Analysis of the CoCoSo Method for Selecting Cleaning Staff at SMK Negeri 2 Ulu Moro'o School

Adil Pikir Gulo, Zulham Sitorus

Abstract

At SMK Negeri 2 Ulu Moro'o, the selection of cleaning staff has been done manually, without written standards and clear assessments, making it subjective and difficult to justify. The purpose of this research is to implement and analyse the Combination of Compromise Solution (CoCoSo) method, which is used as the basis for a Decision Support System to select cleaning staff. The Rank Order Centroid (ROC) method evaluates six qualities: cleanliness results, discipline and attendance, responsibility, attitude and communication, safety compliance, and education and experience. To evaluate candidates, CoCoSo is used through min-max normalisation, weighted sum and weighted multiplication calculations, three compromise assessment strategies, and final scores. The sensitivity test of the parameter λ and the Spearman rank correlation against the Simple Additive Weighting (SAW) method were used to test the consistency of the results. The calculation results for the eight candidates show that candidate A2 received the highest final score of 3.2235, followed by candidate A4 with a score of 3.0999 and candidate A6 with a score of 3.0294. The first rank remains stable across all λ values from 0.1 to 1.0, and the CoCoSo ranking is highly consistent with SAW ($\rho = 0.9286$). Therefore, the ROC–CoCoSo method can be used as a tool to help select fair, honest, and accountable cleaning staff in the school environment.

Keywords: *CoCoSo, Rank Order Centroid, decision support system, cleaning staff, vocational high school*

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Introduction

To enable healthy, comfortable, and enjoyable learning, the school environment must be clean. [1] found that the cleanliness of classrooms and school environments positively contributes to students' comfort, concentration, and readiness to learn. These findings are in line with the systematic research by [2], which identifies classroom cleanliness, lighting, and ventilation as important components of the physical environment that influence learning motivation. Therefore, school cleanliness is part of the quality of educational services and not just an aesthetic issue.

School cleanliness does not only depend on the participation of students and educators, but also on the workforce specifically assigned to do it. According to the National Education Minister Regulation Number 24 of 2008 concerning School/Madrasah Administration Staff Standards, cleaning staff must be part of the school's special service personnel and possess minimum qualifications [3]. This shows that cleaning staff are an official component of the educational workforce, so their selection must be carried out systematically, measurably, and accountably.

SMK Negeri 2 Ulu Moro'o is a state vocational high school located in Loloana'a Village, Ulu Moro'o District, Nias Barat Regency, North Sumatra Province. Because of its status as a vocational school, cleanliness is required in all school facilities, including practice rooms, courtyards, and common areas. According to initial observations and interviews with the school authorities, the selection of cleaning staff at SMK Negeri 2 Ulu Moro'o for the cleanliness of the school and garden is still disorganised because there are only a few cleaning workers. This task continues to be carried out manually without written standards and clear weighting. This condition can lead to subjectivity, inconsistency in candidate assessments, and decisions that are difficult to justify for school staff members.

Previous studies also found issues of subjectivity in the assessment of cleaning staff. According to [4], a Decision Support System (DSS)-based approach is necessary because the evaluation method for cleaning staff at RSUD Banyumas is considered inaccurate and subjective. The selection of cleaning staff is essentially a multi-criteria decision-making (MCDM) problem, as each candidate must be compared based on several criteria simultaneously, such as discipline, work quality, responsibility, attitude, physical condition, and experience. These criteria have different levels of importance and can conflict with each other, making it difficult to make an objective decision based solely on their considerations.

SPK is a computer-based system that utilises data and models to assist decision-makers in solving semi-structured problems. In the local context, DSS is considered an aid that offers alternative choices rather than replacing the role of decision-makers. Various methods have been used to implement DSS on the object of cleaning staff. This includes the AHP-TOPSIS combination [4], COPRAS [5], the entropy-COPRAS combination [6], AHP [7]. The Multi-Objective Optimisation Ratio Analysis (MOORA) and MOORSA methods are used to develop a Decision Support System (DSS) [8]. However, most of these studies were conducted in cleaning companies or hospitals, and most focused on evaluating the performance of employees who were already working, rather than selecting employees to work in schools.

Introduced the mixed conflict solution (CoCoSo), which is one of the relatively new and rapidly developing MCDM methods. This method combines the Simple Additive Weighting model and the Weighted Product model. Then, three compromise aggregation approaches are used along with the multiplication rule to compile the ranking. This structure makes the ranking results more stable than methods that rely on a single aggregation model. [9] chose CoCoSo because it is very flexible compared to other MCDM methods. [10] state that CoCoSo is effective for complex multivariable assessment problems. However, there are some limitations in real cases that need to be tested.

