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Planning Decision Support System Using Building Mall AHP (Analytical Hierarchy Process)

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ABSTRACT

The development of information systems and technology today plays an important role and are very useful in various fields covering all aspects of human life. One of the beneficiaries of the computer and information technology systems in the aspect of human life is in helping determine a decision. PT. Karsa Prima Permata Nusa (KPPN) is a company engaged in the contracting business. In the exercise of business at. KPPN still using manual estimates. As a result of that often appear in this condition is takes a long time to determine the location for a development taking into account the requirements-requirements that already ditentukan.dengan location desired, other than that decisions are rendered ineffective because after the construction of walking occur some problems that do not fit the expected results. One method is a decision support system AHP (Analytical Hierarchy Process). AHP (Analytical Hierarchy Process) is a model of decision support system will spell trouble multi-factor or multi-criteria complex into a hierarchy, the hierarchy is defined as a representation of a complex problem in a structure of interest, which follow the level of the factors, criteria, and so on down to the last level.

1. Introduction

PT. Karsa Prima Permata Nusa (KPPN) is a company engaged in the contracting business. In the exercise of business at. KPPN still using manual estimates. As a result of that often appear in this condition is takes a long time to determine the location for a development taking into account the requirements - requirements that already ditentukan.dengan location desired, in addition to the resulting decisions are considered ineffective because after the construction of walking occur some problems that do not fit expected results.

Decision support system is an interactive information system that provides information, modeling and manipulation of data used to help decision makers on the situation of semi-structured, and no one knows for sure how the decision should be made (Kamalia Safitri, Tinus Fince Waruwu and Mesran, 2017).

2. Theory

2.1 Decision Support System

Mark Lawrence SA (2014: 2) also argues that "the decision support system is an interactive information system that provides information, modeling, and manipulating data. The system is used to aid decisions under semi-structured and unstructured situations, where no one knows for sure how the decision should be made. Decision support systems are usually constructed to support a solution to a problem or to evaluate an opportunity. Decision support systems such as the so-called decision support system application.

2.2 Method AHP (Analytical Hierarchy Process)

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Tominanto (2012) argues that "The procedure in AHP method consists of several stages (Suryadi and Ramdhani, 1998), namely:

a) Draw up a hierarchy of problems dihadapi.Penyusunan hierarchy is by determining the purpose of which is the target of the overall system at the highest level. The next level consists of criteria to assess or consider alternatives and determine such alternatives.

b) Determine the priority elements.

c) The first step in determining the priority is to make paired comparisons of elements, comparing elements in pairs according to the criteria that is given by using a matrix. Matrix is a simple, well-established that offers a framework for consistency check, obtain additional information by making all comparisons are possible and analyze the sensitivity of overall priorities for change considerations. The process of pairwise comparisons starting from the top-level hierarchy to select criteria, such as C, then from below the level of taken elements that will be compared, for example, A1, A2, A3, A4, A5, then the arrangement of elements in a matrix such as Table 1 ,

Table 1. Matrix pairwise comparisons

C	A1	A2	A3	A4	A5
A1	1				
A2		1			
A3			1		
A4				1	
A5					1

d) Filling the pairwise comparison matrix by using numbers to represent the relative importance of one element to the other element is in the form of a scale from 1 to 9. This scale defines and explains the value of 1 to 9 for consideration in pairwise comparisons elements on each level of the hierarchy to a y ang criteria at a higher level. If an element in the matrix and compared with itself, it is given a value of 1.

e) Synthesis.

Considerations on pairwise comparisons in the synthesis to obtain overall priorities.

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.
3) Adding up the value of each matrix and dividing by the number of elements to obtain an average value.
4) Measuring consistency.

AHP measure consideration consistency with consistency ratio (ratio consitency). Consistency value ratio must be less than 5% for 3x3 matrix, 9% for 4x4 matrix and 10% for the larger matrix. Steps calculate the consistency ratio values are:

a) Multiplying the value in the first column with the relative priority of the first element, the value in the second column with the relative priority of the second element, and so on.
b) Summing each row.
c) The results from the sum of the line is shared with the relative priority elements are concerned.
d) Dividing the above results with many existing elements, the result is called eigen value (λmax).
e) Calculating the consistency index (consistency index) with the formula:

CI = (λmax-n) / n 1

Where CI: consistensi Index

λmax : Eigen Value

n Many elements

f) Calculate the consistency ratio (CR) by the formula:

CR = CI / RC 2

Where :

CR: Consistency Ratio

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CI: Consistency Index ".

