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DECISION SUPPORTING SYSTEM FOR MALANG CITY BASEBALL AND SOFTBALL ATHLETES SELECTION USING THE VIKOR METHOD

Eka Larasati Amalia[a], Deasy Sandhya Elya Ikawati[a], Muhammad Arya Puja Laksana[a]

[a]Informatic Engineering Study Program , State Polytechnic of Malang, Malang, Indonesia

A B S T R A C T

Decision support system is a computer-based system that is used to solve problems by semi-structured and unstructured conditions. In this case, the best solution can be found from certain criteria and provided alternatives and is easy to use by users. In this study, researchers designed and built a website-based decision support system to select athletes in PERBASASI Malang with the provided test criteria, namely the hit test, catch test, throw test, and run test. The purpose of this study was to provide recommendations for participants who passed the selection based on test scores that have been processed using the VlseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR) method. From the results of calculations, the use of the VIKOR method for this case study produced an accuracy value of 90.90%, a precision value of 93.33%, and a recall value of 93.33%. In addition, the VIKOR sensitivity test showed a consistent ranking of the calculation of the value with veto (value of v less than 0.5), by consensus (value of v is 0.5), and voting by majority rule (value of v more than 0.5). User testing that was applied by using each level of the existing account, i.e. administrator account level, selection account level, and members account level conducted on this information system concluded that the system that was built was running smoothly and was easy to use.

Keywords: Decision Support System, Athlete Selection, Baseball, Softball, PERBASASI, VlseKriterijumska Optimizacija I Kompromisno Resenje, VIKOR Method.

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1. Introduction

Baseball and softball are two of group sports that developed and popularized in the America, Asia Pacific, and Oceania, including Indonesia. This American originated sport entered Indonesia in the 1960s. To provide a place to channel these baseball and softball activities, Perserikatan Baseball dan Softball Amatir Seluruh Indonesia or so-called PERBASASI organization was established in 1967 [1].

The current selection system used by PERBASASI in Malang City is still manual. Selectors have to write down each executed test's scores on the paper and then move them into Microsoft Excel to be analyzed using mean searching technique. This process is ineffective and wastes time. Therefore, a system is needed to help PERBASASI make the selection process easier. The decision-maker system to be made was using the VlseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR) method, which assessed each candidate based on the comparison result between competition standards. The VIKOR method used to overcome the complex multi-criteria system problems that focused on the rank and selection of an alternative. Also, this method has the advantage of an alternative compromise [2]. A compromise solution is a feasible solution closest to the ideal solution, with the compromise being a decision made together by concession [3].

2. Theoretical basis

2.1. Decision Supporting System

The decision supporting system is a computer-based system used to help/support solutions from problems with semi-structured and unstructured conditions to find the best solution from specific criteria and alternatives provided and is easy to use.

2.2. VIKOR (VlseKriterijumska Optimizacija I Kompromisno Resenje)

VIKOR is one of the decision-maker systems included in a multi-

* *Corresponding author.*
E-mail address: eka.larasati.polinema.ac.id

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criteria optimization and compromise solution technique commonly used for complex decision making using many criteria [4]. The VIKOR method focuses on the ranking and chooses from one sample set with the most conflicting criteria, to help the decision-maker obtain the final decision [5].

The VIKOR method calculation are as follows:

1. Calculating the normalization value using the following formula:

$$R_{ij} = \frac{Xj^{+} - Xij}{Xj^{+} - Xj^{-}} \quad (1)$$

Where:

- R_{ij} : The normalization value from the decision maker matrix
- X_{ij} : The value from the decision maker matrix element
- X_j^{+} : The best element from the j criteria
- X_j^{-} : The lowest element from the j criteria

2. Calculating the utility measures (S) and regret measures (R) values using these following formulas:

$$S_i = \sum_{j=1}^{n} W_j \left(\frac{Xj^{+} - Xij}{Xj^{+} - Xj^{-}}\right) \quad (2)$$

Where:

- S_i : The distance of weighted and normalized Manhattan
- W_j : The weight value of each criteria

$$R_i = Max\ j \left[W_j \left(\frac{Xj^{+} - Xij}{Xj^{+} - Xj^{-}}\right)\right] \quad (3)$$

Where:

- R_i : The distance of weighted and normalized Chebyshev
- W_j : The weight value of each criteria

3. Determining the index value using the following formula:

$$Q_i = \left[\frac{Si - S^{+}}{S^{+} - S^{-}}\right] V + \left[\frac{Ri - R^{+}}{R^{+} - R^{-}}\right](1 - V) \quad (4)$$