CoCoSo has been used in Indonesia to address various selection issues. [11] used CoCoSo to select the head of the school committee at SMP Negeri 1 Rantau Selatan. They found that this method can produce recommendations that are more transparent, honest, and

accountable than other methods. [12] used CoCoSo and AHP to assess the performance of village heads, and [13] used CoCoSo to determine the eligibility of employee incentives with 85% accuracy. The results indicate that CoCoSo can be used for employee recruitment, including in educational units.

The study has not yet demonstrated the CoCoSo method for selecting cleaning staff, particularly in vocational high schools in regions such as West Nias Regency. All aspects of the research, including methods, objects, and locations, are based on this gap. It is expected that this research will produce an objective and measurable model for selecting cleaning staff and test the CoCoSo method at SMK Negeri 2 Ulu Moro'o.

Literature Review

2.1 School Cleaning Staff

According to the [3], cleaning staff join school guards, gardeners, drivers, and messengers as part of the special service staff within the school administrative structure. According to the law, special service officers must have at least a junior high school/equivalent education. Maintaining the cleanliness of classrooms, practice rooms, toilets, yards, and school facilities is their main responsibility. Cleaning staff must be selected based on clear standards because school cleanliness is related to student comfort and their concentration in learning [1].

2.2 Decision Support System (DSS)

A computer-driven framework known as a Decision Support System (DSS) helps decision-makers analyse data and models to deal with unstructured or semi-structured problems. emphasises that while Decision Support Systems (DSS) are tools to enhance decision-making skills, they do not replace decision-makers' judgement. noted that a Decision Support System (DSS) is an aspect of an information system that effectively facilitates decision-making, especially in educational contexts such as determining students' areas of interest and study. Different methods of decision support have been applied in the field of extracurricular selection. For example, in addition to the Preference Selection Index (PSI), there is Simple Additive Weighting (SAW), which combines SMART and MOORA. These methods produce rankings based on the weights of the criteria. Aligning student characteristics with the demands of each extracurricular activity is the study's issue. As a result, a method based on profile alignment is needed.

2.3 Multi-Criteria Decision Making (MCDM)

MCDM is an approach based on several criteria that are usually conflicting to filter, prioritise, rank, or select alternatives from various options [14]. The decision matrix, evaluation criteria, alternatives (prospective cleaning staff), and criteria weights are components of MCDM. The criteria consist of benefit criteria, which indicate higher quality, and cost criteria, which indicate lower quality.

2.4 Criteria Weighting with Rank Order Centroid (ROC)

CoCoSo requests criterion weights but does not specify how to determine them. To conduct this research, Rank Order Centroid (ROC) is a technique that transforms the order of importance of criteria into numerical weights. Because decision-makers are more confident and find it easier to reach an agreement on the order of criteria compared to the magnitude of the weights, [14] explains that rank-based weighting is more accurate than direct weighting. To determine the weight of the j-th criterion out of n criteria, use the following formula:

$$w_j = \frac{1}{n} \sum_{k=j}^{n} \frac{1}{k}$$

For example, the school sets the order of criteria, with weights of 0.4083; 0.2417; 0.1583; 0.1028; 0.0611; and 0.0278, each with a total weight of 1.

2.5 Criteria Weighting with Rank Order Centroid (ROC)

[15] introduced CoCoSo as a method that combines the weighted sum model (SAW) and the weighted product model (WP). Then, three compromise strategies are used to combine them. The process is as follows. Step One: Develop the decision matrix. For criteria m and n, the value of candidate i on criterion j is written as x_ij.

$$X = [x_{ij}]_{m \times n}$$

Step 2: Normalisation. The following formula is used for normalising profit and cost.

$$r_{ij} = \frac{x_{ij} - \min_i x_{ij}}{\max_i x_{ij} - \min_i x_{ij}} \quad \text{(benefit)}$$

Step 3: Finding S_i (weighted sum) and P_i (weighted product).

$$S_i = \sum_{j=1}^{n} w_j \, r_{ij}, \qquad P_i = \sum_{j=1}^{n} (r_{ij})^{w_j}$$

Step 4: Calculate three approaches for compromise assessment. The value of λ is usually set at 0.5 and falls between 0 and 1.

$$k_{ia} = \frac{P_i + S_i}{\sum_{i=1}^{m} (P_i + S_i)}, \qquad k_{ib} = \frac{S_i}{\min_i S_i} + \frac{P_i}{\min_i P_i}$$

Step 5: Finding the final score and assessment. The main recommendation is the candidate with the highest k_i score.

$$k_i = (k_{ia} \, k_{ib} \, k_{ic})^{1/3} + \frac{1}{3} (k_{ia} + k_{ib} + k_{ic})$$

CoCoSo combines various aggregation strategies, making the rankings more stable and flexible for different problems (Yazdani et al., 2019). Due to the fact that CoCoSo results can be unstable in some situations, propose an alternative called CoCoFISo.

