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Decision Support System for The Selection of North Sumatra Atlet Drumband By Applying Elimination and Choice Translation Reality (ELECTRE) (Case Study: United States of Drumband Indonesia North Sumatra Region)

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Abstract

Unity Drumband Indonesia (PDBI) Region of North Sumatra is an organizational body engaged in sports groups, which involves players in various musical instruments. In selecting players, PDBI North Sumatra through the committee to conduct strict selection, through a judging system with several stages of a rigorous process. From the selection of participants, compare each criterion one by one to get the best athletes. Implementation of decision support systems is expected to provide the right solution and can assist the jury in generating a decision. Thus the process of selecting athletes can produce a decision directly without a long time. So that accelerate the selection process of drum band athletes who will strengthen the team of North Sumatra. The Elimination and Choice Translation Reality (ELECTRE) method is required in decision support systems for the selection of drum band athletes who will strengthen the North Sumatra team.

Keywords: *Selection of Athletes, Drum Band, Electre*

1. Introduction

Drumband is a group of people who play multiple songs using a combination of musical instruments (such as wind instruments, percussion and pit instruments) that are played together. In playing drum band instrument using 80% rely on physical strength and 20% rely on the ability to play musical instruments. So it can be said that Drumband is a sports activity.

A rigorous selection process with a judging system manually, from the selection of participants in the comparison of each criterion one by one to get the best athlete, so the resulting decision takes a long time and not maximal. Implementation of decision support systems is expected to assist in the selection process of drum band athletes and produce alternative decisions that fit the criteria. Decision support system is a system capable of providing results in problem solving based on various criteria that have been determined. This system is very important in helping leaders to make decisions [1]–[3]. In the application of this system using methods to perform analysis of decision making, such as Weighted Sum Model (WSM), Technique for order preference by similarity to ideal solution (TOPSIS), Elimination and Choice Translation Reality (ELECTRE), Simple Multi-Attribute Rating Technique (SMART), Analytics Hierarchy Process (AHP), The Extended Preference Ranking Organization Method for Enrichment Evaluations II (Exprom II)[4]–[11].

Some of the related research that the author took in connection with the research that the author did include, as was done by Zulita (2020) in making decisions on regional product selection. The ELECTRE method is able to produce a decision that the Culinary

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and Batik Industry UKM are better than other UKM [12]. Ismay Dahanum (2017) conducted research in determining the best internet service provider by applying the ELECTRE method. The results of the study were able to provide a decision that Lintasarta was the best provider at that time[13]. In this study the authors used the ELECTRE method for the selection of Drumband Athletes. The ELECTRE method is a multi-criteriadecision-making method and is based on the concept of outranking using pairwise comparisons of alternatives based on each appropriate criterion[14].

2. Research Methodology

2.1. Drumband Athletes

An athlete (often called an athlete) is someone who is good at sports and other forms of physical training. According to the Big Indonesian Dictionary, athletes are sportsmen, especially those who participate in competitive sports competitions that rely on strength, agility, and speed. Drumband players are said to be athletes because this sport relies on physical strength, agility, and agility in practice. DrumBand is a group of people playing several songs using a number of musical instrument combinations (such as wind instruments, percussion, and pit instruments) played together. In playing a musical instrument DrumBand uses 80% relying on physical strength and 20% relying on the ability to play a musical instrument. So it can be said that Drumband is a sports activity.

2.2. Decision Support System

Decision Support System (DSS) is a system that provides support to managers in making decisions. SPK is an information system that will accommodate data, both alternative data, and criteria data, which are then processed using the methods[2], [14]–[16].

2.3. Elimination and Choice Translation Reality (ELECTRE)

The method of ELECTRE comes from the word Elimination Et Choix Traduisant La Reality. The Electre (Elimination and Choice Translation Reality) method can be used to assess and rank based on advantages and disadvantages through pairwise comparisons on the same criteria. ELECTRE is one of the multicriteria decision-making methods based on the concept of outranking by using pairwise comparisons of alternatives based on each appropriate criterion[17], [18].

This method is used in conditions where alternatives that are less in line with the criteria are eliminated, and suitable alternatives can be generated. ELECTRE is used for cases that have many alternatives with few criteria. The troubleshooting steps use the ELECTRE [12], [19] method, as follows:

1) Normalization of decision matrix

   Any normalization of the Xij value can be done by the following formula:

   $$r_{ij} = \frac{Xij}{\sqrt{\sum_{i=}^{m} x_{ij}^2}} \text{ for i} = 1,2,3,\dots,m \text{ and } j = 1,2,3,\dots,n \quad (1)$$

   So that obtained matrix R result of normalization

   $$R=\begin{bmatrix} r11 & r12 & \dots & r1n \\ r21 & r22 & \dots & r2n \\ \vdots & & & \\ rm1 & rm2 & \dots & rmn \end{bmatrix}$$

2) Weighted in a normalized matrix. After normalization, each column of the matrix R is multiplied by the weights (w_j) determined by the decision maker. Thus, the weighted normalized matrix is V = RW written as follows:

   V=RW

$$\begin{bmatrix} v11 & v12 & \cdots & v1n \\ v21 & v22 & \dots & v2n \\ & & & \\ vm1 & vm2 & \dots & vmn \end{bmatrix} = \begin{bmatrix} w1r11 & w2r12 & \cdots & wnr1n \\ w1r21 & w2r22 & \dots & wnr2n \\ \vdots & & & \\ wirm1 & w2rm2 & \dots & wnrmn \end{bmatrix} \quad (2)$$

Where W is

$$W=\begin{bmatrix} w1 & 0 & \dots & 0 \\ 0 & w2 & \dots & 0 \\ \vdots & & & \\ 0 & 0 & & wn \end{bmatrix}$$

3) Determine the set *concordance* and *discordance* index. For each pair of alternatives k and l (k, l=1,2,3,…, m and k ≠ l) A collection j of criteria is divided into two subsets ie *concordance* and *discordance*. A criterion in an alternative includes *concordance* if:

C_{kl} ={$j, v_{kj} \geq v_{lj}$}, for $j = 1,2,3, \dots, n.$ (3)

