Social sports Competition Scoring System Design Using Single Value Neutrosophic Environment

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Abstract

The goal of this work the critical criteria that affect social sports competition organization's arrangement. Then determine the relations between criteria with others and alternatives. So, the evaluation of the process of social sports competition contains many conflict criteria. The multi-criteria decision-making (MCDM) process is an effective tool for dealing with conflict and complex criteria. This work employs a new integrated model for dealing with the problem in an analytical hierarchal process (AHP) and Višekriterijumsko Kompromisno Rangiranje (VIKOR) methods under single-valued neutrosophic sets (SVNSs). SVNSs are the best tool for overcoming uncertainty and incomplete information. The AHP method is used for computing the weights of criteria then VIKOR is used for rank alternatives. The twelve criteria and five alternatives are used in this problem. An illustrative example is provided to present a robust hybrid model. This paper can help organizations and countries for arrangement and organize social sports completion with a scoring system design.

Keywords: Social sports competition; AHP; VIKOR; SVNSs

1. Introduction

The development of social sports events has become a trend due to the development of technologies and computers. The process of social sports events has many steps like organizing, planning, controlling, and leading. The critical level in all these is an organized arrangement. Much of the research move toward social

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sports competition organization arrangement. Zaizhen et al. [1]developed a new virtual reality for a combined competition project arrangement system. The main benefit of their model visualizations.

These days, many researchers construct large events and social sports competition arrangement systems. Social sports are essential due to introducing many competitions and services. It has many features and factors like rules of competition, customers, features of project management, market, economic, financial, and cultural. It can achieve demands by the experience of bodies. The main benefit of social sports completion organization arrangement provides many benefits for economic, government, political, society, cultural, ecological, and multiple fields[2]. Completion organization arrangement is a core factor in social sports. So, this study proposed twelve factors and five alternatives to rank the critical factor that organizers consider in social sports completion with the scoring system and responsible for making the scoring system[3], [4].

This work makes a study with a multi-criteria decision-making (MCDM) with conflict and complex criteria under a neutrosophic environment. We use an SVNSs scale with three values such as truth, indeterminacy, and falsity value. The AHP method is used for calculating the weights of the criteria. It builds a comparison matrix between criteria and others. Then VIKOR method is used to rank alternatives in this work. The AHP and VIKOR method used in different fields like healthcare, industry, and manufacturing[5]–[10].

This work employs SVNSs with AHP and VIKOR methods for social sports competition organization arrangement and score system.

The rest of this work: section 2 provides the methodology for this paper. Section 3 provides results and discussion, and section 4 presents the conclusion.

2. Methodology

2.1 The AHP method

Step 1. Define the problem and its objectives
Step 2: Collect experts, criteria, and alternatives
Step 3: Build a pairwise comparison matrix between criteria and other opinions of experts
Step 4. Convert three values of SVNSs into one value

$$S(a) = \frac{2 + x - y - z}{3} \quad (1)$$

x, y, z, present truth, indeterminacy, and falsity of the SVNNs.
Step 5. Combine the matrix which contains opinions of experts into one matrix by average method

Step 6. Build normalized pairwise comparison matrix

$$r_f^b = \frac{r_f}{\sum_{f=1}^{b} r_f} \quad (2)$$

Where r presents the value of the matrix, b, f-number of criteria and alternatives
Step 7. Calculate the weights of 12 criteria by the average of the row in the normalized decision matrix.

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Step 8. Test consistency opinions of experts.

2.2 The VICKOR Method

Step 1. Build a decision matrix between criteria and alternatives then combine them into one matrix.

Step 2. Calculate the maximum and minimum values for positive and negative criteria

$$k_d^+ = \max_x k_{cd} \quad (3)$$

$$k_d^- = \min_x k_{cd} \quad (4)$$

Step 3. Compute the values v_c and s_c

$$v_c = \sum_{d=1}^{c} (W_d \frac{k - k_{cd}}{k_d^+ - k_d^-}) \quad (5)$$

$$s_c = \max_d (W_d \frac{k_d^+ - k_{cd}}{k_d^+ - k_d^-}) \quad (6)$$

Step 4. Compute the maximum value and minimum value of v_c and s_c

$$v_c^+ = \min_c v_c \quad (7)$$

$$v_c^- = \max_c v_c \quad (8)$$

$$s_c^+ = \min_c s_c \quad (9)$$

$$s_c^- = \max_c s_c \quad (10)$$

Step 5. Calculate the P_c

$$p_c = I * \frac{v_c - v_c^+}{v_c^- - v_c^+} + (1 + j) * \frac{s_c - s_c^+}{s_c^- - s_c^+} \quad (11)$$

Where j =0.5

Step 6. Rank alternatives according to the decreasing order of p_c

Figure 1: Criteria of this work

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Director of Marketing (A1)

Director of Volunteers (A2)

Director of Competitive Program (A3)

Director of Academic (A4)

Director of Coaching

Figure 2: Five alternatives of this work.