3. Research methods

a) Problem analysis
At this stage permasalahn-authors analyze problems that occur in the PT. KPPN to find the right penyelessaian.
b) formulating Problems
At this stage, after the problems have been further analyzed authors formulate the problem with the aim of facilitating the process of its solution.
c) Data collection
Once the problem is defined by the author the next stage is to collect data and information required in this study. In gathering the data the authors made some observations directly to the company, literature and engage in a question and answer directly to the parties involved with the planning of any construction to be done in order to obtain accurate data.
d) Implementation Methods
Once the data was collected the next process that the authors do is to process these data into manual calculation with AHP method to calculate in advance the index consistency of the formula: the formula: CI = (λmax-n) / n and then calculate the consistency ratio (CR) with the formula: CR = CI / RC.
e) System planning
At this point the author makes the design a system that will be built by studio 2008 visual programming language and MySQL database.
f) examination
At this stage, after the data has been processed manually by AHP and designed the system has completed further testing data obtained into the system with the purpose of seeing whether the results obtained from testing the same system with manual calculation.

4. Results and Discussion

Decision support systems in development planning, namely mall building construction site, built by the method of AHP. In AHP logical consistency is important. The following table lists the consistency index:

Table 2. Index Consistency

Matrix size (n)	IR Value Index (Random)
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
12	1:48
13	1:56
14	1:57
15	1:59

Then in the determination of the construction site was first performed:

a) enter data obtain these results is the result of each. column using pairwise matrix and then summed.

Table 3. Comparison Values Criteria

	Condition	Situation	location	Security
Condition	1	2	2	2
Situation	0.5	1	7	7
location	0.5	0:14	1	3
Security	0.5	0:14	0:33	1
amount	2.5	3:28	10:33	13

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b) Calculating Normalized Eigenvectors

To calculate the eigen value normalized vectors we will use the table 2 by multiplying the columns and rows as follows .:

Table 4. Eigen Vector Normalization for comparison criteria

	Kondisi	Situasi	Letak	Keamanan	Jumlah	Eigen Vektor Normalisasi
Kondisi	4	4.56	15.66	24	48.22	0.363
Situasi	8	3.86	11.31	36	59.17	0.445
Letak	2.57	1.7	3.97	7.98	16.22	0.122
Keamanan	1.23	1.32	2.64	3.97	9.16	0.068
					132.77	

c) Calculating Ratio Consistency

This consistency ratio is used to determine the level of consistency of assessment criteria comparison.

1) Specifies the maximum eigenvalues (λ max)

Maximum eigen value obtained by multiplying the sum of each row in the pairwise comparison matrix with eigenvectors normalization.

λ max = (2.5 * 0,363) + (3.28 * 0,445) + (10.33 * 0,122) + (13 * 0,068) = 4.5114

2) Calculating the consistency index (CI)

CI = $\frac{4.5114-4}{4-1}$ = 0.1704

3) Calculate the consistency ratio (CR)

Based on Table 4.1. found that the IR for 4x4 matrix is 0.90, to obtain:

CR = $\frac{0.1704}{0.90}$ = 0.1893

The result of the above calculation can be described in a sub-hierarchy comparison between the following criteria:

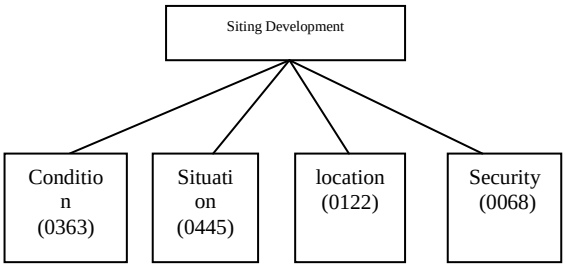

Fig 1. Structure Sub Criteria Hierarchy

Calculation for Alternative Delivery Comparison

1. Against Alternative Comparison Criteria Conditions.

a. Make perbanding matrix pairs.