Instead, the complementary of the subsets *concordance* is the set *discordance*, that is when:

D_{kl}={$j, v_{kj} < v_{lj}$}, for $j = 1,2,3, \dots, n.$ (4)

4) Calculating the matrix *concordance* and *discordance*

a) To calculate the matrix value *concordance* is to add up the weights that belong to the set *concordance*, mathematically to find the matrix *concordance* and *discordance* are as follows:

C_{kl}=$\sum_{j \in C_{kl}} wj$ (5)

b) Calculating matrix *discordance*

To determine the matrix value *discordance* is to divide the maximum of the difference of criteria belonging to the subsets *discordance* with a maximum value difference of all the criteria.

$$d_{kl}=\frac{\max\{|v_{1j}-V_{2j}|\} \quad j \in D_{12}}{\max\{|v_{1j}-V_{2j}|\} \quad \forall j} \quad (6)$$

5) Determining the dominant matrix *concordance* and *discordance*

a) Calculating matrix dominant *concordance*. Matrix F as matrix dominant *concordance* can be built with the help of value *threshold*, that is by comparing each value of the matrix element *concordance* with value *threshold.*

with value *threshold* ($\underline{c}$) is :

$$\underline{C} = \frac{\sum_{k=1}^{m} \sum_{l=1}^{m} c_{kl}}{m(m-1)} \quad (7)$$

So the matrix element F is determined as follows:

$$f_{kl}=\begin{cases} 1, jika\ c_{kl} \geq \underline{c} \\ 0, jika\ c_{kl} < \underline{c} \end{cases}$$

b) Calculating matrix dominant *discordance*

The matrix G as the dominant matrix of discordance can be constructed with the help of the threshold value $\underline{d}$:

$$\underline{d}=\frac{\sum_{k=1}^{m} \sum_{l=1}^{m} d_{kl}}{m(m-1)} \quad (8)$$

And the matrix element G is determined as follows:

$$g_{kl}=\begin{cases} 1, jika\ c_{kl} \geq \underline{d} \\ 0, jika\ c_{kl} < \underline{d} \end{cases}$$

6) Determine the aggregate dominance matrix

Matrix E as an aggregate dominance matrix is a matrix whose elements are multiplications of matrix elements F with corresponding elements of matrix G, can be mathematically expressed as:

$e_{kl}=f_{kl}$xg_{kl} (9)

7) Elimination of less favorable alternatives.
Matrix E gives a sequence of options from each alternative, that is when $e_{kl} = 1$ then alternatives A_k is a better alternative than A_1. So on the line in the matrix e which has the sum e_{kl} = 1 at least can be eliminated.

3. Result and Discussion

Alternative is very important in the decision support system. Here is a list of drumband athletes following PON selection to represent North Sumatra.

Table 1. Criteria and Weights

Information	Weights W
Physical (C1)	0.60%
inflatable tool (C2)	0.20%
Music Analysis (C3)	0.10%
Discipline (C4)	0.10%

Table 2. List of Participants and Values Appropriate Criteria

Name	C1	C2	C3	C4
Ahmad Latif (A1)	90	90	70	60
Akbar Husaini(A2)	80	90	88	80
Jeni Suprapto(A3)	90	80	60	80
Khairil Amri(A4)	80	90	81	90
Rian Afriansyah(A5)	80	90	77	90

Normalization of Decision Matrix. In this procedure, each attribute is converted into a comparable value (1).

$|x_1| = \sqrt{5^2 + 4^2 + 5^2 + 4^2 + 5^2} = 10.344$

$r_{11} = \frac{X_{11}}{|X_1|} = \frac{5}{10.344} = 0.4833$

$r_{21} = \frac{X_{21}}{|X_1|} = \frac{4}{10.344} = 0.3866$

$r_{31} = \frac{X_{31}}{|X_1|} = \frac{5}{10.344} = 0.4833$

$r_{41} = \frac{X_{41}}{|X_1|} = \frac{4}{10.344} = 0.3866$

$r_{51} = \frac{X_{51}}{|X_1|} = \frac{5}{10.344} = 0.4833$

$|x_2| = \sqrt{5^2 + 5^2 + 4^2 + 5^2 + 4^2} = 10.344$

$r_{12} = \frac{X_{12}}{|X_2|} = \frac{5}{10.344} = 0.4833$

$r_{22} = \frac{X_{22}}{|X_2|} = \frac{5}{10.344} = 0.4833$

$r_{32} = \frac{X_{32}}{|X_2|} = \frac{4}{10.344} = 0.3866$

$r_{42} = \frac{X_{42}}{|X_2|} = \frac{5}{10.344} = 0.4833$

$r_{52} = \frac{X_{52}}{|X_2|} = \frac{4}{10.344} = 0.3866$

From the above calculation obtained mariks R

$$R = \begin{bmatrix} 0.4833 & 0.4833 & 0.4193 & 0.3145 \\ 0.3866 & 0.4833 & 0.5241 & 0.4193 \\ 0.4833 & 0.3866 & 0.3144 & 0.4193 \\ 0.3866 & 0.4833 & 0.5241 & 0.5241 \\ 0.4833 & 0.3866 & 0.4193 & 0.5241 \end{bmatrix}$$

Weighted in a normalized matrix. After normalization, each column of the matrix R is multiplied by the weights (w_j) determined by the decision maker. Thus, the weighted normalized matrix is V = RW (2).

$$V=RW=\begin{bmatrix}0.4833 & 0.4833 & 0.4193 & 0.3145\\ 0.3866 & 0.4833 & 0.5241 & 0.4193\\ 0.4833 & 0.3866 & 0.3144 & 0.4193\\ 0.3866 & 0.4833 & 0.5241 & 0.5241\\ 0.4833 & 0.3866 & 0.4193 & 0.5241\end{bmatrix}\cdot\begin{bmatrix}0.60 & 0 & 0 & 0\\ 0 & 0.20 & 0 & 0\\ 0 & 0 & 0.10 & 0\\ 0 & 0 & 0 & 0.10\end{bmatrix}$$

$$V=\begin{bmatrix}0.2900 & 0.0967 & 0.0419 & 0.0314\\ 0.2320 & 0.0967 & 0.0524 & 0.0419\\ 0.2900 & 0.0773 & 0.0314 & 0.0419\\ 0.2320 & 0.0967 & 0.0524 & 0.0524\\ 0.2900 & 0.0773 & 0.0419 & 0.0524\end{bmatrix}$$

Next determine the set of concordance index calculated based on (.3).