3. Results

The first step, collect criteria and alternatives, Fig 1 and 2 present criteria and alternatives. Then compute the weights of the criteria. Select three experts who have experience in the field. Use an SVNN in Table 1 to build a three-pairwise matrix between criteria and others by experts in Table 2-4. The combined pairwise comparison matrix is in Table 5. Then normalized pairwise comparison matrix into Table 6. Then compute the weights of the criteria in Table 7. Fig 3 shows the weights of the criteria. The best criteria are Sponsors, and the lowest weight is government.

Table 2: Pairwise comparison matrix by the first expert

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}
C_1	0.5	0.283	0.8167	0.9	0.9	0.867	0.9	0.8167	0.383	0.8167	0.8167	0.9
C_2	3.533569	0.5	0.283	0.8167	0.8167	0.8167	0.383	0.283	0.283	0.8167	0.9	0.9
C_3	1.22444	3.533569	0.5	0.283	0.283	0.9	0.9	0.9	0.9	0.9	0.9	0.383
C_4	1.111111	1.22444	3.533569	0.5	0.383	0.383	0.9	0.8167	0.283	0.8167	0.8167	0.9
C_5	1.111111	1.22444	3.533569	2.610966	0.5	0.283	0.8167	0.8167	0.383	0.8167	0.283	0.383

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C_6	1.153403	1.22444	1.111111	2.610966	3.533569	0.5	0.9	0.9	0.283	0.283	0.8167	0.8167
C_7	1.111111	2.610966	1.111111	1.111111	1.22444	1.111111	0.5	0.9	0.8167	0.383	0.8167	0.9
C_8	1.22444	3.533569	1.111111	1.22444	1.22444	1.111111	1.111111	0.5	0.9	0.283	0.9	0.8167
C_9	2.610966	3.533569	1.111111	3.533569	2.610966	3.533569	1.22444	1.111111	0.5	0.283	0.9	0.9
C_{10}	1.22444	1.22444	1.111111	1.22444	1.22444	3.533569	2.610966	3.533569	3.533569	0.5	0.383	0.283
C_{11}	1.22444	1.111111	1.111111	1.22444	3.533569	1.22444	1.22444	1.111111	1.111111	2.610966	0.5	0.383
C_{12}	1.111111	1.111111	2.610966	1.111111	2.610966	1.22444	1.111111	1.22444	1.111111	3.533569	2.610966	0.5

Table 3: Pairwise comparison matrix by the second expert

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}
C_1	0.5	0.9	0.9	0.8167	0.8167	0.9	0.8167	0.9	0.9	0.9	0.9	0.283
C_2	1.111111	0.5	0.383	0.9	0.9	0.283	0.383	0.283	0.283	0.8167	0.9	0.9
C_3	1.111111	2.610966	0.5	0.283	0.9	0.8167	0.283	0.383	0.8167	0.9	0.8167	0.383
C_4	1.22444	1.111111	3.533569	0.5	0.283	0.383	0.9	0.9	0.8167	0.283	0.8167	0.8167

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C_5	1.22444	1.111111	1.111111	3.533569	0.5	0.283	0.8167	0.8167	0.283	0.8167	0.383	0.8167
C_6	1.111111	3.533569	1.22444	2.610966	3.533569	0.5	0.9	0.283	0.283	0.283	0.8167	0.9
C_7	1.22444	2.610966	3.533569	1.111111	1.22444	1.111111	0.5	0.9	0.8167	0.9	0.9	0.383
C_8	1.111111	3.533569	2.610966	1.111111	1.22444	3.533569	1.111111	0.5	0.283	0.283	0.9	0.8167
C_9	1.111111	3.533569	1.22444	1.22444	3.533569	3.533569	1.22444	3.533569	0.5	0.9	0.8167	0.9
C_{10}	1.111111	1.22444	1.111111	3.533569	1.22444	3.533569	1.111111	3.533569	1.111111	0.5	0.383	0.9
C_{11}	1.111111	1.111111	1.22444	1.22444	2.610966	1.22444	1.111111	1.111111	1.22444	2.610966	0.5	0.8167
C_{12}	3.533569	1.111111	2.610966	1.22444	1.22444	1.111111	2.610966	1.22444	1.111111	1.111111	1.22444	0.5