Where:

- Q_i : The VIKOR index value
- V : The weight value of the strategy of the maximum group utility
- 1-V : The weight value of the individual regret
- S_i : The distance of weighted and normalized Manhattan
- R_i : The distance of weighted and normalized Chebyshev
- S^{+} : The maximum S value of all Si values
- S^{-} : The minimum S value of all Si values
- R^{+} : The maximum R value of all Ri values
- R^{-} : The minimum R value of all Ri values

4. Conducting the acceptable advantage condition checking using the following formula:

$$Q_{(A2)} - Q_{(A1)} \geq DQ \quad (5)$$

Where:

- $Q_{(A2)}$: the runner up alternative on the Q rank
- $Q_{(A1)}$: the first alternative on the Q rank

DQ : The comparison value for the acceptable advantage condition (DQ = 1 / (m-1))

2.3. The VIKOR Sensitivity Test

The VIKOR sensitivity test is a test conducted to see the stability of an alternative when the value on the v variable is changed. The v default value is 0.5, and it was changed into v < 0.5 (with veto) and v > 0.5 (voting by majority rule) in the testing process.

2.4. Accuracy, Precision, and Recall

The testing method of accuracy, precision, and recall. Precision is the data accuracy resulted from the system through its calculation using the real data. Recall is the system suitability degree in the calculation to regain information.

Formulas for accuracy, precision, and recall are as follows:

$$accuracy = \frac{TP+TN}{TP+TN+FP+FN} \quad (6)$$

$$precision = \frac{TP}{TP+FP} \quad (7)$$

$$recall = \frac{TP}{TP+FN} \quad (8)$$

Where:

- TP : True Positive
- TN : True Negative
- FP : False Positive
- FN : False Negative

3. Method

3.1. Determination of Criteria and Weight Value

In this decision-making system research, there were 4 main criteria and 6 sub-criteria. Those criteria are defined below:

Table 1. Table of Criteria Weight

Criteria	Weight	Conversion
Striking Test	30%	0.3
Catching Test	30%	0.3
Throwing Test	30%	0.3
Running Test	10%	0.1

Table 2. Criteria of Striking and Catching Test

Performance Test		Capability Test	
Score	Weight value	Score	Weight Value
1 Correct Position	1	0 – 2	1
2 Correct Position	2	3 – 4	2
3 Correct Position	3	5 – 6	3
4 Correct Position	4	7 – 8	4
5 Correct Position	5	9 - 10	5

Table 3. Criteria of Throwing Test

Performance Test		Capability Test	
Score	Weight Value	Score	Weight Value
1 Correct Position	1	< 101 m	1
2 Correct Position	2	101 - 200 m	2
3 Correct Position	3	201 - 300 m	3
4 Correct Position	4	301 - 400 m	4
5 Correct Position	5	> 400 m	5

Table 4. Criteria of Running Test

Time	Weight Value
> 5,11 seconds	1

Time	Weight Value
4,73 - 5,11 seconds	2
4,35 - 4,72 seconds	3
3,92 - 4,34 seconds	4
< 3,92 seconds	5

3.2. Table of Weighing Value

This weighing value table was created by conversing the value on the data table to be the corresponding value on the criteria table.

Table 5. Weighing of Striking Test

No	Participant	Striking Test			
		Performance Test		Capability Test	
		set 1	set 2	set 1	set 2
1	KVDVH	4	4	3	4
2	RF	5	5	3	5
...	...	...	...	...	...
22	BS	5	5	3	5

Table 6. Weighing of Catching Test

No	Participant	Catching Test			
		Performance Test		Capability Test	
		set 1	set 2	set 1	set 2
1	KVDVH	4	5	3	3
2	RF	4	4	4	5
...	...	...	...	...	...
22	BS	5	5	3	4

Table 7. Weighing of Throwing Test

No	Participant	Throwing Test			
		Performance Test		Capability Test	
		set 1	set 2	set 1	set 2
1	KVDVH	4	4	2	2
2	RF	4	5	2	2
...	...	...	...	...	...
22	BS	5	4	2	2

Table 8. Weighing of Running Test

No	Participant	Running Test				
		Traveling Time				
		Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
1	KVDVH	1	1	1	1	1
2	RF	1	2	1	1	1
...	...	...	...	...	...	...
22	BS	1	1	1	1	1

Table 9. Average of All Tests

No	Participant	Striking	Catching	Throwing	Running	Total Value
		Test	Test	Test	Test	
1	KVDVH	3.75	3.75	3	1	11.5
2	RF	4.5	4.25	3.25	1.2	13.2
..	...	...	...	...	...	...
22	BS	4.5	4.25	3.25	1	13

3.3. Determination of The Maximum and Minimum Value of Each Criteria

The maximum (X_j^+) and minimum (X_j^-) values was used to normalize the data in the weighing table.

