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The Implementation of MOORA Methods to Support the Refinement of Decision Priority System in Information Technology

Fanni Rahmah Tsani[-1*)], Umi Chotijah[-2]

Teknik Informatika
Universitas Muhammadiyah Gresik
Kabupaten Gresik, Indonesia
https://umg.ac.id/
fanirahmatsani039@gmail.com[-1*)], umi.chotijah@umg.ac.id[-2]

(*) Corresponding Author

Abstract

Maintenance of information and communications technology scoped on the Lamongan Regency Government is the responsibility of the Lamongan Regency Communications and Information Department. The application of information technology is closely related to the problems that appear, such as Communication Network Interruption/Damage. In this case, the report is provided by the user via WhatsApp message, and no single point of contact is used for delivery, retard the refinement process and making it difficult for technicians to prioritize refinement. In this study, the authors built a decision-supporting to assist technicians in prioritizing refinement. The Multi-Objective Optimization Based Ratio Analysis (MOORA) method is appropriate for this study as it allows us to perform the ranking process based on different weighting attributes. The calculation process of the MOORA method is based on specified criteria and weightings. Criteria are the type of damage, risk of a complaint, duration of the claim, and type of service. In one day, the three regional apparatuses with the highest scores are selected, and recommendations for prioritized refinement are provided. In this study, we found that samples with high criterion weights and scores tended to be prioritized over other samples. The results MOORA calculated show the library service as the best alternative with a value of 0.396 on ten regional apparatus tested.

Keywords: Decision Support System; Repair Priority; Multi-Objective Optimization based on Ratio Analysis (MOORA); Information Technology

Abstrak

Pemeliharaan teknologi informasi dan komunikasi dilingkup Pemerintahan Kabupaten Lamongan merupakan tanggung jawab Dinas Komunikasi dan Informatika Kabupaten Lamongan. Penerapan teknologi informasi tidak terlepas dari permasalahan yang timbul seperti adanya gangguan/kerusakan jaringan komunikasi. Dalam hal ini teknisi kesulitan dalam menentukan prioritas perbaikan dikarenakan pelaporan yang diberikan pengguna melalui pesan whattsapp dan tidak digunakan kontak tunggal dalam penyampaiannya, sehingga memperlambat proses penyelesaian perbaikan. Pada penelitian ini, penulis membangun suatu sistem pendukung keputusan yang bertujuan untuk membantu teknisi dalam menghasilkan suatu keputusan prioritas perbaikan. Metode Multi-Objective Optimization Based Ratio Analysis (MOORA) adalah metode yang tepat diterapkan pada penelitian ini karena mampu melakukan proses perangkingan berdasarkan atribut bobot yang berbeda. Proses perhitungan metode MOORA berdasakan kriteria dan bobot yang telah ditentukan. Kriteria penilaian yang digunakan adalah jenis kerusakan, resiko komplain, lama permintaan, dan jenis pelayanan. Dalam satu hari akan dipilih tiga perangkat daerah dengan nilai tertinggi untuk dilakukan rekomendasi prioritas perbaikan. Dalam penelitian ini ditemukan bahwa sample dengan nilai kriteria yang tinggi dengan bobot kriteria yang tinggi cenderung mendapatkan prioritas yang lebih dibandingkan sample yang lain. Hasil perhitungan MOORA menunjukkan Dinas Perpustakaan sebagai alternative tertinggi dengan nilai 0,396 pada sepuluh perangkat daerah yang diuji coba.

Kata kunci: Sistem Pendukung Keputusan; Prioritas Perbaikan; Multi-Objective Optimization based on Ratio Analysis (MOORA); Teknologi Informasi.

INTRODUCTION

The communication and Informatics Department of Lamongan Regency is the regional apparatus responsible for maintaining information and communication technology for all regional apparatus that use communication networks and data exchange in carrying out their duties. The application of information technology cannot be separated from the problems that arise from disruption to information technology service resulting in service interruptions that could affect Lamongan Regency Government's performance. When performing their duties, technicians have faced problems determining the priority of each issue in regional apparatus. Furthermore, repair requests are not handled by a single contact person. Therefore, the data collection is disorganized and slows response time (Santoso, Wijaya, & Nugraha, 2019). fulfill that need, and a decision support system is recommended to assist decision-makers in prioritizing requests from the regional apparatus.