Table 4: Pairwise comparison matrix by the third expert

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}
C_1	0.5	0.8167	0.283	0.9	0.9	0.8167	0.8167	0.9	0.8167	0.8167	0.9	0.8167
C_2	1.22444	0.5	0.383	0.383	0.383	0.8167	0.383	0.8167	0.283	0.8167	0.9	0.9
C_3	3.533569	2.610966	0.5	0.9	0.383	0.8167	0.8167	0.283	0.9	0.283	0.8167	0.8167

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C_4	1.111111	2.610966	1.111111	0.5	0.283	0.9	0.9	0.8167	0.283	0.9	0.383	0.8167
C_5	1.111111	2.610966	2.610966	3.533569	0.5	0.283	0.8167	0.8167	0.8167	0.8167	0.383	0.8167
C_6	1.22444	1.22444	1.22444	1.111111	3.533569	0.5	0.9	0.283	0.283	0.9	0.8167	0.9
C_7	1.22444	2.610966	1.22444	1.111111	1.22444	1.111111	0.5	0.8167	0.8167	0.283	0.9	0.8167
C_8	1.111111	1.22444	3.533569	1.22444	1.22444	3.533569	1.22444	0.5	0.9	0.8167	0.383	0.8167
C_9	1.22444	3.533569	1.111111	3.533569	1.22444	3.533569	1.22444	1.111111	0.5	0.9	0.8167	0.8167
C_{10}	1.22444	1.22444	3.533569	1.111111	1.22444	1.111111	3.533569	1.22444	1.111111	0.5	0.383	0.383
C_{11}	1.111111	1.111111	1.22444	2.610966	2.610966	1.22444	1.111111	2.610966	1.22444	2.610966	0.5	0.8167
C_{12}	1.22444	1.111111	1.22444	1.22444	1.22444	1.111111	1.22444	1.22444	1.22444	2.610966	1.22444	0.5

Table 5: Combined Pairwise comparison matrix

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}
C_1	0.5	0.666567	0.666567	0.872233	0.872233	0.861233	0.844467	0.872233	0.6999	0.844467	0.872233	0.666567
C_2	1.956373	0.5	0.349667	0.6999	0.6999	0.6388	0.383	0.4609	0.283	0.8167	0.9	0.9

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C_3	1.956373	2.9185	0.5	0.488667	0.522	0.844467	0.666567	0.522	0.872233	0.694333	0.844467	0.527567
C_4	1.148887	1.648839	2.726083	0.5	0.316333	0.555333	0.9	0.844467	0.4609	0.666567	0.672133	0.844467
C_5	1.148887	1.648839	2.418549	3.226035	0.5	0.283	0.8167	0.8167	0.494233	0.8167	0.349667	0.672133
C_6	1.162984	1.99415	1.186664	2.111014	3.533569	0.5	0.9	0.488667	0.283	0.488667	0.8167	0.872233
C_7	1.186664	2.610966	1.956373	1.111111	1.22444	1.111111	0.5	0.872233	0.8167	0.522	0.872233	0.6999
C_8	1.148887	2.763859	2.418549	1.186664	1.22444	2.726083	1.148887	0.5	0.694333	0.4609	0.727667	0.8167
C_9	1.648839	3.533569	1.148887	2.763859	2.456325	3.533569	1.22444	1.918597	0.5	0.694333	0.844467	0.872233
C_{10}	1.186664	1.22444	1.918597	1.956373	1.22444	2.726083	2.418549	2.763859	1.918597	0.5	0.383	0.522
C_{11}	1.148887	1.111111	1.186664	1.686615	2.9185	1.22444	1.148887	1.611063	1.186664	2.610966	0.5	0.672133
C_{12}	1.956373	1.111111	2.148791	1.186664	1.686615	1.148887	1.648839	1.22444	1.148887	2.418549	1.686615	0.5

Table 6: Normalized combined Pairwise comparison matrix

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}
C_1	0.03096	0.030672	0.035788	0.049032	0.050774	0.053317	0.067019	0.06764	0.074788	0.073214	0.092113	0.077816

