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SELECTION DECISION SUPPORT SYSTEM PON HOCKEY ATHLETES CENTRAL JAVA CONTINGENT USING AHP AND PROMETHEE METHODS

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ABSTRACT

Hockey is one of the sports that will be competed in the National Sports Week (PON). In the selection process for the Central Java contingent hockey athletes involved many criteria that were assessed, so that in the selection a multi-criteria decision support system was needed for more objective results. The method used in the decision support system for the selection of the Central Java contingent hockey athletes is a combination of the AHP method and the Promethee method. The AHP method is used to weight the criteria and test the consistency of the pairwise comparison matrix, while the Promethee method is used to rank in determining the best alternative. The purpose of the study was to determine the design and build a decision support system for the selection of Central Java contingent PON hockey athletes using a combination of AHP and Promethee methods, and to find out the results of implementing a combination of AHP and Promethee methods of decision support for the selection of PON hockey athletes from the Central Java contingent. The result obtained is a decision support system that has the output of a hockey athlete ranking from the highest net flow value to the lowest net flow value. From the ranking results, it was found that male hockey athletes who had the highest score were athletes with code A3 with a value of 0.564 and female hockey athletes who had the highest score were athletes with code A23 with a value of 0.172,

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1. INTRODUCTION

Advances in information technology are increasingly widespread in all aspects of human life. In everyday life, humans are often faced with problems regarding decision makers. The size of the risk posed is in accordance with the decisions that have been taken. At this time, many people are no longer looking for alternatives to make decisions on their own, but using a decision support system. Even in the world of sports, sports actors are often faced with decision-making problems.

Sport is one of the activities carried out to improve one's physical fitness. There are so many types of sports that a person can do according to their abilities and talents. Various kinds of sports began to be developed and socialized in Indonesia, one of which is hockey. Hockey is a game that is almost the same as football, which is played by 2 teams, each team consisting of 11 players, and

played on a field that is almost the same size.(Nugraha, 2016). The purpose of the hockey game is to enter the ball into the opponent's goal, hitting the ball may only use a hockey stick, it may not be kicked, thrown or tossed with limbs.(Suwardi, 2011).

The Analytical Hierarchy Process (AHP) method and the Preference Ranking Organization Method for Enrichment Evaluation (Promethee) are several methods for solving the Multi-criteria Decision Making problem. Multi-criteria decision making (MCDM) is a decision-making method to determine the best alternative from a number of alternatives based on certain criteria or multi-criteria(Agus & Sulastri, 2018).

The AHP method is a model with a functional hierarchy where the input is human perception. With a hierarchy, a complex and unstructured problem is solved into groups. Then the groups are organized into a hierarchical form(Wahyuningsih, Accounting, & Janti, 2016). The AHP method is a comprehensive and rational decision support system method to provide solutions to complex criteria problems in various alternatives by taking into account qualitative and quantitative matters.(Ahmad, 2018).

The method used in the selection decision for the Central Java contingent PON hockey athletes is a combination of the Analytic Hierarchy Process (AHP) method with the Preference Ranking Organization Method for Enrichment Evaluation (Promethee).(Suwarjono & Wayangkau, 2018). The AHP method is used to determine the weight of the value of each criterion and test the consistency of the comparison so as to obtain the eigenvalues used in the Promethee method for comparisons between alternatives so as to produce a final value that becomes a reference for decision makers to determine the ranking of hockey athletes.(Ardiyansyah & Ilyas, 2016).

2. METHOD

2.1 Research methods

The AHP method was first developed in the 1970s by Dr. Thomas L. Saaty a mathematician from the University of Pittsburg, United States. The AHP method is a model with a functional hierarchy where the input is human perception. With a hierarchy, a complex and unstructured problem is solved into its groups. Then the groups are organized into a form of hierarchy (Suryadi and Ramdhani, 2002: 130). The AHP method is also widely used in decisions for criteria, planning, resource allocation and prioritizing players' strategies in conflict situations.(Lemantara, Setiawan, & Aji, 2013). The steps used in this method are:(Budiasih & Nyoman, 2014):

a. Define the problem and determine the desired solution.
   At this stage, it is attempted to determine the problem to be solved in a clear, detailed and easy to understand manner and to determine a solution that may be suitable for the problem. There may be more than one solution to the problem. The solution will be further developed in the next stage.
b. Create a hierarchical structure that starts with the main goal.
   Creating a hierarchical structure aims to solve or divide the complete problem into a hierarchical form of the decision-making process, where each element or elements are related. The AHP Hierarchical Structure can be seen in the following Figure:

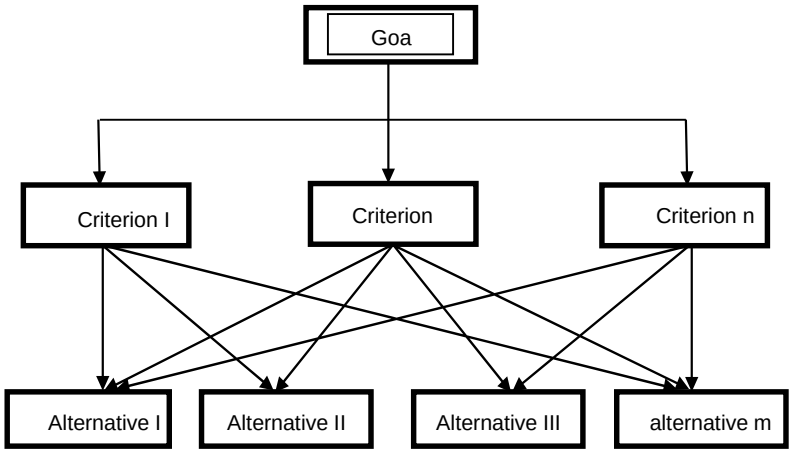

Figure 1. AHP Hierarchical Structure

c. Create a pairwise comparison matrix
The first step in determining the priority of elements is to make pairwise comparisons, which is to compare elements in pairs according to the given criteria. For pairwise comparisons used matrix form. To start the pairwise comparison process, start at the top level of the hierarchy to select criteria.

3. RESULTS AND DISCUSSIONS

3.1 Results

To fill in the pairwise comparison matrix, by using numbers to represent the relative importance of one element to the other elements referred to in the form of a scale from 1 to 9. If an element is in the matrix and compared with itself, then it is given a value of 1. If i is compared to j get a certain value, then j compared to i is the inverse. An example of a pairwise comparison matrix table can be seen in the following table:

Table 1.
Pairwise Comparison Matrix

	A1	A2	A3	A4	A5
A1	1	3	1	2	1/3
A2	0.333	1	1	2	□
A3	1	1	1	1/3	2
A4	0.5	0.5	3	1	1

In row A1 column A2 contains 3 this means that A1 is slightly more important 3 times than A2, while in row A1 column A3 contains 1 this means that both elements are equally important. Calculating the eigenvalues and testing their consistency, if they are not consistent then the data collection is repeated. Consistency is important to get valid results in the real world. AHP measures the consistency of judgment with a consistency ratio. The steps for calculating the consistency ratio value are:

a. Multiply the value in the first column by the relative priority of the first element, and so on.
b. Sum each row.
c. The result of the row summation is divided by the corresponding relative priority element
d. Dividing the above result by the number of elements present, the result is called the eigenvalue (max).
e. Calculating the Consistency Index (CI) with the formula:

CI = (λ max-n)/n-1 (2.1)
where is CI : Consistency Index
λ maks : *Eigen Value*
n : Many elements

f. Calculating Random Consistency (RC) with the formula:
CR = CI/RC (2.2)
where is CR : Consistency Ratio
CI : *Consistency Index*
RC : *Random Consistency*

The list of Random Consistency values can be seen in Table 2.3 below.

Table 2.
Random Consistency Index Value

Matrix Size	*Random Consistency*	Matrix Size	*Random Consistency*
1, 2	0.0	9	1.45
3	0.58	10	1.49
4	0.90	11	1.51
5	1.12	12	1.48
6	1.24	13	1.56
7	1.32	14	1.57

1. A case study in determining employee bonuses where the assessment criteria include: 1). Discipline 2). Work performance 3). Work Experience 4). Behavior during work.
   a. Determine the criteria that will be used as a reference in the decision. The criteria data can be seen in Table 2.4.

Table 2.
Random Consistency Index Value

No	Criteria	Symbol
1	Discipline	C1
2	Work performance	C2
3	Work experience	C3
4	Behavior During Work	C4

   b. Determine the pairwise comparison matrix between criteria and calculate the number of priority values for each criterion. The Paired Matrix can be seen in the following table:

Table 2.
Paired Matrix

Criteria	C1	C2	C3	C4
C1	1	3	5	7
C2	0.333	1	3	5
C3	0.200	0.333	1	3
C4	0.143	0.200	0.33	1
Amount	1,676	4,533	9,333	16

Based on Table 2.5 above, it can be explained that the comparison value for itself is 1 which means that the intensity of interest is the same. The comparison of C1 with C2 is worth 3 based on the current condition that C1 is slightly more important than C2. Then the comparison of C2 with C1 is a reflection of the comparison of C1 with C2 which means 1/3 = 0.333. The comparison of C1 with C3 gets a value of 5 which means C1 is more important than C3, and the comparison of C3 with C1 is a reflection of the comparison of C1 with C3 which means 1/ 5 = 0.20. The comparison of C1 with

C4 got a value of 7 which means C1 is very important from C4, and the comparison of C4 with C1 is a reflection of the comparison of C1 with C4 which means 1/7 = 0.143.

c. Normalizing matrix

After getting the value of the pairwise comparison matrix between criteria, each value will be divided by the result of the sum of its columns.