A decision support system is a computerized system used to facilitate decision-making (Risykiyana, Rosyid, Chotijah, & Mar'i, 2022). A decision support system helps users make decisions (Yunus & Senung, 2021). The Lamongan Department Communications and Information Department needs an effective and efficient decision support system to expedite repairs.

This study uses one of the Multi-Criteria Decision Making (MCDM) methods, namely the Multi-Objective Optimization based on Ratio Analysis (MOORA), with the consideration of being able to carry out the process simultaneously optimizing two or more conflicting attributes (Maharrani & Somantri, 2020) Where the attributes can be profitable (benefit) or unprofitable (cost) (Fadli & Imtihan, 2019). It can provide a better alternative assessment than other methods and carry out an easy and fast ranking process (Pane & Erwansyah, 2020).

Several studies applying the MOORA method were conducted in PT. Indonesia Comnets Plus SBU Regional Sumbagsel that determining the level of urgency to improve the damaged towers is still being done manually. Determine the severe damage using MOORA (Abdurrasyid, Nugroho, Dakhlan, Arman, & Mahayana, 2022), and the same thing is applied to the priority of selecting tower construction areas because the high cost of building a tower is the reason for providers to be selective and right on target in determining the location of tower construction using the AHP method and MOORA (Pane & Erwansyah, 2020).

From several studies that have been carried out, the data used is data that no longer has been updated, so the data cannot experience re-versioning of the running time series.

This research provides objective, fast, and transparent input or recommendations in determining priorities for improving information technology so that the decisions to be taken will be effective and appropriate (Pane & Erwansyah, 2020).

RESEARCH METHODS

Types of research

This research belongs to qualitative research.

Time and Place of Research

This research was carried out from March 2022 to April 2022. The research was carried out at the Lamongan Regency Communication and Informatics Department in the Informatics Application Field in Jalan, KH. Ahmad Dahlan, Lamongan Regency.

Research Target / Subject

This research targeted the efficiency of decision priority making.

Procedure

1. Identification of Problem

Often technicians have difficulty determining refinement priorities due to the reporting that users provide via WhatsApp messages and not using a single contact in their delivery, thus slowing down the refinement completion process.

In this study, the authors built a decision support system to assist technicians in making a priority refinement decision. The Multi-Objective Optimization based on Ratio Analysis (MOORA) method is the right method to be applied to this study because it can carry out a ranking process based on different weight attributes so that the improvement priority results obtained are optimally and appropriate.

2. Data, Instruments, and Data Collection Techniques

This study used repair submission data from regional apparatus at the Lamongan District Communication and Information Department. In one day, three local officials will be selected for repairs. Priority improvement activities need to be carried out within regional apparatus so that decisions to be taken are more effective and optimal. The criteria used in priority repairs are the type of damage, the

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risk of complaints, the length of request, and the type of service. The followings are the techniques used for data collection:

a) Field Research

The research was carried out by directly observing the problem to be studied and by taking the data needed for research at the Lamongan Regency Communication and Information Service.

b) Literature Research

Previous research related to journal topics and used as a reference source.

Research conducted by (Abdurrasyid et al., 2022) at PT. Indonesia Comnets Plus SBU Regional Sumbagsel determines the level of urgency of tower repairs using the MOORA method with 100% accurate results. The same is also applied (Pane & Erwansyah, 2020) by applying the AHP and MOORA methods to determine the weight of the criteria and the best alternative to select tower construction sites with a level of accuracy at the seven locations tested. Other research was also conducted by (Akmaludin, Sihombing, Dewi, Rinawati, & Arisawati, 2021), testing conducted with the MOORA method in collaboration with the Price-Quality Ratio approach. The results obtained were the selection of object-based software applications, which can be done optimally and provide efficiency in the benefits and costs incurred.

From the many studies used as reference sources, no decision support system has been found using versioning-type data.