Table 10. Maximum and minimum values

	Striking Test	Catching Test	Throwing Test	Running Test
X_j^+	4.5	4.75	4	2.4
X_j^-	3.75	2.75	3	1

3.4. Creation of The Normalization Table

Determining the normalization value using the formula (1)

Table 11. Table of Normalization Value

No	Participant	Striking Test	Catching Test	Throwing Test	Running Test
1	KVDVH	1	0.5	1	1
2	RF	0	0.25	0.75	0.8571
...	...	...	...	...	...
22	BS	0	0.25	0.75	1

3.5. Calculation of Si and Ri Value

Utility measures (S) and Regret measures (R) was calculated using the formula (2) and (3)

Table 12. Table of Si and Ri Value

No	Participant	Si Value	Ri Value
1	KVDVH	0.85	0.3
2	RF	0.3857	0.225
...	...	...	...
22	BS	0.4	0.225

3.6. Finding The Maximum and Minimum Value of Si and Ri

Finding the maximum and minimum value of each participant's Si and Ri.

Table 13. Table of maximum and minimum value from of Si and Ri

Si Max (S^+)	Si Min (S^-)	Ri Max (S^+)	Ri Min (S^-)
0,8875	0.1179	0.3	0.075

3.7. Calculation of VIKOR Index Value (Qi)

Calculation of VIKOR index value is following the formula (3)

Tabel 14. Table of Qi Value

No	Participant	Qi
1	KVDVH	0.9756
2	RF	0.5073
...	...	...
22	BS	0.5166

3.8. Alternative Ranking

This ranking was conducted discerning the calculated Qi value and other aspects as the comparison if there is any equal Qi value of more than 1 alternatives.

Table 15. Table of Alternative Ranking

Ranking	Qi	Participant
1	0.0000	BN
2	0.0962	RAK
...	...	...
15	0.7011	MRSP

3.9. Acceptable Advantage Condition Checking

After Qi value ranking, the next step was to check the Acceptable Advantage condition using the formula (5)

$$DQ = \frac{1}{(m-1)} = \frac{1}{(22-1)} = 0.0476$$

$$Q_{(A2)} - Q_{(A1)} = 0.0962 - 0 = 0.0962$$

$$Q_{(A2)} - Q_{(A1)} \geq DQ$$

$$0.0962 \geq 0.0476$$

From the results above, all of these calculation has fulfilled the Acceptable Advantage condition

4. Testing and Discussion

On the overall conducted test calculation, weight value was used 30% for each striking, catching, and throwing tests, and 10% for the running test. Besides that, the standard value used in striking and catching tests was 3 for each test, while in throwing and running tests, it was 2.

The VIKOR sensitivity test conducted in the calculation result shows the same ranking order from all 3 v values, i.e., v = 0.45, v = 0.5, and v = 0.65.

For the alternative data with the same Qi value, the ranking was executed by looking into other aspects. On the ranking of striking, catching, and throwing tests, other aspects considered were the average of capability and performance tests and using the age aspect as the final choice. For the overall test, other aspects considered began from looking into the average score of the striking test, then continued to the average score of running, catching, and throwing tests. Age consideration was used if the average of 4 test scores were equal.

This VIKOR sensitivity test might generate a better result if more decimal numbers are involved because the more detailed calculated Qi value, the easier it would be to compare the Qi value.

The accuracy, precision, and recall tests conducted on the succeeded participants show the proximity between the prediction value and real value (accuracy) for 90.90%, the success of the system to regain information (recall) for 93.33%, and the accuracy of the information given from the system compared to what the user asked (precision) for 93.33%.

From the conducted calculation, this VIKOR method has an advantage in the ranking process by having the ranking preference value.

5. Conclusion

An information system to conduct the selection of baseball and softball athletes with changeable criteria and weight value for several tests was successfully established using the *VlseKriterijumska Optimizacija I Kompromisno Resenje* (VIKOR) method and obtained the testing result for accuracy level of 90.90%, precision of 93.33%, and recall of 93.33%. To overcome the selection ranking problem if the end alternative results were all equal while possessed to a limited quota, overlooking other factors is necessary for the ranking process.

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