Study of Financing Effect Caused by Social Issues on Infrastructure Development Activities in North Lombok Regency using Simple Additive Weighting (SAW) Method

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Abstract. During its implementation, development projects sometimes encounter obstacles, and these occur in various regions. Frequently encountered problems include delays in implementation, poor quality, and insufficient quantity of work. These three issues can be classified as technical. Beyond technical issues, project problems can also be examined from a non-technical perspective. One form of this type is social issues. This study determined the impact of non-technical issues on the quality, quantity, and time of project implementation. Moreover, the study determined both the maximum funding percentage for non-technical issues and the approaches for managing them. To obtain the research results, interviews were conducted using questionnaires. The first questionnaire was used to capture criteria related to non-technical issues. The second questionnaire was used to determine the weight of each criterion. The data obtained was processed using the Simple Additive Weighting (SAW) method. Based on the results of the first stage of questionnaire data processing, the following criteria were obtained that influenced non-technical problems in construction activities in the field: Work environment safety, Reduction in work quality, Ease of material procurement, Reduction in work quantity, Ease of labor procurement, and Delayed work time. Furthermore, the maximum percentage value of financing for non-technical problems was 0.77% of the total work value. To manage non-technical problems, one can refer to the criteria identified in the first stage of the questionnaire, which include involving local individuals as workers, purchasing building materials from nearby sources, and engaging community members to ensure the safety of the work implementation.

Introduction

Development is a rapidly occurring activity that supports daily human activities. Development is carried out across various sectors, particularly civil engineering, which is widely utilized. Indonesia evenly distributes development across various regions. The process includes infrastructure development that supports mobility, such as roads, bridges, ports, and airports. It also includes infrastructure development that serves as activity centers, such as buildings with various functions.

Social issues are a non-technical issue in development implementation that is currently trending. Although not included in the development budget, these issues often require funding to resolve. Consequently, service providers must allocate funds from the project budget to complete them. These issues can impact the quality, quantity, and duration of the project. This is an ongoing issue, occurring throughout the region, including North Lombok Regency. Therefore, determining the highest funding percentage possible is essential to maintain the project's quantity, quality, and timeliness.

The simple additive weighting (SAW) method is one of the oldest and most widely used decision-making methods. Different subject areas such as engineering, environmental sciences, and energy can utilize its simple process [1]. That is to say, the SAW, as a classic version of the multi-attribute value method, is “a value function established based on a simple addition of scores that represent the goal achievement under each criterion, multiplied by the particular weights” [2].

Method

The Simple Additive Weighting method is one of the most common multi-attribute decision-making (MADM) methods. Finding the weighted sum of the performance ratings for each alternative, considering all attributes, is the basic concept of the SAW method. For this, a normalized decision matrix must be prepared. This normalization process results in a scale that makes comparing with all alternative ratings possible [3].

The advantage of Simple Additive Weighting (SAW) compared to other decision-making methods is its ability to make more precise assessments due to predetermined values of criteria and preference weights. Moreover, the SAW method can deliver the best alternative from several identified options, thanks to the ranking process generated after assigning weight values to each attribute [4][5][6][7]. There are some steps in the Simple Additive Weighting (SAW) method, namely:

1. Define alternatives (Ai)
2. Determine the criteria (Cj)
3. Assess according to each alternative (Ai) and also the criteria (Cj)
4. Determine the weight or degree of importance (W) for each criterion
5. Create a decision matrix consisting of a suitability rating table for each criterion alternative. The value of each alternative (Ai) according to each given criterion (Cj)

$$X = \left(X_{11}\, X_{12}\, X_{13} \;\ldots\; \ldots \;\ldots\; X_{i2}\, X_{i3}\, X_{i4}\right) \quad (1)$$

6. Normalize the decision matrix by calculating the normalised performance rating value (rij) of alternative Ai using criteria Cj.

$$rij = \frac{Xij}{Max\, Xij} \quad (2)$$

7. The results of matrix normalisation are entered into the normalised matrix (R).

$$R = \left(R_{11}\, R_{12}\, R_{13} \;\ldots\; \ldots \;\ldots\; R_{i2}\, R_{i3}\, R_{i4}\right) \quad (3)$$

8. The final preference value (Vi) is obtained by multiplying the normalised matrix row elements (R) by the preference weights (W) corresponding to the matrix column elements (W).

$$Vi = \sum_{i=1}^{n} wj.\, rij \quad (4)$$

The excellent Vi calculation result indicates that Ai is the best alternative [8].