C1,C1 = 1/1.676 = 0.597
C1,C2 =3/4.533 = 0.662
C1,C3 =5/9.333 = 0.536

In the same way for each criterion will produce a Normalization matrix as in Table 2.6 as follows:

Table 2.
Normalization Matrix

Criteria	C1	C2	C3	C4	Weight
C1	0.597	0.662	0.536	0.438	0.558
C2	0.199	0.221	0.321	0.313	0.263
C3	0.199	0.074	0.107	0.188	0.122
C4	0.085	0.044	0.036	0.063	0.057

To get the Weight value, the average value of each criterion is as follows:
C1 = (0.597+ 0.662 + 0.536 + 0.438) / 4 = 0.558
C2 = (0.199 + 0.221 + 0.321 + 0.313) / 4 = 0.2563
C3 = (0.199 + 0.074 + 0.107 + 0.188) / 4 = 0.122
C4 = (0.085 + 0.044 + 0.036 + 0.063) / 4 = 0.057

d. Testing consistency

In finding the consistency index, the value of is needed□max is the average value of□each criterion. The calculation results□ max can be seen in the following table:

Table 2.
Normalization Matrix

Criteria	C1	C2	C3	C4	Amount	□
C1	0.558	0.790	0.609	0.398	2,356	4.222
C2	0.186	0.263	0.366	0.284	1,099	4.175
C3	0.112	0.088	0.122	0.171	0.492	4.036
C4	0.080	0.053	0.041	0.057	0.230	4041
Quantity						16,474
Average ((λmax)						4.118

Furthermore, the value of max and the number of criteria are used to find the value of the consistency index using the following equation:

CI = (λmax-n)/n-1 = (4.118-4)/3 = 0.0393

After the CI value is obtained, then the next step is to calculate the CR value by dividing the CI value by the RC value. In this case the number of criteria is 4 then RC = 0.9, it can be seen in the Random Consistency Index Value. As for finding Random Consistency by using the following equation:

CR = CI/RC= 0.0393/0.9 =0.043

The value of 0.043 is smaller than the limit of the consistency value, which is < 0.1 so that the pairwise comparison matrix between the criteria is consistent.

4. CONCLUSION

Designing and building a decision support system for the selection of Central Java contingent hockey PON athletes using the waterfall model system development. The stages in system

development with the waterfall model are: (1) the analysis phase (2) the design phase, (3) the coding phase, and (4) the testing phase. In testing the system using the black-box method, where system testing is focused on the functional requirements of the software that has been built. Based on the results of testing using Black-box, it can be concluded that the decision support system for the selection of the Central Java contingent PON hockey athletes that was built was in accordance with the design, free from syntax errors and functionally the output results were as expected. The implementation of the AHP method and the Promethee method in the decision support system for the selection of PON hockey athletes in Central Java uses 8 criteria. The AHP process is used in the weighting of the criteria and the consistency test on the pairwise comparison matrix, the CR value is less than 10%, namely 0.025 so that the weight of the criteria obtained is declared consistent. Furthermore, the Promethee process is used in ranking so that the ranking results using this system are obtained that male hockey athletes who have the highest score are athletes with A3 code with a value of 0.564 while female hockey athletes who have the highest score are athletes with A23 code with a value of 0.172 . The AHP process is used in the weighting of the criteria and the consistency test on the pairwise comparison matrix, the CR value is less than 10%, namely 0.025 so that the weight of the criteria obtained is declared consistent. Furthermore, the Promethee process is used in ranking so that the ranking results using this system are obtained that male hockey athletes who have the highest score are athletes with A3 code with a value of 0.564 while female hockey athletes who have the highest score are athletes with A23 code with a value of 0.172 . The AHP process is used in the weighting of the criteria and the consistency test on the pairwise comparison matrix, the CR value is less than 10%, namely 0.025 so that the weight of the criteria obtained is declared consistent. Furthermore, the Promethee process is used in ranking so that the ranking results using this system are obtained that male hockey athletes who have the highest score are athletes with A3 code with a value of 0.564 while female hockey athletes who have the highest score are athletes with A23 code with a value of 0.172 .

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