3. Data Processing

From filling out the repair form, the following sample data is obtained:

Table 1. the repair data

Regional apparatus	Type of damage	The risk of complain	Demand Hour	Type of services
Kec. Maduran	Local network	Level 2	1 day	Public services
Kec. Sekaran	Local network	Level2	10 minute	Public services
Gedung PKK	Internet network	Level 5	>24 our	Management
Kec. Pucuk	Software	Level 2	2 hour	Public services
Kec. Brondong	Hardware	Level 2	1,5 hour	Public services
Bakesbangpol	Internet network	Level 4	24 hour	Management
Gedung DPRD	Internet network	Level 3	1 hour	Management
Dinas perpustakaan	Local network	Level 1	12 hour	Public services
Diaspora	Internet network	Level 3	1 hour	Management
Inspectorate	PC	Level 3	4 hour	Management

4. Data Analysis

The Multi-Objective Optimization method based on Ratio Analysis (MOORA) is an algorithm that optimizes two or more conflicting attributes simultaneously (Sunardi, Fadlil, & Fitrian Pahlevi, 2021) as well as a method used to optimize the ranking of several alternatives with several stages based on ratio analysis (Akmaludin, Sihombing, Dewi, Rinawati, & Arisawati, 2021). The first algorithm is to input the value of the criteria where the value of the criteria in an alternative is the value that will later be processed, and the result becomes a decision. The criteria values are then converted into a decision matrix that defines the rows of data. The form of the matrix in question can be seen in equation 1.

$$X = x_{ij} = \begin{bmatrix} x_{ij} & \cdots & x_{in} \\ \vdots & \vdots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{bmatrix} \quad \text{.....(1)}$$

In this equation, the data takes the form of rows and columns. In equation (1), 'i' represents the number of rows, 'j' represents the number of columns. 'm' is the alternative, and 'n' is the number of attributes.

The next process is normalization in the MOORA algorithm to unite each element of the matrix so that the elements on the matrix have a uniform value. Normalization of the matrix can be seen in equation 2.

$$X_{ij}^{*} = \frac{x}{\sqrt{\sum_{i=1}^{*} x_{ij}^{2}}} \quad \text{..... (2)}$$

Equation (2) is obtained by dividing alternative values by square roots and alternate quadratic quantities

The normalization that has been carried out is then continued by reducing the values of max and min-max to indicate that an attribute is more important multiplied by the corresponding weight, as depicted in equation 3.

$$Y_i^{*} = \sum_{j=1}^{g} w_j X_{ij}^{*} - \sum_{j=g+1}^{n} w_j X_{ij}^{*} \quad \text{.....(3)}$$

Equation (3) aims the summary of benefit attribute 'j' to 'g' and then reduces the cost attribute iteratively 'g+1' until 'n' for each alternative 'i'. Yi is the preference value, and W is the weight.

The final value of the calculation uses equation 3 to determine the ranking of the MOORA calculation results, with the highest ranking value being the highest preference value.

RESULTS AND DISCUSSION

In determining the selection of priorities for information technology improvements, a method was needed to determine the regional apparatus whose damage was repaired, and a decision support system was needed to find out which regional apparatus was prioritized for repairs. The method used in the improvement priority is Multi-Objective Optimization based on Ratio Analysis (MOORA). The algorithm to be used in the process of prioritizing information technology improvements can be seen in Figure 1.

```
Name: Moora method calculation
Function: displays priority repair data
Input: type of damage, the risk of complaints,
demand hour, type of services
Output: priority refinement table
Begin
   double normalization results, optimization,
   preferences
   int type of damage, the risk of complaints,
   demand hour, type of services resultMoora
   =0;
   for (int i=0;i<tbl length:i++)
      type of damage =column value for the
      amount of data for the type of damage the
      risk of complaining = column value for
      the number of data the risk of complain
      demand hour = value of the number of
      demand hour column
      type of services = column value for the
      number of types of services
      normalization <= (the result of the
      decision matrix/square root of each
      alternative per attribute)
      optimization <= (normalized
      value*criteria weight)
      preferences <= (value of the number of
      multiplication weights of the criteria
      with the type of benefit) - (value of the
      total multiplication of the weight of the
      criteria with the type of cost)
      calculation results <= (sort the results
      of the calculation of the weight of the
      criteria from the highest to smallest)
      return resultMoora:
End
```

Figure 1. Pseudocode calculation MOORA

The process of calculating the MOORA method began by giving weight to each criterion, then a suitability rating was generated to form a decision matrix and normalized the decision matrix. After normalization, attribute optimization was performed by including weights. Benefit optimization value (max) minus cost optimization value (min). The biggest optimization result showed that the alternative was prioritized.