Research Methodology

The problem formulation is reinforced by previous research, and the chosen approach is based on theory. The framework of thought shows the logical flow from the problem to the research results. SPK based on ROC and CoCoSo addresses the issue of subjective selection. The result is a ranking of candidates that can be justified to the school leadership.

In the intersection of two clusters of literature on decision support systems for cleaning staff and the application of CoCoSo for HR selection, this research fills the gap.

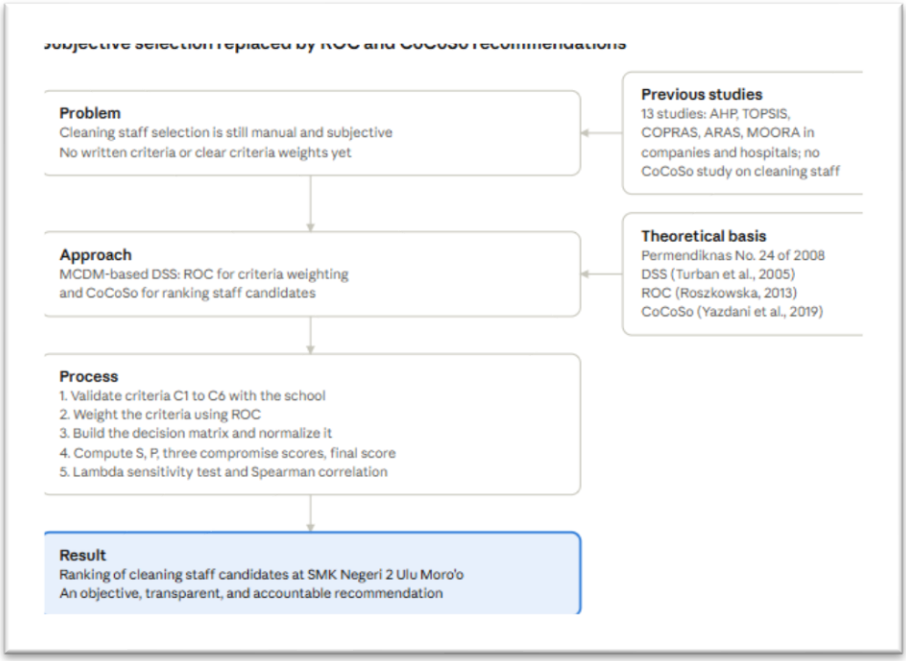


Figure 1. Research Conceptual Framework

Figure 1 shows the research framework. It starts with the problem, approach, process, and finally the results. The selection of cleaning staff at SMK Negeri 2 Ulu Moro'o is the main issue of this research because it is conducted subjectively and manually without written criteria or clear measurements. 13 previous studies using the AHP, TOPSIS, COPRAS, ARAS, and MOORA methods in cleaning service companies and hospitals reinforce the conclusion of this issue. However, there has been no research using CoCoSo for the selection of cleaning staff. This study uses a Decision Support System (DSS) based on Multi-Criteria Decision Making (MCDM), which employs Rank Order Centroid (ROC) for criterion weighting and Combined Compromise Solution (CoCoSo) for candidate ranking to address the problem. The CoCoSo method developed Permendiknas No. 24 of 2008, the DSS concept according, and the ROC method according to are the foundation of this approach.

The research process consists of five steps. Criteria C1 to C6 are validated with the school, weighted with ROC, created and normalised decision matrices, calculated weighted sum values (S), weighted product values (P), three compromise assessment strategies, and the final value for each candidate. Next, the results were tested with value sensitivity (lambda) and Spearman rank correlation to ensure the consistency of the results. The research produced a ranking of candidates for the cleaning staff at SMK Negeri 2 Ulu Moro'o, which can be used by the school as an unbiased, honest, and sincere recommendation. Therefore, this framework of thought demonstrates how the theoretical and empirical foundations, the methods used, the field problems, and the expected outcomes of the research all logically correlate with one another.

