Implementation of Simple Additive Weighting Method to Analyze the Selection of Rover/Ranger Mate Scout

Maoren G.F. K Banat
University of Technology Yogyakarta
Yogyakarta - Indonesia

Joko Aryanto
University of Technology Yogyakarta
Yogyakarta - Indonesia

ABSTRACT
Choosing a scout/ranger is an important process in determining leadership roles within the Scouting organization. This study presents an innovative solution that uses electronic voting technology supported by the SAW (Simple Additional Weighting) method to enhance the efficiency and security of the selection process. This system is designed to provide better access to all members of the organization to vote electronically for their preferred candidate. Implementing the SAW method helps evaluate each candidate's criteria based on academic, emotional, social and performance aspects. The results of this evaluation process will produce a top ranking for each candidate, helping voters make informed decisions. Once this system is in place, it could improve transparency, reduce the risk of human error and speed up the vote counting process. In addition, the system also provides a high level of security thanks to a dual authentication mechanism and strong data encryption. Therefore, this solution is not only effective in improving the efficiency of the selection process but also ensures data integrity and security throughout the process. This research positively contributes to the development of electronic voting technology in the context of rover/ranger companion selection. The implications of this research will lay the foundation for further advances in electronic voting systems and the use of the SAW method in other contexts.

General Terms
SAW Method

Keywords
Scout, E-Voting, Simple Additive Weighting (SAW), Assessment Criteria, Electronic Voting System.

1. INTRODUCTION
The world of technology today is no longer terrifying rather, it is now required in every aspect of existence. Most people incorporate technology into their daily routines. Including those of our pupils who attend vocational or high school especially the term “Mobile” technology. IT use has both positive and negative aspects. Information is data that has been transformed into a more usable and understandable form. Greater significance for the recipient. Data is the source of information. Reality information depict a true occurance and harmony. Events are things that happen at specific periods [1]

The Senior Scout, which gathers both Rover Scouts and Gang Scouts as members. A rover scout is accompanied by a Rover Scoutmaster who serves as their advisor and helps them lead their patrol[2]. The Senior Scout is responsible for managing numerous responsibilities and ensuring the seamless execution of all planned activities[3], [4]. Voting is an important decision-making activity results in each election [5]. There are concerns that needs to be taken into account, especially in terms of voting methods must be kept, what rules or regulations have been negotiated and how to determined who is elected and who is elected voting rights. Digital voting applications have become a viable alternative as information technology has developed, offering greater efficiency, security, and accessibility in the democratization process [6]. Different evaluation techniques and alternative selection strategies have been created in an effort to reduce prejudice and enhance the accuracy of election decisions.

Simple Additive Weighting (SAW) method is known as a weighted summation method. The Simple Additive Weighting (SAW) method, which has been successful in numerous multi-criteria decision-making scenarios, is one approach that has drawn attention [7] [8]. SAW gives us the ability to evaluate and contrast the effectiveness of various options or alternatives according to predetermined standards[9]. We may assign suitable weights to pertinent criteria by using SAW in the context of a voting application, allowing voters to make better decisions.

In this journal, we present the use of the SAW method in the context of digital voting applications, investigating its potential and benefits in improving general election processes. Through comprehensive analysis and simulation experiments, we aimed to evaluate the performance of the SAW-enhanced voting application to meet the needs of an increasingly interconnected modern society.

2. RESEARCH METHODS
To conduct research that produces research that can appropriately solve problems, it is necessary to organize. Research phases include a step-by-step process for researchers to conduct research. Where steps exist, Processes are performed in a structured, sequential, standard, logical and systematic manner [10]. Steps to follow this study is shown in Figure 1.

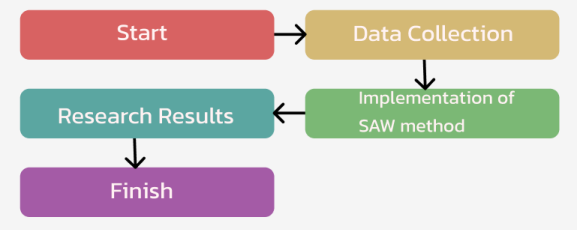

Figure 1 Stage of Research

Based on Figure 1, there are several stages, namely data collection is determining the problem in the process of determining the Rover/Ranger mate, here is the explanation.

a. Data collection is about identifying problems in the process of selecting Rover/Ranger mate. Data collection techniques refer to the methods used to obtain the

necessary information and data for a research study[11]. The problem faced is that the selection process for Rover/Ranger mates is still based on the highest number of votes and does not utilize other existing criteria.

b. The implementation of the SAW method in determining the Rover/Ranger mate is to find the weighted sum of the performance scores for each alternative over all attributes. The SAW method requires a process of normalizing the decision matrix (X) on a scale comparable to all available surrogate notations [12]. After obtaining the decision matrix, proceed to calculate the normalized matrix and calculate the priority values. This process will yield a total value and ranking for the candidates.

c. The results of this research will provide a solution in determining the best Rover/Ranger mate through a voting application that yields rankings using the Simple Additive Weighting (SAW) method.