K=1 i=1 C_{11} identity = {1,2,3,4}
i=2 C_{12}
j=1 if $V_{11} \geq V_{21}$ = 0.2900 ≥ 0.2320
yes j = 1
j=2 if $V_{12} \geq V_{22}$ = 0.0967 ≥ 0.0967
yes j = 2
j=3 if $V_{13} \geq V_{23}$ = 0.0419 ≥ 0.0524
no
j=4 if $V_{14} \geq V_{24}$ = 0.0314 ≥ 0.0419
no
C_{12} = {1,2}
i=3 C_{13}
j=1 if $V_{11} \geq V_{31}$ = 0.2900 ≥ 0.2900
yes j = 1
j=2 if $V_{12} \geq V_{32}$ = 0.0967 ≥ 0.0773
yes j = 2
j=3 if $V_{13} \geq V_{33}$ = 0.0419 ≥ 0.0314
yes j = 3
j=4 if $V_{14} \geq V_{34}$ = 0.0314 ≥ 0.0419
no
C_{13} = {1,2 3}
i= 4 C_{14}
j=1 if $V_{11} \geq V_{41}$ = 0.2900 ≥ 0.2320
yes j = 1
j=2 if $V_{12} \geq V_{42}$ = 0.0967 ≥ 0.0967
yes j = 2
j=3 if $V_{13} \geq V_{43}$ = 0.0419 ≥ 0.0524
no
j=4 if $V_{14} \geq V_{44}$ = 0.0314 ≥ 0.0524
no
C_{14} = {1,2}
i= 5 C_{15}
j=1 if $V_{11} \geq V_{51}$ = 0.2900 ≥ 0.2900
yes j = 1
j=2 if $V_{12} \geq V_{52}$ = 0.0967 ≥ 0.0773
yes j = 2
j=3 if $V_{13} \geq V_{53}$ = 0.0419 ≥ 0.0419
yes j = 3
j=4 if $V_{14} \geq V_{54}$ = 0.0314 ≥ 0.0524
no
C_{15} = {1,2,3}

K=2 i=1 C_{21}
j=1 if $V_{21} \geq V_{11}$ = 0.2320 ≥ 0.2900
no
j=2 if $V_{22} \geq V_{12}$ = 0.0967 ≥ 0.0967
yes j = 2
j=3 if $V_{23} \geq V_{13}$ = 0.0524 ≥ 0.0419
yes j = 3
j=4 if $V_{24} \geq V_{14}$ = 0.0419 ≥ 0.0314
yes j = 4
C_{21} = {2,3,4}
i=1 C_{22} identity = {1,2,3,4}
i=3 C_{23}
j=1 if $V_{21} \geq V_{31}$ = 0.2320 ≥ 0.2900
no
j=2 if $V_{22} \geq V_{32}$ = 0.0967 ≥ 0.0773
yes j = 2
j=3 if $V_{23} \geq V_{33}$ = 0.0524 ≥ 0.0314
yes j = 3
j=4 if $V_{24} \geq V_{34}$ = 0.0419 ≥ 0.0419
yes j = 4
C_{23} = {2,3,4}
i=4 C_{24}
j=1 if $V_{21} \geq V_{41}$ = 0.2320 ≥ 0.2320
yes j = 1
j=2 if $V_{22} \geq V_{42}$ = 0.0967 ≥ 0.0967
yes j = 2
j=3 if $V_{23} \geq V_{43}$ = 0.0524 ≥ 0.0524
yes j = 3
j=4 if $V_{24} \geq V_{44}$ = 0.0419 ≥ 0.0524
no
C_{24} = {1,2,3}
i=1 C_{25}
j=1 if $V_{21} \geq V_{51}$ = 0.2320 ≥ 0.2900
no
j=2 if $V_{22} \geq V_{52}$ = 0.0967 ≥ 0.0773
yes j = 2
j=3 if $V_{23} \geq V_{53}$ = 0.0524 ≥ 0.0419
yes j = 3
j=4 if $V_{24} \geq V_{54}$ = 0.0419 ≥ 0.0524
no
C_{25} = {2,3}

K=3 i=1 C_{31}

j=1 if $V_{31} \geq V_{11}$ = 0.2900 ≥ 0.2900
yes j = 1
j=2 if $V_{32} \geq V_{12}$ = 0.0773 ≥ 0.0967
no
j=3 if $V_{33} \geq V_{13}$ = 0.0314 ≥ 0.0419
no
j=4 if $V_{34} \geq V_{14}$ = 0.0419 ≥ 0.0314
yes j = 4
C_{31} = {1,4}
i=2 C_{32}
j=1 if $V_{31} \geq V_{21}$ = 0.2900 ≥ 0.2320
yes j = 1
j=2 if $V_{32} \geq V_{22}$ = 0.0773 ≥ 0.0967
no
j=3 if $V_{33} \geq V_{23}$ = 0.0314 ≥ 0.0524
no
j=4 if $V_{34} \geq V_{24}$ = 0.0419 ≥ 0.0419
yes j = 4
C_{32} = {1,4}
i=3 C_{33} identity = {1,2,3,4}
i=4 C_{34}
j=1 if $V_{31} \geq V_{41}$ = 0.2900 ≥ 0.2320
yes j = 1
j=2 if $V_{32} \geq V_{42}$ = 0.0773 ≥ 0.0967
no
j=3 if $V_{33} \geq V_{43}$ = 0.0314 ≥ 0.0524
no
j=4 if $V_{34} \geq V_{44}$ = 0.0419 ≥ 0.0524
no
C_{34} = {1,}
i=5 C_{35}
j=1 if $V_{31} \geq V_{51}$ = 0.2900 ≥ 0.2900
yes j = 1
j=2 if $V_{32} \geq V_{52}$ = 0.0773 ≥ 0.0773
yes j = 2
j=3 if $V_{33} \geq V_{53}$ = 0.0314 ≥ 0.0419
no
j=4 if $V_{34} \geq V_{54}$ = 0.0419 ≥ 0.0524
no
C_{35} = {1,2,}