Results

4.1 Alternative Data, Criteria, and Decision Matrix

At the analysis stage, the results of manual calculations were used, which showed that candidate A2 is the most recommended cleaning staff, with a final CoCoSo score of 3.2235. This study outlines the calculations step by step, starting from ROC weighting to the consistency test of the results.

In the alternative study, eight candidates for the janitor position coded A1 to A8 were evaluated based on six criteria using a Likert scale of 1 to 5, with each criterion indicating a type of advantage, so that higher scores indicate more talented candidates.

Table 1. Evaluation Scale

Value	Explanation
1	Very lacking
2	Less
3	Enough
4	Good
5	Very good

In the order of criteria C1 to C2 to C3 to C4 to C5 to C6, the quality of cleanliness results, discipline and attendance, responsibility, attitude, and communication, compliance with safety regulations, and education and experience are the most important. The principal must confirm this order.

Table 2. Decision Matrix (X)

Alternative	C1	C2	C3	C4	C5	C6
A1	4	5	4	3	4	3
A2	5	4	4	4	3	4
A3	3	3	4	5	4	2
A4	4	4	5	4	5	3
A5	2	3	3	3	2	5
A6	5	5	3	4	4	2
A7	3	4	2	2	3	4
A8	4	2	3	4	3	3
Maks	5	5	5	5	5	5
Min	2	2	2	2	2	2

4.2 Profile Criteria Weighting with ROC

Because it is in the first position, criterion C1 receives the largest weight, which is 0.4083. The ROC formula for n = 6 criteria is used to calculate the weight:
Calculation of each weight:

$$w_1 = \frac{1}{6}\left(1+\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\frac{1}{5}+\frac{1}{6}\right) = \frac{2{,}4500}{6} = 0{,}4083$$
$$w_2 = \frac{1}{6}\left(\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\frac{1}{5}+\frac{1}{6}\right) = \frac{1{,}4500}{6} = 0{,}2417$$
$$w_3 = \frac{1}{6}\left(\frac{1}{3}+\frac{1}{4}+\frac{1}{5}+\frac{1}{6}\right) = \frac{0{,}9500}{6} = 0{,}1583$$
$$w_4 = \frac{1}{6}\left(\frac{1}{4}+\frac{1}{5}+\frac{1}{6}\right) = \frac{0{,}6167}{6} = 0{,}1028$$
$$w_5 = \frac{1}{6}\left(\frac{1}{5}+\frac{1}{6}\right) = \frac{0{,}3667}{6} = 0{,}0611$$
$$w_6 = \frac{1}{6}\left(\frac{1}{6}\right) = \frac{0{,}1667}{6} = 0{,}0278$$

Table 3. ROC Result Criteria Weights

Kode	Kriteria	Urutan	Bobot (w)
C1	Kualitas hasil kebersihan	1	0,4083
C2	Kedisiplinan dan kehadiran	2	0,2417
C3	Tanggung jawab terhadap tugas	3	0,1583
C4	Sikap dan kemampuan berkomunikasi	4	0,1028

C5	Kepatuhan keselamatan kerja	5	0,0611
C6	Pendidikan dan pengalaman kerja	6	0,0278
	Jumlah		**1,0000**

4.3 Normalisation of the Decision Matrix

Each criterion has a benefit value, with a minimum value of 2 and a maximum value of 5. Therefore, all values are normalised with a divisor of 5 - 2 = 3.

$$r_{11} = \frac{4-2}{5-2} = 0{,}6667 \qquad r_{12} = \frac{5-2}{5-2} = 1{,}0000 \qquad r_{13} = \frac{4-2}{5-2} = 0{,}6667$$
$$r_{14} = \frac{3-2}{5-2} = 0{,}3333 \qquad r_{15} = \frac{4-2}{5-2} = 0{,}6667 \qquad r_{16} = \frac{3-2}{5-2} = 0{,}3333$$

The same calculation is applied to all alternatives.

Table 4. Normalised Matrix (R)

Alternative	C1	C2	C3	C4	C5	C6
A1	0,6667	1,0000	0,6667	0,3333	0,6667	0,3333
A2	1,0000	0,6667	0,6667	0,6667	0,3333	0,6667
A3	0,3333	0,3333	0,6667	1,0000	0,6667	0,0000
A4	0,6667	0,6667	1,0000	0,6667	1,0000	0,3333
A5	0,0000	0,3333	0,3333	0,3333	0,0000	1,0000
A6	1,0000	1,0000	0,3333	0,6667	0,6667	0,0000
A7	0,3333	0,6667	0,0000	0,0000	0,3333	0,6667
A8	0,6667	0,0000	0,3333	0,6667	0,3333	0,3333