3. METHODOLOGY

The utilization of the SAW method in this coting application aims to achieve the best results. Generally, during voting the final result is determined by the highest number of votes. However, when using this method, the final voting results are no longer based solely on the total number of votes but on a number of criteria [13]:

1. Determining alternatives, denoted as Ai.
2. Identify the criteria to be used as references in the decision-making process, denoted as Cj.
3. Assign weight values to each criterion as (W) each criterion W=[W1 W2 W3 W4]
4. Provide the appropriate evaluation scores for each option under each criterion.
5. Creating a decision matrix is formed from the compatibility rating table of each alternative for each criterion. The value of each alternative (Ai) for each predetermined criterion (Cj) is determined, where i=1,2m and j=1,2..n.

$$x = \begin{bmatrix} r11 & r12 \cdots & rij \\ \vdots & & \vdots \\ ri1 & ri2 \cdots & rij \end{bmatrix}$$

6. Normalize the decision matrix by calculating the normalized performance rating value (rij) for alternative Ai on criterion Cj.

The formula is:

a. If j is Benefit

$$Rij = \frac{Xij}{MaxXij}$$

b. If j is Cost

$$Rij = \frac{MinXij}{Xij}$$

Vi = ranking for each alternative

Wj = weight value of each criterion

Rij = normalized performance rating value

7. The results of the normalized performance ratings (rij) forms the normalized matrix (R)

$$R = \begin{bmatrix} r11 & r12 \cdots & rij \\ \vdots & & \vdots \\ ri1 & ri2 \cdots & rij \end{bmatrix}$$

8. The final preference values (Vi) are obtained by summing the products of the row elements of the normalized matrix (R) with the corresponding column elements of the preference weights (W)

$$Vi = \sum_{j=1}^{n} WjRij$$

3.1 Requirement analysis

The data specifications used include candidate data, criteria data, criteria aspect data, and result data. Candidate data originates from the biographical information of the Rover/Ranger mate candidates. Criteria data and criteria aspect data are used to assign values to each candidate and are calculated using the SAW method. Result data represents the outcome of the Rover/Ranger mate selection. The criteria used in this research are shown in table 1 as follows:

Table 1 Criteria Values and Criterion Aspects

Criteria	Criteria Aspect	The weight of criteria aspect
Academic Weight (W) = 2 (benefit)	Creative	1
	Innovative	2
	Intelligent	3
	Able to master Scouting material well and correctly	4
	Able to explain Scouting material effectively	5
Affective Weight (W) = 2 (benefit)	Able to solve problems wisely	1
	Firm in decision-making	2
	Courageous in making decisions and ready to bear the consequences	3
	Responsible	4
	Possesses leadership skills	5
Vision-Mission (W) = 1 (benefit)	Imaginable (can be imagined)	1
	Desirable (attractive)	2
	Realistic	3
	Clear and easily understood	4
	Aspirational and responsive to change	5
Social(W) = 2 (cost)	Able to socialize well	1
	Possesses good social etiquette	2
	Proficient in communication	3
	Able to place oneself in specific situations	4
	Respecting elders	5
Ego (W) = 3 (cost)	Rejecting advice and criticism from others	1

	More focused on gaining recognition, praise, and respect from others	2
	Prioritizing personal interests over collective interest	3
	Seeing oneself as superior and others as inferior	4
	Tending to exert power and not providing opportunities for others to progress	5

In the table above, there are five criteria in the test. These criteria are academic, affectivity, vision and mission, social, and ego. These five criteria aim to select the right person in the selection process. During the selection, careful consideration must be made to determine who is eligible for the opportunity to become a Rover/Ranger mate. The assessment of the suitability of each option according to each criterion is as follows:

Very low = 1

Low = 2

Fair = 3

High = 4

Very high = 5

Each criterion even has measurable value limits. These values differ for each criterion.