K=4

i=1 C_{41}
j=1 if $V_{41} \geq V_{11}$ = 0.2320 ≥ 0.2900
no
j=2 if $V_{42} \geq V_{12}$ = 0.0967 ≥ 0.0967
yes j = 2
j=3 if $V_{43} \geq V_{13}$ = 0.0524 ≥ 0.0419
yes j = 3
j=4 if $V_{44} \geq V_{14}$ = 0.0524 ≥ 0.0314
yes j = 4
C_{41} = {2,3,4}
i=2 C_{42}
j=1 if $V_{41} \geq V_{21}$ = 0.2320 ≥ 0.2320
yes j = 1
j=2 if $V_{42} \geq V_{22}$ = 0.0967 ≥ 0.0967
yes j = 2
j=3 if $V_{43} \geq V_{23}$ = 0.0524 ≥ 0.0524
yes j = 3
j=4 if $V_{44} \geq V_{24}$ = 0.0524 ≥ 0.0419
yes j = 4
C_{42} = {1,2,3,4}
i=3 C_{43}
j=1 if $V_{41} \geq V_{31}$ = 0.2320 ≥ 0.2900
no
j=2 if $V_{42} \geq V_{32}$ = 0.0967 ≥ 0.0773
yes j = 2
j=3 if $V_{43} \geq V_{33}$ = 0.0524 ≥ 0.0314
yes j = 3
j=4 if $V_{44} \geq V_{34}$ = 0.0524 ≥ 0.0419
yes j = 4
C_{43} = {2,3,4}
i=4 C_{44} identity = {1,2,3,4}
i=5 C_{45}
j=1 if $V_{41} \geq V_{51}$ = 0.2320 ≥ 0.2900
no
j=2 if $V_{42} \geq V_{52}$ = 0.0967 ≥ 0.0773
yes j = 2
j=3 if $V_{43} \geq V_{53}$ = 0.0524 ≥ 0.0419
yes j = 3
j=4 if $V_{44} \geq V_{54}$ = 0.0524 ≥ 0.0524
yes j = 4
C_{45} = {2,3,4}

K=5

i=1 C_{51}
j=1 if $V_{51} \geq V_{11}$ = 0.2900 ≥ 0.2900
yes j = 1
j=2 if $V_{52} \geq V_{12}$ = 0.0773 ≥ 0.0967
no
j=3 if $V_{53} \geq V_{13}$ = 0.0419 ≥ 0.0419
yes j = 3
j=4 if $V_{54} \geq V_{14}$ = 0.0524 ≥ 0.0314
yes j = 4
C_{51} = {1,3,4}
i=2 C_{52}
j=1 if $V_{51} \geq V_{21}$ = 0.2900 ≥ 0.2320
yes j = 1
j=2 if $V_{52} \geq V_{22}$ = 0.0773 ≥ 0.0967
no
j=3 if $V_{53} \geq V_{23}$ = 0.0419 ≥ 0.0524
no
j=4 if $V_{54} \geq V_{24}$ = 0.0524 ≥ 0.0419
yes j = 4
C_{52} = {1,4}
i=3 C_{53}

j=1 if $V_{51} \geq V_{31}$ = 0.2900 ≥ 0.2900
yes j = 1
j=2 if $V_{52} \geq V_{32}$ = 0.0773 ≥ 0.0773
yes j = 2
j=3 if $V_{53} \geq V_{33}$ = 0.0419 ≥ 0.0314
yes j = 3
j=4 if $V_{54} \geq V_{34}$ = 0.0524 ≥ 0.0419
yes j = 4
C_{53} = {1,2,3,4}
i=4 C_{54}

j=1 if $V_{51} \geq V_{41}$ = 0.2900 ≥ 0.2320
yes j = 1
j=2 if $V_{52} \geq V_{42}$ = 0.0773 ≥ 0.0967
no
j=3 if $V_{53} \geq V_{43}$ = 0.0419 ≥ 0.0524
no
j=4 if $V_{54} \geq V_{44}$ = 0.0524 ≥ 0.0524
yes j = 4
C_{54} = {1,4}
i=5 C_{55} identity = {1,2,3,4}

Next determine the set of discordance index calculated based on (4).

K=1 i=1 D_{11} identity = {}
i=2 D_{12}
j=1 if $V_{11} < V_{21}$ = 0.2900 < 0.2320
no
j=2 if $V_{12} < V_{22}$ = 0.0967 < 0.0967
no
j=3 if $V_{13} < V_{23}$ = 0.0419 < 0.0524
yes j = 3
j=4 if $V_{14} < V_{24}$ = 0.0314 < 0.0419
yes j = 4
D_{12} = {3,4}
i=3 D_{13}
j=1 if $V_{11} < V_{31}$ = 0.2900 < 0.2900
no
j=2 if $V_{12} < V_{32}$ = 0.0967 < 0.0773
no
j=3 if $V_{13} < V_{33}$ = 0.0419 < 0.0314
no
j=4 if $V_{14} < V_{34}$ = 0.0314 < 0.0419
yes j = 4
D_{13} = {4}
i=4 D_{14}
j=1 if $V_{11} < V_{41}$ = 0.2900 < 0.2320
no
j=2 if $V_{12} < V_{42}$ = 0.0967 < 0.0967
no
j=3 if $V_{13} < V_{43}$ = 0.0419 < 0.0524
yes j = 3
j=4 if $V_{14} < V_{44}$ = 0.0314 < 0.0524
yes j = 4
D_{14} = {3,4}
i=5 D_{15}
j=1 if $V_{11} < V_{51}$ = 0.2900 < 0.2900
no
j=2 if $V_{12} < V_{52}$ = 0.0967 < 0.0773
no
j=3 if $V_{13} < V_{53}$ = 0.0419 < 0.0419
no
j=4 if $V_{14} < V_{54}$ = 0.0314 < 0.0524
yes j = 4
D_{15} = {4}