4.4 Weighted Sum Value (S) and Weighted Product (P)

Candidate A2 has the highest P score (5.7275) and candidate A6 has the highest S score (0.8120), which were obtained by multiplying each r_ij by its weight and then summing them up.

$$S_1 = (0{,}4083)(0{,}6667) + (0{,}2417)(1) + (0{,}1583)(0{,}6667) + (0{,}1028)(0{,}3333) + (0{,}0611)(0{,}6667) + (0{,}0278)(0{,}3333)$$
$$= 0{,}2722 + 0{,}2417 + 0{,}1056 + 0{,}0343 + 0{,}0407 + 0{,}0093 = 0{,}7037$$
$$P_1 = (0{,}6667)^{0{,}4083} + (1)^{0{,}2417} + (0{,}6667)^{0{,}1583} + (0{,}3333)^{0{,}1028} + (0{,}6667)^{0{,}0611} + (0{,}3333)^{0{,}0278}$$
$$= 0{,}8474 + 1{,}0000 + 0{,}9378 + 0{,}8932 + 0{,}9755 + 0{,}9699 = 5{,}6239$$

The value of r_ij = 0 results in a power term of 0, so this criterion does not add to the candidate's P score.

Table 5. Weighted sum matrix (w × r) and S value

Alternative	C1	C2	C3	C4	C5	C6	S
A1	0,2722	0,2417	0,1056	0,0343	0,0407	0,0093	0,7037
A2	0,4083	0,1611	0,1056	0,0685	0,0204	0,0185	0,7824
A3	0,1361	0,0806	0,1056	0,1028	0,0407	0,0000	0,4657
A4	0,2722	0,1611	0,1583	0,0685	0,0611	0,0093	0,7306
A5	0,0000	0,0806	0,0528	0,0343	0,0000	0,0278	0,1954
A6	0,4083	0,2417	0,0528	0,0685	0,0407	0,0000	0,8120
A7	0,1361	0,1611	0,0000	0,0000	0,0204	0,0185	0,3361
A8	0,2722	0,0000	0,0528	0,0685	0,0204	0,0093	0,4231

4.5 Ranking

A2, A4, A6, A1, A3, A8, A7, and A5 are the recommended order. Candidates with the highest k scores receive the highest rankings.

Table 6. shows the CoCoSo ranking results.

Peringkat	Alternatif	Nilai akhir (k)	Keterangan
1	A2	3,2235	Direkomendasikan
2	A4	3,0999	Cadangan pertama
3	A6	3,0294	Cadangan kedua
4	A1	3,0261	
5	A3	2,1621	
6	A8	2,1311	
7	A7	1,6539	
8	A5	1,3510	

The difference in value between A6 and A1 is only 0.0033, so the positions of both need to be further tested through a sensitivity analysis.

4.6 Sensitivity Test of λ Value

Candidate A2 remains in the first position for all λ values from 0.1 to 1.0. Changes only occur in positions 2 to 4, which have close values.

Table 7. Candidate rankings at various λ values

λ	A1	A2	A3	A4	A5	A6	A7	A8
0,1 – 0,4	3	1	5	2	8	4	7	6
0,5 – 0,8	4	1	5	2	8	3	7	6
0,9 – 1,0	4	1	5	3	8	2	7	6

At $\lambda \leq 0.4$, positions A1 and A6 swap, while at $\lambda \geq 0.9$, positions A4 and A6 swap. Rank 1 and ranks 5 to 8 do not change, so the main recommendations are considered stable.

The CoCoSo ranking is very consistent with the SAW method, with a Spearman coefficient $\rho = 0.9286$.

Conclusion

Manual calculations show that the ROC–CoCoSo method can be used to select cleaning staff who can be tracked and measured. In the simulation data, candidate A2 is recommended as the cleaning staff with a final score of 3.2235, followed by candidate A4 with a score of 3.0999, and candidate A6 with a final score of 3.0294. The main recommendation is stable against value changes from 0.1 to 1.0 and very consistent, with ranking differences only occurring among candidates with comparable scores, so the school's contribution should be considered when determining the reserve position.

Table 2 must be recalculated using the same formula before this chapter is used in the thesis. The values of candidates A1–A8 must be replaced with the actual assessment results from SMK Negeri 2 Ulu Moro'o, and the order of importance of the criteria must be confirmed with the principal because this order determines the ROC weight. After that, the values of n and m must be sufficiently adjusted without changing the calculation stages if the number of candidates or criteria changes.

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