value

The linguistic scale used as a reference for calculations starts from 1-100. this picture in figure 11.

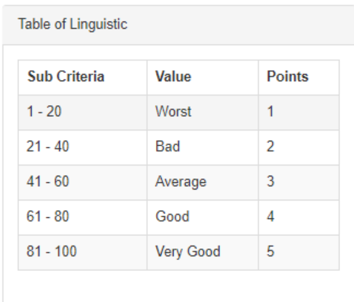


Table of Linguistic

Sub Criteria	Value	Points
1 - 20	Worst	1
21 - 40	Bad	2
41 - 60	Average	3
61 - 80	Good	4
81 - 100	Very Good	5

Figure 11 Table of Linguistic

3.2.4 Calculation of Ranking

After obtaining the criteria weight results from the AHP calculation, it will be continued with alternative calculation using the TOPSIS method which will produce a preference value that is contained in the results of the preference value. The alternative with the highest preference value will be the selected alternative. The final result is shown in Figure 12.

preference value(V_i)

No	Alternative	Name	Preference Value (V_i)
1	**A1**	TRANSMART	0.65533097197512
2	**A2**	JAVA MALL	0.16849034965844
3	**A3**	DP MALL	0.52784063531172
4	**A4**	CITRALAND	0.71354457301362
5	**A5**	PARAGON	0.83052910659695

Figure 12 Value of Preference or Ranking

4. CONCLUSIONS

This research has been through the validation process using a comparison of actual data and obtained a value of 0.90 on the Spearman Correlation Coefficient so that it can produce a system that is useful in assisting Batik Hatta Boutique in obtaining a recommendation for the location of the stand establishment.

5. SUGGESTION

There are few deficiencies in the system that has been built, as the interface designs. The interface design should be developed further and this research can be done with another method, such as SMART, MOORA, and COPRAS.

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