K=2 i=1 D_{21}
j=1 if $V_{21} < V_{11}$ = 0.2320 < 0.2900
yes j = 1
j=2 if $V_{22} < V_{12}$ = 0.0967 < 0.0967
no
j=3 if $V_{23} < V_{13}$ = 0.0524 < 0.0419
no
j=4 if $V_{24} < V_{14}$ = 0.0419 < 0.0314
no
D_{21} = {1}
i=2 D_{22} identity = {}
i=3 D_{23}
j=1 if $V_{21} < V_{31}$ = 0.2320 < 0.2900
yes j = 1
j=2 if $V_{22} < V_{32}$ = 0.0967 < 0.0773
no
j=3 if $V_{23} < V_{33}$ = 0.0524 < 0.0314
no
j=4 if $V_{24} < V_{34}$ = 0.0419 < 0.0419
no
D_{23} = {1}
i=4 D_{24}
j=1 if $V_{21} < V_{41}$ = 0.2320 < 0.2320
no
j=2 if $V_{22} < V_{42}$ = 0.0967 < 0.0967
no
j=3 if $V_{23} < V_{43}$ = 0.0524 < 0.0524
no
j=4 if $V_{24} < V_{44}$ = 0.0419 < 0.0524
yes j = 4
D_{24} = {4}
i=5 D_{25}
j=1 if $V_{21} < V_{51}$ = 0.2320 < 0.2900
yes j = 1
j=2 if $V_{22} < V_{52}$ = 0.0967 < 0.0773
no
j=3 if $V_{23} < V_{53}$ = 0.0524 < 0.0419
no
j=4 if $V_{24} < V_{54}$ = 0.0419 < 0.0524
yes j = 4
D_{25} = {1,4}

K=3 i=1 D_{31}
j=1 if $V_{31} < V_{11}$ = 0.2900 < 0.2900
no
j=2 if $V_{32} < V_{12}$ = 0.0773 < 0.0967
yes j = 2
j=3 if $V_{33} < V_{13}$ = 0.0314 < 0.0419
yes j = 3
j=4 if $V_{34} < V_{14}$ = 0.0419 < 0.0314
no
D_{31} = {2,3}
i=2 D_{32}
j=1 if $V_{31} < V_{21}$ = 0.2900 < 0.2320
no
j=2 if $V_{32} < V_{22}$ = 0.0773 < 0.0967
yes j = 2
j=3 if $V_{33} < V_{23}$ = 0.0314 < 0.0524
yes j = 3
j=4 if $V_{34} < V_{24}$ = 0.0419 < 0.0419
no
D_{32} = {2,3}
i=3 D_{33} identity = {}
i=4 D_{34}
j=1 if $V_{31} < V_{41}$ = 0.2900 < 0.2320
no
j=2 if $V_{32} < V_{42}$ = 0.0773 < 0.0967
yes j = 2
j=3 if $V_{33} < V_{43}$ = 0.0314 < 0.0524
yes j = 3
j=4 if $V_{34} < V_{44}$ = 0.0419 < 0.0524
yes j = 4
D_{34} = {2,3,4}
i=5 D_{35}
j=1 if $V_{31} < V_{51}$ = 0.2900 < 0.2900
no
j=2 if $V_{32} < V_{52}$ = 0.0773 < 0.0773
no
j=3 if $V_{33} < V_{53}$ = 0.0314 < 0.0419
yes j = 3
j=4 if $V_{34} < V_{54}$ = 0.0419 < 0.0524
yes j = 4
D_{35} = {3,4}

K=4 i=1 D_{41}
j=1 if $V_{41} < V_{11}$ = 0.2320 < 0.2900
yes j = 1
j=2 if $V_{42} < V_{12}$ = 0.0967 < 0.0967
no
j=3 if $V_{43} < V_{13}$ = 0.0524 < 0.0419
no
j=4 if $V_{44} < V_{14}$ = 0.0524 < 0.0314
no
D_{41} = {1}
i=2 D_{42}
j=1 if $V_{41} < V_{21}$ = 0.2320 < 0.2320
no
j=2 if $V_{42} < V_{22}$ = 0.0967 < 0.0967
no
j=3 if $V_{43} < V_{23}$ = 0.0524 < 0.0524
no
j=4 if $V_{44} < V_{24}$ = 0.0524 < 0.0419
no
D_{42} = {}
i=3 D_{43}
j=1 if $V_{41} < V_{31}$ = 0.2320 < 0.2900
yes j = 1
j=2 if $V_{42} < V_{32}$ = 0.0967 < 0.0773
no
j=3 if $V_{43} < V_{33}$ = 0.0524 < 0.0314
no
j=4 if $V_{44} < V_{34}$ = 0.0524 < 0.0419
no
D_{43} = {1}
i=4 D_{44} identity = {}
i=5 D_{45}
j=1 if $V_{41} < V_{51}$ = 0.2320 < 0.2900
yes j = 1
j=2 if $V_{42} < V_{52}$ = 0.0967 < 0.0773
no
j=3 if $V_{43} < V_{53}$ = 0.0524 < 0.0419
no
j=4 if $V_{44} < V_{54}$ = 0.0524 < 0.0524
no
D_{45} = {1}

K=5 i=1 D_{51}
j=1 if $V_{51} < V_{11}$ = 0.2900 < 0.2900
no
j=2 if $V_{52} < V_{12}$ = 0.0773 < 0.0967
yes j = 2
j=3 if $V_{53} < V_{13}$ = 0.0419 < 0.0419
no
j=4 if $V_{54} < V_{14}$ = 0.0524 < 0.0314
no
D_{51} = {2}
i=2 D_{52}
j=1 if $V_{51} < V_{21}$ = 0.2900 < 0.2320
no
j=2 if $V_{52} < V_{22}$ = 0.0773 < 0.0967
yes j = 2
j=3 if $V_{53} < V_{23}$ = 0.0419 < 0.0524
yes j = 3
j=4 if $V_{54} < V_{24}$ = 0.0524 < 0.0419
no
D_{52} = {2,3}
i=3 D_{53}

j=1 if $V_{51} < V_{31}$ = 0.2900 < 0.2900
no
j=2 if $V_{52} < V_{32}$ = 0.0773 < 0.0773
no
j=3 if $V_{53} < V_{33}$ = 0.0419 < 0.0314
no
j=4 if $V_{54} < V_{34}$ = 0.0524 < 0.0419
no
D_{53} = {}
i=4 D_{54}

j=1 if $V_{51} < V_{41}$ = 0.2900 < 0.2320
no
j=2 if $V_{52} < V_{42}$ = 0.0773 < 0.0967
yes j = 2
j=3 if $V_{53} < V_{43}$ = 0.0419 < 0.0524
yes j = 3
j=4 if $V_{54} < V_{44}$ = 0.0524 < 0.0524
no
D_{54} = {2,3}
i=4 D_{55} identity = {}

Calculating matrix *concordance* (35).