In the MOORA method, there were criteria as an assessment process to determine priority improvements. The criteria used in the repair priority were the type of damage (C1), the risk of complaints (C2), the time of request (C3), and the type of service (C4). The alternative selection is shown in table 2.

Table 2. Alternative selection

Alternative	Criteria			
	C1	C2	C3	C4
Kec. Maduran	Local network	Level 2	1 day	Public services
Kec. Sekaran	Local network	Level2	10 minute	Public services
Alternative	Criteria			
	C1	C2	C3	C4
Gedung PKK	Internet network	Level 5	>24 hour	Management
Kec. Pucuk	Software	Level 2	2 hour	Public services
Kec. Brondong	Hardware	Level 2	1,5 hour	Public services
Bakesbangpol	Internet network	Level 4	24 hour	Management
Gedung DPRD	Internet network	Level 3	1 hour	Management
Dinas perpustakaan	Local network	Level 1	12 hour	Public services
Dispora	Internet network	Level 3	1 hour	Management
Inspektorat	PC	Level 3	4 hour	Management

Furthermore, the determination of criteria and weights by predetermined qualifications is indicated in Table 3.

Table 3. criteria and quality

Criteria	Description	Quality	Type
C1	Type of damage	0,14	Benefit
C2	The risk of complain	0,29	Benefit
C3	Demand Hour	0,21	Benefit
C4	Type of services	0,36	Benefit

After knowing the alternative determination, determine the quantitative value of the criteria on each alternative. The weight of the criteria uses the proposed approach (Annisaa, Anugrah, & Devi, 2022). The criteria used are as follows ;

The type of malfunction (C1) is data sourced from the request, with the type of criteria that are of the benefit type, where if the vulnerability or damage is higher, it has a high level of assessment. The rating is in table 4.

Table 4. Value of the risk of damage

Type of damage	Description	Value
Internet network	very high	5
Local network	High	4
Hardware	Enough	3
PC	Low	2
Software	very low	1

The risk of complaint (C2) is the risk of complaints from the user. The criteria are of the benefit type, where if the risk of the complaint is high, it has a high level of assessment. The rating is in table 5.

Table 5. The value of risk complain

The risk of complaint	Description	Value
Level 1	very high	5
Level 2	High	4
Level 3	Enough	3
Level 4	Low	2
Level 5	very low	1

In this case, the request hour (C3) is the time it takes to make repairs. The criteria are of the benefit type, where if the time required is a lot, the assessment given is high. The rating is in table 6.

Table 6. The value of demand hour

Demand hour	Description	Value
>24 hour	very high	5
10 - 24 hour	High	4
3-10 hour	Enough	3
30 minutes – 3 hours	Low	2
0 – 30 minutes	very low	1

Type of service (C4) is a service contained in the regional apparatus with the type of benefit criteria, where if the type of public service there is damaged, the value provided is high from management services. The rating is in table 7.

Table 7. Type of service value

Demand hour	Description	Value
Public service	High	2
Management	Moderate	1

If the value of each criterion has been determined, create a matching rating table as in table 8.

Table 8. The Alternate match rating

Alternative	Criteria			
	C1	C2	C3	C4
Kec. Maduran	4	4	5	2
Kec. Sekaran	4	4	1	2
Gedung PKK	5	1	5	1
Kec. Pucuk	1	4	2	2
Kec. Brondong	3	4	1	2
Bakesbangpol	5	2	4	1
Gedung DPRD	5	3	2	1
Dinas perpustakaan	4	5	4	2
Dispora	5	3	2	1
Inspektorat	2	3	3	1

Furthermore, the MOORA method was applied to select improvement priorities to produce the best alternative that could be chosen and recommended (Hendrayana & Mahendra, 2019) to prioritize the improvement.