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C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}
0.121139	0.121139	0.071139	0.071139	0.072012	0.073478	0.071139	0.102096	0.073478	0.071139	0.121139
0.023008	0.134295	0.075872	0.075872	0.091761	0.120144	0.12718	0.162598	0.056343	0.051128	0.051128
0.018774	0.026845	0.146364	0.129852	0.063712	0.105038	0.129852	0.061684	0.10301	0.063712	0.115369
0.039344	0.02747	0.028107	0.181349	0.118669	0.06246	0.066707	0.155368	0.109976	0.094812	0.066707
0.040742	0.030386	0.018414	0.029106	0.205694	0.071276	0.071276	0.142986	0.071276	0.16989	0.09818
0.039547	0.052279	0.03438	0.01752	0.030954	0.068787	0.168766	0.218756	0.168766	0.075803	0.071125
0.030396	0.052901	0.071427	0.064816	0.071427	0.039681	0.091179	0.097175	0.191943	0.091179	0.130857
0.035742	0.04048	0.065487	0.063334	0.037895	0.06764	0.038774	0.148784	0.214333	0.124935	0.094953
0.03024	0.093203	0.04925	0.052811	0.03024	0.087269	0.074193	0.053428	0.205012	0.126801	0.122765
0.070807	0.060198	0.057791	0.070807	0.042367	0.045257	0.039959	0.060198	0.043349	0.226368	0.209685
0.095045	0.089181	0.070981	0.036927	0.086248	0.092113	0.076846	0.089181	0.040447	0.052803	0.178116
0.105067	0.061589	0.098584	0.078466	0.101826	0.081707	0.095343	0.101826	0.060939	0.078466	0.058371

Table 7: Weights of criteria

Criteria	Weights

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C_1	0.058595
C_2	0.054154
C_3	0.065831
C_4	0.06565
C_5	0.072667
C_6	0.0794
C_7	0.076238
C_8	0.087601
C_9	0.116173
C_{10}	0.111573
C_{11}	0.102253
C_{12}	0.109866

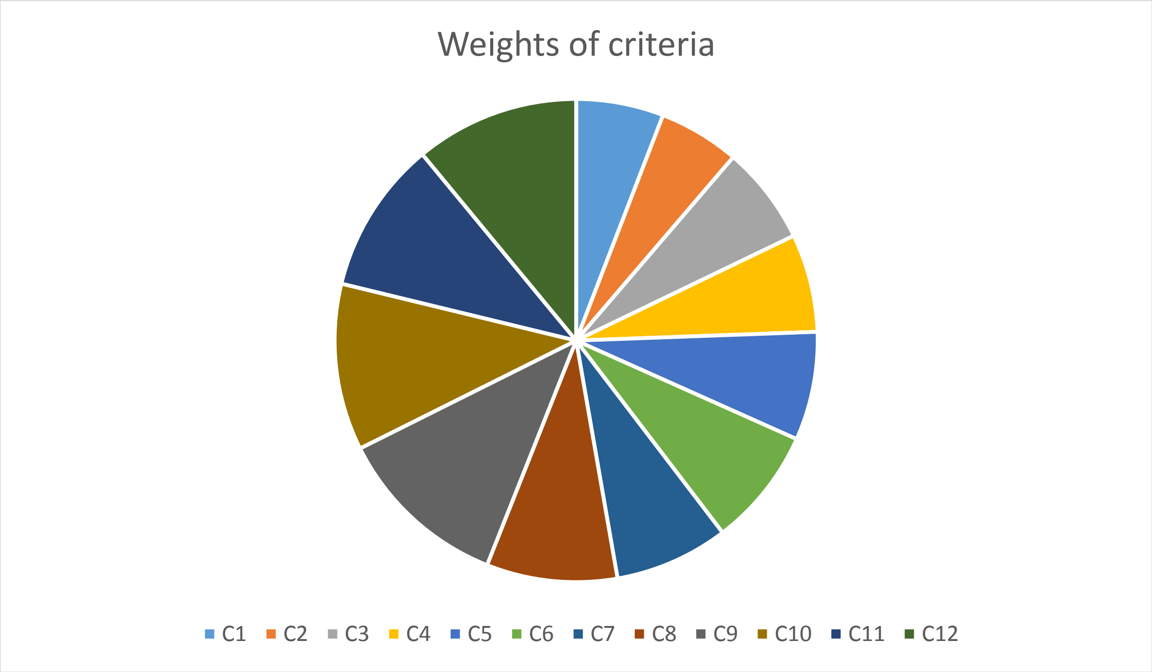

Figure 3: Present weights of criteria

Then compute the consistency opinions of experts is less than 0.1. So, the opinions of experts are consistent.

Then rank alternatives according to VIKOR method. First, build a decision matrix between criteria and alternatives in Table 8-10. Then combine three decision matrices into one matrix in Table 11. The normalized decision matrix is in Table 12. Then rank alternatives in Table 13. Fig 4 presents the rank of five alternatives. The best alternatives are the director of the competitive program then the director of marketing then the director of coaching then the director of volunteers.