3.2 Implementation

The implementation of the system is demonstrated through the interface of the application when a voter is about to cast their vote for a candidate.

a. Login page
This page is the login page for users who have previously registered by entering their email and password.

Figure 2 Login Page

b. Dashboard Page
In this page contains three menus: choose candidate, candidate information, and voting results.

Figure 3 Dashboard Page

c. Select Candidate Page
The select candidate menu is used to select a candidate by assigning a value to each criterion.

Figure 4 Select Candidate Page

d. Candidate information page
In the candidate information menu, there is a photo, name, and vision-mission statement of each candidate.

Figure 5 Candidate Information Page

e. Vote Results Page
In the vote results menu, users can view the voting results after the election has concluded.

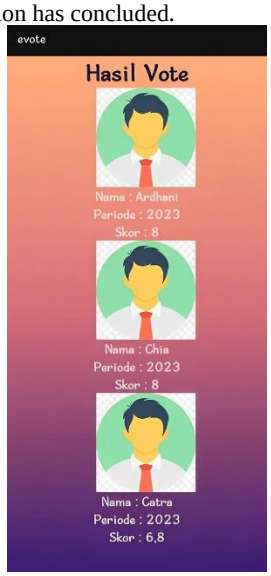

Figure 6 Vote Results Page

4. RESULTS AND DISCUSSION

A android-based system model for e-voting in Rover/Ranger mate elections consists of an admin module and a voter module. The admin module is accessed by the committee responsible for entering candidate data for Rover/Ranger mate within a specified time frame. Meanwhile, the voter module is used by voters to provide ratings for each criterion for each candidate. These values are then processed and calculated using the Simple Additive Weighting (SAW) method. The values for each criterion of each candidate are summed and averaged among as many voters as possible to form a normalize matrix (R). the following calculation determines the preference values for each alternative, in this case, Rover/Ranger mate candidates. Specifically, by summing the product of the normalized matrix (R) with the weight values (W). the highest score will be selected as the Rover/Ranger mate.

The test data is a sample taken to test and verify the SAW algorithm during the Rover/Ranger mate selection process. In this data, several names are taken as examples in choosing the Rover/Ranger mate. The following table explains the names and abilities based on criteria table in the previous chapter.

Table 2 Dataset

Name	C1	C2	C3	C4	C5
Ardhani	2	4	5	3	1
Catra	4	3	4	2	3
Shagufta	3	2	4	5	4
Chia	5	2	4	3	1

The criteria above represent utility criteria, where each criterion value is considered better when it is larger. The decision-maker assigns priority weights as follows W =(2,2,1,2,3). Here is the detailed calculation:

1. The benefit criterion factor using the following formula:
Rii = (Xij / max{Xij})

From column C1, the maximum value is 5, so each row in column C1 is divided by the maximum value in column C1

R11 = 2/5 = 0,4

R21 = 4/5 = 0,8

R31 = 3/5 = 0,6

R41 = 5/5 = 1

From column C2, the maximum value is 4, so each row in column C2 is divided by the maximum value in column C2

R21 = 4/4 = 1

R22 = 3/4 = 0,75

R23 = 2/4 = 0,5

R24 = 2/4 = 0,5

From column C3, the maximum value is 5, so each row in column C3 is divided by the maximum value in column C3

R31 = 5/5 = 1

R32 = 5/4 = 0,8

R33 = 5/4 = 0,8

R34 = 5/4 = 0,8

2. The cost criterion factor using the following formula:

Rii = (min {Xij} /Xij)

From column C4, the minimum value is 2, so each row in column C4 becomes the denominator for the maximum value in column C4

R41 = 2/3 = 0,6

R42 = 2/2 = 1

R43 = 2/5 = 0,4

R44 = 2/3 = 0,6

From column C5, the minimum value is 1, so each row in column C5 becomes the denominator for the maximum value in column C5

R51 = 1/1 = 1

R52 = 1/3 = 0,3

R53 = 1/4 = 0,25

R54 = 1/1 = 1

Table 3 The Values of the Normalized Matrix

0,4	1	1	0,6	1
0,8	0,75	0,8	1	0,3

0,6	0,5	0,8	0,4	0,25
1	0,5	0,8	0,6	1

Next, multiply each column in the table with the declared criteria weights (W) using the formula:

Ardhani: (0,4 * 2) + (1 * 2) + (1 * 1) + (0,6 * 2) + (1 * 3) = 8

Catra: : (0,8 * 2) + (0,75 * 2) + (0,8 * 1) + (1 * 2) + (0,3 * 3) = 6,8

Shagufta: : (0,6 * 2) + (0,5 * 2) + (0,8 * 1) + (0,4 * 2) + (0,25 * 3) = 4,55

Chia: (1 * 2) + (0,5 * 2) + (0,8 * 1) + (0,6 * 2) + (1 * 3) = 8

Table 4 Manual Calculation Table

Name	Score
Ardhani	8
Catra	6,8
Shagufta	4,55
Chia	8

From the calculations above, it can be seen that the highest scores are for Ardhani and Chia. With this result, it is declared that Ardhani is selected as the Rover Mate and Chia is selected as the Ranger Mate.