After the results of the suitability rating in table 8 are transformed into the X matrix as follows:

$$\mathbf{X} = \begin{pmatrix} 4 & 4 & 5 & 2 \\ 4 & 4 & 1 & 2 \\ 5 & 1 & 5 & 1 \\ 1 & 4 & 2 & 2 \\ 3 & 4 & 1 & 2 \\ 5 & 2 & 4 & 1 \\ 5 & 3 & 2 & 1 \\ 4 & 5 & 4 & 2 \\ 5 & 3 & 2 & 1 \\ 2 & 3 & 3 & 1 \end{pmatrix}$$

The approach taken to the MOORA method in the matrix normalization process is obtained from the denominator. The best choice is the square root of the sum of the squares and each alternative per attribute (Agustina & Sutinah, 2022). Matrix normalization is used to calculate the number of alternatives and the number of criteria (Wardani, Parlina, & Revi, 2018). The normalization calculation is done by dividing each alternative by the root value of the sum of the alternative values for each criterion

raised to the first power. The following is an example of calculating matrix normalization:

$$A_{11} = \frac{4}{\sqrt{4^2+4^2+5^2+1^2+3^2+5^2+5^2+4^2+5^2+2^2}} = 0{,}314$$

$$A_{21} = \frac{4}{\sqrt{4^2+4^2+5^2+1^2+3^2+5^2+5^2+4^2+5^2+2^2}} = 0{,}314$$

In the same way, please do it for all alternative C1 and other criteria to obtain the results as in Table 9.

Table 9. normalization results

Alternative	Criteria			
	C1	C2	C3	C4
Kec. Maduran	0,314	0,364	0,488	0,400
Kec. Sekaran	0,314	0,364	0,098	0,400
Gedung PKK	0,393	0,091	0,488	0,200
Alternative	Criteria			
	C1	C2	C3	C4
Kec. Pucuk	0,079	0,364	0,195	0,400
Kec. Brondong	0,236	0,364	0,098	0,400
Bakesbangpol	0,393	0,182	0,390	0,200
Gedung DPRD	0,393	0,273	0,195	0,200
Dinas perpustakaan	0,314	0,455	0,390	0,400
Dispora	0,393	0,273	0,195	0,200
Inspektorat	0,157	0,273	0,293	0,200

Optimizing the criteria for each alternative is given an importance value, provided that the maximum criteria type weight value is greater than the minimum criteria quality (Ferdian & Chotijah, 2022). Get the results of the optimization calculations. It was done using the results of the matrix normalization multiplied by the weights determined for each criterion (Siregar, Poningsih, & Safii, 2018). The results of optimization calculations can be seen in Table 10.

Table 10. The result of optimization

Alternative	Criteria			
	C1	C2	C3	C4
Kec. Maduran	0,044	0,105	0,102	0,144
Kec. Sekaran	0,044	0,105	0,020	0,144
Gedung PKK	0,055	0,026	0,102	0,072
Kec. Pucuk	0,011	0,105	0,041	0,144
Kec. Brondong	0,033	0,105	0,020	0,144
Bakesbangpol	0,055	0,053	0,082	0,072
Gedung DPRD	0,055	0,079	0,041	0,072
Dinas perpustakaan	0,044	0,132	0,082	0,144
Dispora	0,055	0,079	0,041	0,072
Inspektorat	0,022	0,079	0,061	0,072

The preference value is obtained by calculating the maximum and minimum values by adding the benefit and cost criteria values. Max is the criterion for the type of benefit, and min is the criterion for the type of cost (Alisia, Ginting, & Syari, 2021). In this study, there are only types of benefit criteria, and the calculation results can be seen in Table 11.