Table 8: Decision matrix by the first expert.

C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}

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A_1	0.2833	0.9	0.9	0.8167	0.9	0.2833	0.3833	0.2833	0.8167	0.383	0.9	0.9
A_2	0.9	0.8167	0.9	0.2833	0.9	0.3833	0.2833	0.2833	0.283	0.283	0.8167	0.8167
A_3	0.8167	0.8167	0.283	0.3833	0.8167	0.8167	0.9	0.8167	0.383	0.9	0.283	0.9
A_4	0.8167	0.9	0.9	0.2833	0.8167	0.9	0.8167	0.9	0.9	0.8167	0.383	0.9
A_5	0.383	0.283	0.383	0.9	0.8167	0.8167	0.9	0.283	0.283	0.9	0.8167	0.8167

Table 9: Decision matrix by the second expert.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}
A_1	0.9	0.8167	0.8167	0.8167	0.383	0.9	0.9	0.9	0.283	0.9	0.8167	0.383
A_2	0.8167	0.9	0.9	0.2833	0.9	0.8167	0.2833	0.2833	0.283	0.283	0.8167	0.8167
A_3	0.283	0.8167	0.283	0.9	0.283	0.8167	0.9	0.383	0.383	0.8167	0.9	0.8167
A_4	0.283	0.283	0.383	0.2833	0.8167	0.9	0.8167	0.9	0.8167	0.8167	0.383	0.9
A_5	0.383	0.283	0.383	0.8167	0.9	0.9	0.8167	0.9	0.383	0.9	0.9	0.9

Table 10: Decision matrix by the third expert.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}

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A_1	0.283	0.9	0.283	0.9	0.9	0.8167	0.283	0.383	0.9	0.8167	0.9	0.9
A_2	0.8167	0.9	0.8167	0.2833	0.8167	0.8167	0.2833	0.2833	0.283	0.283	0.8167	0.8167
A_3	0.383	0.283	0.283	0.8167	0.283	0.9	0.8167	0.383	0.9	0.9	0.9	0.9
A_4	0.283	0.283	0.383	0.2833	0.9	0.8167	0.8167	0.9	0.8167	0.8167	0.383	0.283
A_5	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.8167	0.8167	0.383	0.283	0.383

Table 11: Combined decision matrix.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}
A_1	0.488767	0.872233	0.666567	0.844467	0.727667	0.666667	0.5221	0.5221	0.666567	0.6999	0.872233	0.727667
A_2	0.844467	0.872233	0.872233	0.2833	0.872233	0.672233	0.2833	0.2833	0.283	0.283	0.8167	0.8167
A_3	0.494233	0.6388	0.283	0.7	0.4609	0.844467	0.872233	0.527567	0.555333	0.872233	0.694333	0.872233
A_4	0.4609	0.488667	0.555333	0.2833	0.844467	0.872233	0.8167	0.9	0.844467	0.8167	0.383	0.694333
A_5	0.555333	0.488667	0.555333	0.872233	0.872233	0.872233	0.872233	0.666567	0.494233	0.727667	0.666567	0.6999

Table 12: Normalized combined decision matrix.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}

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A_1	0.054338	0	0.022978	0.003095	0.025539	0.0794	0.045325	0.05368	0.036809	0.032632	0	0.089281
A_2	0	0	0	0.06565	0	0.07725	0.076238	0.087601	0.116173	0.111573	0.011607	0.034296
A_3	0.053502	0.032958	0.065831	0.019199	0.072667	0.010725	0	0.052904	0.059825	0	0.037182	0
A_4	0.058595	0.054154	0.035405	0.06565	0.004905	0	0.007189	0	0	0.010515	0.102253	0.109866
A_5	0.044169	0.054154	0.035405	0	0	0	0	0.033159	0.072467	0.027374	0.042986	0.106428

Table 13: Rank alternatives

Alternatives	Rank
A_1	2
A_2	5
A_3	1
A_4	4
A_5	3

4. Conclusions

This paper uses five alternatives, twelve criteria, and three experts to evaluate the criteria and alternatives. The neutrosophic is employed for overcoming uncertain information. The AHP method is used for calculating the weights of criteria by building a pairwise comparison matrix. The sponsor is the highest weight of criteria, and the government is the lowest weight of criteria.

The VIKOR method was used for ranking alternatives. The experts evaluate criteria and alternatives. Then the decision matrix is built. Then ranking alternatives. The director of the competitive program is the highest rank, and the director of volunteers is the lowest rank.

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