$C_{12} = w_1+w_2$ = 0.60+0.20 = 0.80
$C_{13} = w_1+w_2+ w_3$ = 0.60+0.20+0.10 = 0.90
$C_{14} = w_1+w_2$ = 0.60+0.20 = 0.80
$C_{15} = w_1+w_2+ w_3$ = 0.60+0.20+0.10 = 0.90
$C_{21} = w_2+w_3+w_4$ = 0.20+0.10+0.10 = 0.40
$C_{23} = w_2+w_3+w_4$ = 0.20+0.10+0.10 = 0.40
$C_{24} = w_1+w_2+ w_3$ = 0.60+0.20+0.10 = 0.90
$C_{25} = w_2 + w_3$ = 0.20+0.10 = 0.30
$C_{31} = w_1+w_4$ = 0.60+0.10 = 0.70
$C_{32} = w_1+w_4$ = 0.60+0.10 = 0.70
$C_{34} = w_1$ = 0.60
$C_{35} = w_1+w_2$ = 0.60+0.20= 0.80
$C_{41} = w_2+w_3+w_4$ = 0.20+0.10+0.10 = 0.40
$C_{42} = w_1+w_2+w_3+w_4$ = 0.60+0.20+0.10+0.10 = 1
$C_{43} = w_2+w_3+w_4$ = 0.20+0.10+0.10 = 0.40
$C_{45} = w_2+w_3+w_4$ = 0.20+0.10+0.10 = 0.40
$C_{51} = w_1+w_3+ w_4$ = 0.60+0.10+0.10 = 0.80
$C_{52} = w_1+w_4$ = 0.60+0.10 = 0.70
$C_{53} = w_1+w_2+w_3+w_4$ = 0.60+0.20+0.10+0.10 = 1
$C_{54} = w_1+w_4$ = 0.60+0.10 = 0.70

Concordance matrix is:

$$C = \begin{bmatrix} - & 0.80 & 0.90 & 0.80 & 0.90 \\ 0.40 & - & 0.40 & 0.90 & 0.30 \\ 0.70 & 0.70 & - & 0.60 & 0.80 \\ 0.40 & 1 & 0.40 & - & 0.40 \\ 0.80 & 0.70 & 1 & 0.70 & - \end{bmatrix}$$

Calculating matrix *discordance* (6).

$$D_{12} = \frac{\max\{|v_{1j}-v_{2j}|\} \quad j\in D_{12}}{\max\{|v_{1j}-v_{2j}|\} \quad \forall j}$$

$$D_{12} = \frac{\max\{0.0419-0.0524|;|0.0314-0.0419\}}{\max\{|0.2900-0.2320|;|0.0967-0.0967|;|0.0419-0.0524|;|0.0314-0.0419|\}} = \frac{\max\{0.0105;0.0105\}}{\max\{0.0580;0;0,0105;0,0105\}}$$

$$= \frac{0.0105}{0.0580} = 0.181$$

$$D_{13} = \frac{\max\{|v_{1j}-v_{3j}|\} \quad j\in D_{12}}{\max\{|v_{1j}-v_{3j}|\} \quad \forall j}$$

$$D_{13} = \frac{\max\{0.0314-0.0419\}}{\max\{|0.2900-0.2900|;|0.0967-0.0773|;|0.0419-0.0314|;|0.0314-0.0419|\}} = \frac{\max\{0.0105\}}{\max\{0;0.0193;0,0105;0,0105\}}$$

$$= \frac{0.0105}{0.0193} = 0.542$$

$$D_{14} = \frac{\max\{|v_{1j}-v_{4j}|\} \quad j\in D_{12}}{\max\{|v_{1j}-v_{4j}|\} \quad \forall j}$$

$$D_{14} = \frac{\max\{0.0419-0.0524|;|0.0314-0.0524\}}{\max\{|0.2900-0.2320|;|0.0967-0.0967|;|0.0419-0.0524|;|0.0314-0.0524|\}} = \frac{\max\{0.0105;0.0210\}}{\max\{0.0580;0;0,0105;0,0210\}}$$

$$= \frac{0.0210}{0.0580} = 0.361$$

$$D_{15} = \frac{\max\{|v_{1j}-v_{5j}|\} \quad j\in D_{12}}{\max\{|v_{1j}-v_{5j}|\} \quad \forall j}$$

$$D_{15} = \frac{\max\{0.0314-0.0524\}}{\max\{|0.2900-0.2900|;|0.0967-0.0773|;|0.0419-0.0419|;|0.0314-0.0524|\}} = \frac{\max\{0.0210\}}{\max\{0;0,0193;0;0,0210\}}$$

$$= \frac{0.0210}{0.0210} = 1$$

$$D_{21} = \frac{\max\{|v_{2j}-v_{1j}|\} \quad j\in D_{12}}{\max\{|v_{2j}-v_{1j}|\} \quad \forall j}$$

$$D_{21} = \frac{\max\{0.2320-0.2900\}}{\max\{|0.2320-0.2900|;|0.0967-0.0967|;|0.0524-0.0419|;|0.0419-0.0314|\}} = \frac{\max\{0.0580\}}{\max\{0.580;0;0.0105;0,0105\}}$$

$$= \frac{0.0580}{0.0580} = 1$$

$$D_{23} = \frac{\max\{|v_{2j}-v_{3j}|\} \quad j\in D_{12}}{\max\{|v_{2j}-v_{3j}|\} \quad \forall j}$$