Just as a comparison between the criteria, the comparison between alternative decision makers also provide ratings for each alternative,

Table 5.
Pairwise Comparison Matrix Condition Criteria

Condition	Podomoro	Ringroad	pine	Johor
Podomoro	1	3	5	5
Ringroad	0:33	1	3	7
pine	0.2	0:33	1	3
Johor	0.2	0:14	0:33	1
amount	1.73	4:47	9:33	16

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b. Calculating Normalized Eigenvectors

This calculation is performed the same as in the process of calculating the eigenvectors normalized to compare the criteria. At this stage of the process of calculating the value of the normalization of eigenvectors we did by diverting columns and rows.

Table 6. Normalized Eigenvectors Conditions

Situation	Podomoro	Ringroad	pine	Johor	amount	Eigen Vector Normalization
Podomoro	3.99	8:35	20.65	46	78.99	0549
Ringroad	2.66	3.96	9.96	24.65	41.23	0287
pine	1:11	1.68	3.98	9:31	16:08	0112
johor	0:51	0.99	2:08	3.97	7:55	0052
amount					143.85	

c. Calculating Ratio Consistency

This consistency ratio is used to determine the level of consistency of assessment criteria comparison.

4) Specifies the maximum eigenvalues (λ max)

Maximum eigen value obtained by multiplying the sum of each row in the pairwise comparison matrix with eigenvectors normalization.

λ max = (1.73 * 0,549) + (4.47 * 0,287) + (9.33 * 0,112) + (16 * 0,052) = 4.1139

5) Calculating the consistency index (CI)

Based on the index table consistency equation is obtained:

$$CI = \frac{4.233-4}{4-1} = 0078$$

6) Calculate the consistency ratio (CR)

Based on table 1 shows that IR for 4x4 matrix is 0.90, to obtain:

$$CR = \frac{0.078}{0.90} = 0086$$

2. Against Alternative Comparison Criteria situation.

a. Make perbanding matrix pairs.

Just as a comparison between the criteria, the comparison between alternative decision makers also provide ratings for each of the alternatives.

Table 7. Criteria situation Pairwise Comparison Matrix

Situation	Podomoro	Ringroad	pine	Johor
Podomoro	1	3	3	7
Ringroad	0:33	1	3	5
pine	0:33	0:33	1	1
Johor	0:14	0.2	1	1
amount	1:18	4:53	8	14

b. Calculating Normalized Eigenvectors

This calculation is performed the same as in the process of calculating the eigenvectors normalized to compare the criteria. At this stage of the process of calculating the value of the normalization of eigenvectors we did by diverting columns and rows.

Table 8. Criteria situation Pairwise Comparison Matrix.

Situation	Podomoro	Ringroad	pine	Johor	amount	Eigen Vector Normalization
Podomoro	3.96	8:39	22	32	66.35	0547
Ringroad	2:35	3.98	11.99	15:31	33.63	0277
pine	0.91	1.85	3.98	5.96	12.73	0104
Johor	0.68	0.87	3:02	3.98	8:55	0070
amount					121.26	

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c. Calculating Ratio Consistency

This consistency ratio is used to determine the level of consistency of assessment criteria comparison.

7) Specifies the maximum eigenvalues (λ max)

Maximum eigen value obtained by multiplying the sum of each row in the pairwise comparison matrix with eigenvectors normalization.

λ max = (1.8 * 0,547) + (4.53 * 0,277) + (8 * 0,104) + (14 * 0,070) = 4.0514

8) Calculating the consistency index (CI)

$$CI = \frac{4.0514-4}{4-1} = 0.0171$$

9) Calculate the consistency ratio (CR)

Based on the index table shows that IR's consistency 4x4 matrix is 0.90, to obtain:

$$CR = \frac{0.0171}{0.90} = 0019$$

3. Comparison of Alternative Against Location Criteria

a. Make perbanding matrix pairs.

Just as a comparison between the criteria, the comparison between alternative decision makers also provide ratings for each alternative.

Table 9. Pairwise Comparison Matrix Criteria Location

Condition	Podomoro	Ringroad	pine	Johor
Podomoro	1	3	3	7
Ringroad	0:33	1	3	3
pine	0.2	0:33	1	3
Johor	0:14	0:33	0:33	1
amount	1.67	4.66	9:33	14

b. Calculating Normalized Eigenvectors

This calculation is performed the same as in the process of calculating the eigenvectors normalized to compare the criteria. At this stage of the process of calculating the value of the normalization of eigenvectors we did by diverting columns and rows.