Table 11. Rankings

Alternative	Max	Min	Yi
Kec. Maduran	0,396	0	0,396
Kec. Sekaran	0,314	0	0,314
Gedung PKK	0,256	0	0,256
Alternative	Max	Min	Yi
Kec. Pucuk	0,301	0	0,301
Kec. Brondong	0,303	0	0,303
Bakesbangpol	0,262	0	0,262
Gedung DPRD	0,247	0	0,247
Dinas perpustakaan	0,402	0	0,402
Dispora	0,247	0	0,247
Inspektorat	0,235	0	0,235

After calculating the preference value, the result of the highest preference value is the best alternative. The results of the ranking can be seen in Table 12.

Tabel 12. Rankings

Alternative	Result	Ranking
Dinas Perpustakaan	0,396	1
Kecamatan Maduran	0,314	2
Kecamatan Sekaran	0,256	3
Kecamatan Brondong	0,301	4
Kecamatan Pucuk	0,303	5
Bakesangpol	0,262	6
Gedung PKK	0,247	7
Gedung DPRD	0,402	8
Dispora	0,247	9
Inspektorat	0,235	10

Based on the analysis carried out using the MOORA method, the highest value calculation results are shown in Table 12. Rank 1 is obtained at the library service alternative with the type of damage to the internet network, the level of damage is 1, with a request time of 12 hours, and the type of service is public service.

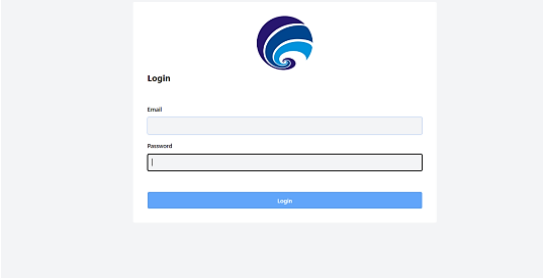

Figure 2. Login page

The login page is the first page a user sees before accessing the refinement Priorities web, which can be seen in Figure 2.

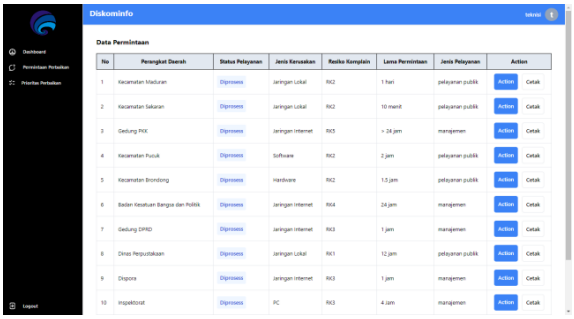

Figure 3. Demand data MOORA

After performing the calculation manually using the MOORA method, when this method is implemented in the system, the calculation result is displayed as shown in Figure 3. It is an alternative assessment of the regional apparatus's required data for repair.

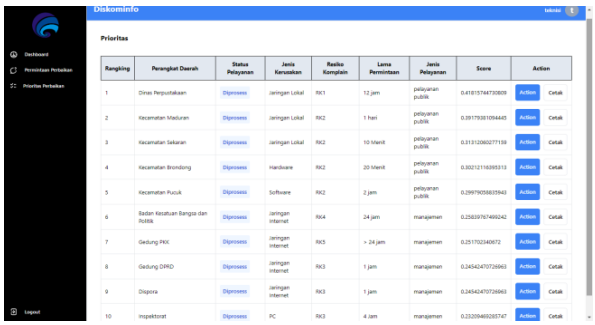

Figure 4. Refinement priority results from MOORA

Figure 4 shows the implementation of priority improvement results using the web-based MOORA method. On this page, the technician can see which repairs are prioritized according to the MOORA method.

CONCLUSIONS AND SUGGESTIONS

Conclusion

The prioritization of information technology improvement using the MOORA method can be applied properly and optimally because it produces index values on all alternatives. The ten regional devices tested by the Library Service showed the highest priority results with a value of 0.396. Technicians use the results to prioritize information technology repairs within the Lamongan Regency by grouping damage types based on service type.

Suggestion

It is recommended to add the number of criteria and category variations using cost-benefit analysis; so that the differences in the use of the types of criteria can be seen to affect the results of alternative priority values.

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