$$D_{23} = \frac{\max\{0.2320-0.2900\}}{\max\{|0.2320-0.2900|;|0.0967-0.0773|;|0.0524-0.0314|;|0.0419-0.0419|\}} = \frac{\max\{0.0580\}}{\max\{0.580;0.0193;0.0210;0\}}$$

$$= \frac{0.0580}{0.0580} = 1$$

$$D_{24} = \frac{\max\{|v_{2j}-v_{4j}|\} \quad j\in D_{12}}{\max\{|v_{2j}-v_{4j}|\} \quad \forall j}$$

$$D_{24} = \frac{\max\{0.0419-0.0524\}}{\max\{|0.2320-0.2320|;|0.0967-0.0967|;|0.0524-0.0524|;|0.0419-0.0524|\}} = \frac{\max\{0.0105\}}{\max\{0;0;0;0.0105\}}$$

$$= \frac{0.0105}{0.0105} = 1$$

$$D_{25} = \frac{\max\{|v_{2j}-v_{5j}|\} \quad j\in D_{12}}{\max\{|v_{2j}-v_{5j}|\} \quad \forall j}$$

$$D_{25} = \frac{\max\{0.2320-0.2900|;|0.0419-0.0524\}}{\max\{|0.2320-0.2900|;|0.0967-0.0773|;|0.0524-0.0419|;|0.0419-0.0524|\}} = \frac{\max\{0.0580\}}{\max\{0.0580;0.0193;0.0105;0.0105\}}$$

$$= \frac{0.0580}{0.0580} = 1$$

$$D_{31} = \frac{\max\{|v_{3j}-v_{1j}|\} \quad j\in D_{12}}{\max\{|v_{3j}-v_{1j}|\} \quad \forall j}$$

$$D_{31} = \frac{\max\{0.0773-0.0967|;|0.0314-0.0419\}}{\max\{|0.2900-0.2900|;|0.0773-0.0967|;|0.0314-0.0419|;|0.0419-0.0314|\}} = \frac{\max\{0.0193;0.0105\}}{\max\{0;0.0193;0.0105;0.0105\}}$$

$$= \frac{0.0193}{0.0193} = 1$$

$$D_{32} = \frac{\max\{|v_{3j}-v_{2j}|\} \quad j\in D_{12}}{\max\{|v_{3j}-v_{2j}|\} \quad \forall j}$$

$$D_{32} = \frac{\max\{0.0773-0.0967|;|0.0314-0.0524\}}{\max\{|0.2900-0.2320|;|0.0773-0.0967|;|0.0314-0.0524|;|0.0419-0.0419|\}} = \frac{\max\{0.0193;0.0210\}}{\max\{0.0580;0.0193;0.0210;0\}}$$

$$= \frac{0.0210}{0.0580} = 0.361$$

$$D_{34} = \frac{\max\{|v_{3j}-v_{4j}|\} \quad j\in D_{12}}{\max\{|v_{3j}-v_{4j}|\} \quad \forall j}$$

$$D_{34} = \frac{\max\{0.0773-0.0967|;|0.0314-0.0524|;|0.0419-0.0524\}}{\max\{|0.2900-0.2320|;|0.0773-0.0967|;|0.0314-0.0524|;|0.0419-0.0524|\}} = \frac{\max\{0.0193;0.0210;0.0105\}}{\max\{0.0580;0.0193;0.0210;0.0105\}}$$

$$= \frac{0.0210}{0.0580} = 0.361$$

$$D_{35} = \frac{\max\{|v_{3j-V_{5j}}|\} \quad j\epsilon D_{12}}{\max\{|v_{3j-V_{5j}}|\} \quad \forall j}$$

$$D_{35} = \frac{\max\{0.0314-0.0419|;|0.0419-0.0524\}}{\max\{|0.2900-0.2900|;|0.0773-0.0773|;|0.0314-0.0419|;|0.0419-0.0524|\}} = \frac{\max\{0.0105;0.0105\}}{\max\{0;0;0.0105;0.0105\}}$$

$$= \frac{0.0105}{0.0105} = 1$$

$$D_{41} = \frac{\max\{|v_{4j-V_{1j}}|\} \quad j\epsilon D_{12}}{\max\{|v_{4j-V_{1j}}|\} \quad \forall j}$$

$$D_{41} = \frac{\max\{0.2320-0.2900\}}{\max\{|0.2320-0.2900|;|0.0967-0.0967|;|0.0524-0.0419|;|0.0524-0.0314|\}} = \frac{\max\{0.0580\}}{\max\{0.0580;0;0.0105;0.0210\}}$$

$$= \frac{0.0580}{0.0580} = 1$$

$$D_{42} = \frac{\max\{|v_{4j-V_{2j}}|\} \quad j\epsilon D_{12}}{\max\{|v_{4j-V_{2j}}|\} \quad \forall j}$$

$$D_{42} = \frac{\max\{0\}}{\max\{|0.2320-0.2320|;|0.0967-0.0967|;|0.0524-0.0524|;|0.0524-0.0419|\}} = \frac{\max\{0\}}{\max\{0;0;0;0.0105\}}$$

$$= \frac{0}{0.0105} = 0$$

$$D_{43} = \frac{\max\{|v_{4j-V_{3j}}|\} \quad j\epsilon D_{12}}{\max\{|v_{4j-V_{3j}}|\} \quad \forall j}$$

$$D_{43} = \frac{\max\{0.2320-0.2900\}}{\max\{|0.2320-0.2900|;|0.0967-0.0773|;|0.0524-0.0314|;|0.0524-0.0419|\}} = \frac{\max\{0.0580\}}{\max\{0.0580;0.0193;0.0210;0.0105\}}$$

$$= \frac{0.0580}{0.0580} = 1$$

$$D_{45} = \frac{\max\{|v_{4j-V_{5j}}|\} \quad j\epsilon D_{12}}{\max\{|v_{4j-V_{5j}}|\} \quad \forall j}$$