Table 10. Pairwise Comparison Matrix Criteria Location

Condition	Podomoro	Ringroad	pine	Johor	amount	Eigen Vector Normalization
Podomoro	3.97	7.96	21:21	38	71.14	0560
Ringroad	1.68	3.97	8.64	17:21	31.5	0247
pine	0.93	2:25	3.98	8:39	15:55	0122
Johor	0:45	2:07	2:35	3.96	8.83	0069
amount					127.02	

c. Calculating Ratio Consistency

This consistency ratio is used to determine the level of consistency of assessment criteria comparison.

10) Specifies the maximum eigenvalues (λ max)

Maximum eigen value obtained by multiplying the sum of each row in the pairwise comparison matrix with eigenvectors normalization.

λ max = (1.67 * 0,560) + (4.66 * 0,247) + (9.33 * 0,122) + (14 * 0,069) = 4.1904

11) Calculating the consistency index (CI)

$$CI = \frac{4.1904-4}{4-1} = 0.0634$$

12) Calculate the consistency ratio (CR)

Based on the index table shows that IR's matrix 4x4 matrix is 0.90, to obtain:

$$CR = \frac{0.0634}{0.90} = 0.0704$$

4. Comparison of Alternative Against Security Criteria

a. Make perbanding matrix pairs.

Just as a comparison between the criteria, the comparison between alternative decision makers also provide ratings for each alternative.

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Table 11. Pairwise Comparison Matrix Security Criteria

Condition	Podomoro	Ringroad	pine	Johor
Podomoro	1	5	3	7
Ringroad	0.2	1	3	1
pine	0:33	0:33	1	3
Johor	0:14	1	0:33	1
amount	1.67	7:33	7:33	12

b. Calculating Normalized Eigenvectors

This calculation is performed the same as in the process of calculating the eigenvectors normalized to compare the criteria. At this stage of the process of calculating the value of the normalization of eigenvectors we did by diverting columns and rows.

Table 12. Criteria Location Pairwise Comparison Matrix

Condition	Podomoro	Ringroad	pine	Johor	amount	Eigen Vector Normalization
Podomoro	3.97	17.99	23:31	28	73.27	0594
Ringroad	1:53	3.99	6.93	6.4	18.85	0152
pine	1.74	5:31	3.97	8.64	19.66	0159
Johor	0589	2,809	4:08	3.97	11 448	0092
amount					123 228	

c. Calculating Ratio Consistency

This consistency ratio is used to determine the level of consistency of assessment criteria comparison.

13) Specifies the maximum eigenvalues (λ max)

Maximum eigen value obtained by multiplying the sum of each row in the pairwise comparison matrix with eigenvectors normalization.

$$\lambda \text{ max} = (1.67 * 0{,}594) + (7.33 * 0{,}152) + (7.33 * 0{,}159) + (12 * 0{,}092) = 4.3754$$

14) Calculating the consistency index (CI)

$$CI = \frac{4.3754 - 4}{4 - 1} = 0.124$$

15) Calculate the consistency ratio (CR)

Based on Table 4.1. found that the IR for 4x4 matrix is 0.90, to obtain:

$$CR = \frac{0.124}{0.90} = 0138$$

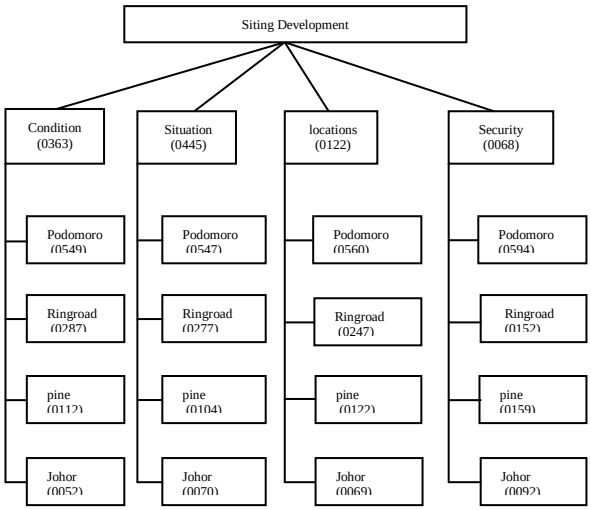

Fig 2. Structure and Their Hierarchy Eigen Value Vector Normalization

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The next step is the determination of rank calculation based on eigenvector normalization, the following values obtained from the calculation of eigenvectors described above. The calculation is as follows:

a) Score Podomoro = (0,549 * 0,363) + (0,547 * 0,445) + (0,560 * 0,122) + (0,594 * 0,068) = 0.5512
b) Score Ringroad = (0,287 * 0,363) + (0,277 * 0,445) + (0,247 * 0,122) + (0,152 * 0,068) = 0.2677
c) Score pine = (0,112 * 0,363) + (0,104 * 0,445) + (0,122 * 0,122) + (0,159 * 0,068) = 0.1124
d) Score Johor = (0,052 * 0,363) + (0,070 * 0,445) + (0,069 * 0,122) + (0,092 * 0,068) = 0.0645

Based on the calculation of the above, the best location in determining the location of the development is Tembung.

5. Conclusion

a) Decision support system with AHP method can be used to determine the location of the mall building.
b) From the research that has been done obtained information that the building site is the most appropriate mall in Tembung.
c) Results of testing the system with Visual Studio 2010 programming language and MySQL database together with manual testing with AHP.

6. Reference

[1] Abdullah Jamil, Nia Kumala Sari, Zainuddin Bey. Sistem Pendukung Keputusan Dalam Perekrutan Guru Menggunakan Model AHP (*Analytical Hierarchy Process*) Studi Kasus MI Irsyaduthallibin Sukabumi.
[2] M. Nurfalah Setiawan. Sistem Pendukung Keputusan Pemilihan Karyawan Teladan Di STMIK Balikpapan Berbasis Website.
[3] Nurmalasari, Angga Agus Pratama. Sistem Pendukung Keputusan Pemilihan Supplier Menggunakan Metode AHP Pada PT. Transcoal Pasific Jakarta
[4] Aji Sasongko, Indah Fitri Astuti, Septya Maharani. Pemilihan Karyawan Baru Dengan Metode AHP (*Analytical Hierarchy Process*).
[5] Dameria E br. Jabat, James Pawer Hutajulu. Sistem Pendukung Keputusan Menggunakan Metode AHP (*Analytical Hierarchy Process*) Studi Kasus Penentuan Penerima Beasiswa Pada Politomas.
[6] Herson Anwar. Proses Pengambilan Keputusan untuk Mengembangkan Mutu Madrasah.
[7] Liza Yuliani, Herlina Latipa Sari, B. Herawan Hayadi. Sistem Pendukung Keputusan Peserta KB Teladan DI BKKBN Bengkulu Menggunakan Pemrograman Visual Basic 6.0.
[8] Markus Hendrawan SA. Sistem Pendukung Keputusan Rekrutment Karyawan Di PT. Indo Beras Unggul Menggunakan Metode AHP (*Analytical Hierarchy Process*)
[9] Raymundus Nandy Irawan, Wawan Laskito YS, Sri Siswanti. Sistem Pendukung Keputusan Untuk Menentukan Status Prestasi Siswa Menggunakan Metode K - *Nearest Neighbor*.
[10] Rini Asmara, S. Kom, M. Kom. Sistem Informasi Pengolahan Data Penanggulangan Bencana Pada Kantor BPBD Kabupaten Padang Pariaman.
[11] Romi hardianto, Rometdo Muzawi. Sistem Pendukung Keputusan Untuk Menentukan Pemenang Tender Kontraktor Menggunakan Metode AHP (*Analytical Hierarchy Process*) Studi Kasus Di Dinas Pekerjaan Umum Kabupaten Agam.
[12] Jufriadi Na'am. Sebuah Tinjauan Penggunaan Metode AHP (*Analytical Hierarchy Process*) Dalam Sistem Penunjang Keputusan Pada Jurnal Berbahasa Indonesia.
[13] Diana, S.SI., M.Kom. Metode dan Aplikasi Sistem Pendukung Keputusan.