5. CONCLUSIONS

In this study, we present the SAW method for the selection of rover/ranger mates. Simple software such as MS Excel can be used to enhance the efficiency and ease of use of the proposed model. For future use of this model, candidate evaluations based on criteria alone will be sufficient, and conducting this evaluation with simple software will be faster. The limitation of this article is that SAW overlooks the uncertainty of executive judgments during the decision-making process. Additionally, some criteria may have a structure that cannot be precisely measured or may be qualitative. In such situations, evaluation matrices can be obtained using fuzzy numbers, and the suggested model can be expanded by incorporating fuzzy numbers.

6. REFERENCES

[1] Y. Darmayunata and F. Alfarasy Syam, "IMPLEMENTATION AND DEVELOPMENT OF E-VOTING SYSTEM FOR ELECTION OF STUDENT COUNCIL CHAIRPERSON OF SMP NEGERI 10 PEKANBARU."

[2] M. Sri Rahayu, "Aktualisasi Pramuka Pra Siaga dan Proses Pembinaannya dalam Perspektif Pendidikan Karakter Bangsa", doi: 10.32585/jp.v28i2.342.

[3] "312-Article Text-1559-1-10-20210115".

[4] "2520-2530".

[5] D. Sartika, L. Novianti, D. Irmawati, and I. Meiriska, "Android-Base m-Voting Application Development With Simple Additive Weighting Method," 2021. [Online]. Available: www.oxforddictionaries.com

[6] P. Wolf, Rushdi. Nackerdien, Domenico. Tuccinardi, and International Institute for Democracy and Electoral Assistance., Introducing electronic voting : essential considerations.

[7] E. Elviwani, A. Hasudungan Lubis, A. Putera Utama Siahaan, M. Donni Lesmana Siahaan, and A. Br Surbakti, "Implementation of Simple Additive Weighting Algorithm in Particular Instance," 2017, [Online]. Available: www.ijsrst.com

[8] M. R. Ramadhan and M. Khairul, "Penerapan Metode SAW (Simple Additive Weighting) Dalam Pemilihan Siswa-Siswi Berprestasi Pada Sekolah SMK Swasta Mustafa," Terapan Informatika Nusantara, vol. 1, no. 9, pp. 459–471, 2021, [Online]. Available: https://ejurnal.seminar-id.com/index.php/tin

[9] A. Yulandari and S. Risqika, "Sistem Pendukung Keputusan Pemilihan Calon Ketua OSIS Menggunakan Metode Saw Pada Sma Negeri 3 Sigi Berbasis Website," 2020.

[10] J. Rahmadian and J. Fajaryanti, "IMPLEMENTATION OF THE SIMPLE ADDITIVE WEIGHTING (SAW) METHOD FOR SELECTION OF SALESPERSON," 2023. [Online]. Available: https://ejurnal.teknokrat.ac.id/index.php/teknoinfo/index

[11] T. Darma Rosmalasari, M. Ayu Lestari, F. Dewantoro, and E. Russel, "PENGEMBANGAN E-MARKETING SEBAGAI SISTEM INFORMASI LAYANAN PELANGGAN PADA MEGA FLORIST BANDAR LAMPUNG," 2020. [Online]. Available: https://ejurnal.teknokrat.ac.id/index.php/teknoabdimas

[12] P. Metode SAW, M. Elistri, J. Wahyudi, and R. Supardi, "PENERAPAN METODE SAW DALAM SISTEM PENDUKUNG KEPUTUSAN PEMILIHAN JURUSAN PADA SEKOLAH MENENGAH ATAS NEGERI 8 SELUMA," Jurnal Media Infotama, vol. 10, no. 2, 2014.

[13] A. Setiadi et al., "Penerapan Metode Simple Additive Weighting(SAW) Untuk Pemilihan Siswa Terbaik," 2018.