$$D_{45} = \frac{\max\{0.2320-0.2900\}}{\max\{|0.2320-0.2900|;|0.0967-0.0773|;|0.0524-0.0419|;|0.0524-0.0524|\}} = \frac{\max\{0.0580\}}{\max\{0.0580;0.0193;0.0105;0\}}$$

$$= \frac{0.0580}{0.0580} = 1$$

$$D_{51} = \frac{\max\{|v_{5j-V_{1j}}|\} \quad j\epsilon D_{12}}{\max\{|v_{5j-V_{1j}}|\} \quad \forall j}$$

$$D_{51} = \frac{\max\{0.0773-0.0967\}}{\max\{|0.2900-0.2900|;|0.0773-0.0967|;|0.0419-0.0419|;|0.0524-0.0314|\}} = \frac{\max\{0.0193\}}{\max\{0;0.0193;0;0.0210\}}$$

$$= \frac{0.0193}{0.0210} = 0.922$$

$$D_{52} = \frac{\max\{|v_{5j-V_{2j}}|\} \quad j\epsilon D_{12}}{\max\{|v_{5j-V_{2j}}|\} \quad \forall j}$$

$$D_{52} = \frac{\max\{0.0773-0.0967|;|0.0419-0.0524\}}{\max\{|0.2900-0.2320|;|0.0773-0.0967|;|0.0419-0.0524|;|0.0524-0.0419|\}} = \frac{\max\{0.0193;0.0105\}}{\max\{0.0580;0.0193;0.0105;0.0105\}}$$

$$= \frac{0.0193}{0.0580} = 0.333$$

$$D_{53} = \frac{\max\{|v_{5j-V_{3j}}|\} \quad j\epsilon D_{12}}{\max\{|v_{5j-V_{3j}}|\} \quad \forall j}$$

$$D_{53} = \frac{\max\{0\}}{\max\{|0.2900-0.2900|;|0.0773-0.0773|;|0.0419-0.0314|;|0.0524-0.0419|\}} = \frac{\max\{0\}}{\max\{0;0;0.0105;0.0105\}}$$

$$= \frac{0}{0.0105} = 0$$

$$D_{54} = \frac{\max\{|v_{5j}-V_{4j}|\} \quad j\in D_{12}}{\max\{|v_{5j}-V_{4j}|\} \quad \forall j}$$

$$D_{54} = \frac{\max\{0.0773-0.0967|;|0.0419-0.0524\}}{\max\{|0.2900-0.2320|;|0.0773-0.0967|;|0.0419-0.0524|;|0.0524-0.0524|\}} = \frac{\max\{0.0193;0.0105\}}{\max\{0.0580;0.0193;0.0105;0\}}$$

$$= \frac{0.0193}{0.0580} = 0.333$$

Discordance matrix is:

$$D = \begin{bmatrix} - & 0.181 & 0.542 & 0.361 & 1 \\ 1 & - & 1 & 1 & 1 \\ 1 & 0.361 & - & 0.361 & 1 \\ 1 & 0 & 1 & - & 1 \\ 0.922 & 0.7333 & 0 & 0.333 & - \end{bmatrix}$$

Calculating matrix dominant *concordance Threshold* (c) value is (7)

$$\underline{C} = \frac{0.8+0.9+0.8+0.9+0.4+0.4+0.9+0.3+0.7+0.7+0.7+0.9+0.4+1+0.4+0.4+0.8+0.7+1+0.7}{5(5-1)} = \frac{13.7}{20} = 0.685$$

The matrix element F is determined as follows:

$$f_{kl} = \begin{cases} 1, jika\ c_{kl} \geq \underline{c} \\ 0, jika\ c_{kl} < \underline{c} \end{cases}$$

So the concordance dominant matrix is $F = \begin{bmatrix} - & 1 & 1 & 1 & 1 \\ 0 & - & 0 & 1 & 0 \\ 1 & 1 & - & 1 & 1 \\ 0 & 1 & 0 & - & 0 \\ 1 & 1 & 1 & 1 & - \end{bmatrix}$

Calculating matrix dominant *discordance Threshold* (d) value is (8)

$$\underline{D} = \frac{0.181+0.542+0.361+1+1+1+1+1+1+0.361+0.361+1+1+0+1+1+0.922+0.333+0+0.333}{5(5-1)} = \frac{13.4}{20} =$$

0,67

And the matrix element G is determined as follows:

$$g_{kl} = \begin{cases} 1, jika\ c_{kl} \geq \underline{d} \\ 0, jika\ c_{kl} < \underline{d} \end{cases}$$

The dominant matrix of discordance is

$$G = \begin{bmatrix} - & 0 & 0 & 0 & 1 \\ 1 & - & 1 & 1 & 1 \\ 1 & 0 & - & 0 & 1 \\ 1 & 0 & 1 & - & 1 \\ 1 & 0 & 0 & 0 & - \end{bmatrix}$$

Specifies the aggregate dominance matrix. The general formula for members of the aggregate dominance matrix is (9)

$e_{kl} = f_{kl} \text{x} g_{kl}$

The aggregate dominance matrix is

$$E = \begin{bmatrix} - & 0 & 0 & 0 & 1 \\ 0 & - & 0 & 1 & 0 \\ 1 & 0 & - & 0 & 1 \\ 0 & 0 & 0 & - & 0 \\ 1 & 0 & 0 & 0 & - \end{bmatrix}$$

Alternative elimination is less favorable. Matrix E provides a sequence of options from each alternative, ie if e_{kl}=1 then alternative A_k is a better alternative than A_1. Thus, the rows in the E matrix that have the number of e_kl = more can be eliminated. Thus, A_3 is better than A_1. A_3 when compared to A_2, alternative A_3 is better than A_2 because it has more number 1. If A_3 compared to A_4 and A_5 alternatives more than other alternatives and can be seen in table 3.

Table 3. Calculation Results

Alternative	Criteria			
	C1	C2	C3	C4
A3	1	0	0	1
A5	1	0	0	0
A2	0	0	1	0
A1	0	0	0	1
A4	0	0	0	0

4. Conclusion

The calculation process produces a consistent value based on the criteria despite having many alternatives and the application of the ELECTRE method is very suitable for the selection of drumband athletes and the completion steps are quite simple where the results of the calculation process are given in table form

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