Questionnaire. In this study, 50 respondents were used. Respondents were service providers and stakeholders directly involved in the development activities. The respondent breakdown is as follows:

1. Implementing Contractors = 30 respondents,
2. Supervising Consultants = 10 respondents,
3. North Lombok District Government = 10 respondents.

Results and Discussion

By using the first stage questionnaire, it showed there are 6 factors that influence the infrastructure development and cause non-technical issues, namely: Workplace safety, decrease of work quality, Ease of material procurement, decrease of work quantity, Ease of manpower procurement, and delayed work schedules.

The benefit criterion indicates the attributes desired by the decision maker. The higher the value of this criterion, the better the alternative. Meanwhile, the cost criterion indicates the attributes the decision maker wants to minimize. The lower the value of this criterion, the better the alternative [4]. The following are the classification results for the benefit and cost criteria based on the six factors collected in the first phase of the questionnaire.

Table 1. Criteria Classification

No.	Benefit Criteria	Cost Criteria
1.	Work environment safety (C1)	Reduction in the quality of work (C4)
2.	Ease of material procurement (C2)	Reduction in quantity of work (C5)
3.	Ease of labor procurement (C3)	Work time is delayed (C6)

This stage was conducted using a second-stage questionnaire. Respondents assessed each criterion based on its level of influence on the maximum value of financing non-technical issues. The following are the criteria scores determined by respondents, as follows:

Very High : 5
High : 4
Sufficient : 3
Low : 2
Very Low : 1

Furthermore, based on the results of the second-stage questionnaire, weights were obtained for each criterion, as outlined in the table below.

Table 2. Criteria Scores

Max Non-technical Financing Value	Criteria					
	C1	C2	C3	C4	C5	C6
0,1% of contract value	0.50	0.40	0.34	0.25	0.30	0.50
0,3% of contract value	0.60	0.56	0.67	0.30	0.39	0.60
0,5% of contract value	0.65	0.45	0.65	0.15	0.60	0.40
0,7% of contract value	0.66	0.45	0.40	0.20	0.65	0.66
1% of contract value	0.65	0.67	0.60	0.40	0.45	0.35
2% of contract value	0.45	0.12	0.56	0.12	0.45	0.60
3% of contract value	0.57	0.39	0.30	0.39	0.57	0.65
4% of contract value	0.70	0.46	0.34	0.67	0.65	0.40
5% of contract value	0.80	0.50	0.80	0.70	0.60	0.90

Afterward, each criterion was weighted. The weighting was based on the average of the choices for each financing value. The weighting of each criterion is outlined in the table below.

Table 3. Criteria Weighting

Criteria	Weighting
C1	0.20
C2	0.20
C3	0.26
C4	0.12

C5	0.12
C6	0.10
Total	**1.00**

The next step is to convert the criteria table into a matrix. The following is the resulting matrix based on the 6 criteria and 6 kinds of releasing financing to eliminate non-technical issues, each with its usage trends.

Table 4. Criteria values in matrix form

R	1	2	3	4	5	6
1	0.63	0.6	0.43	0.48	1.00	0.70
2	0.75	0.84	0.84	0.40	0.77	0.58
3	0.81	0.67	0.81	0.80	0.50	0.88
4	0.83	0.67	0.50	0.60	0.46	0.53
5	0.81	1.00	0.75	0.30	0.67	1.00
6	0.56	0.18	0.70	1.00	0.67	0.58
7	0.71	0.58	0.38	0.31	0.53	0.54
8	0.88	0.69	0.43	0.18	0.46	0.88
9	1.00	0.75	1.00	0.17	0.50	0.39

Based on **Table 4** above, normalization was performed for the benefit and cost criteria. The results of the normalization for six types of criteria are presented in **Table 5** below.

Table 5. Normalized Criteria Values

R	1	2	3	4	5	6
1	0.13	0.12	0.11	0.06	0.12	0.07
2	0.15	0.17	0.22	0.05	0.09	0.06
3	0.16	0.13	0.21	0.10	0.06	0.09
4	0.17	0.13	0.13	0.07	0.06	0.05
5	0.16	0.20	0.20	0.04	0.08	0.10
6	0.11	0.04	0.18	0.12	0.08	0.06
7	0.14	0.12	0.10	0.04	0.06	0.05
8	0.18	0.14	0.11	0.02	0.06	0.09
9	0.20	0.15	0.26	0.02	0.06	0.04

After normalizing the six criteria, the next step is to determine the weighting of each financing percentage. The weighting is done by multiplying the values in **Table 5** by the values in **Table 3**. The weighting of each implementation system is outlined in the **Table 6** below.

Table 6. Selection Weighting

No.	Financing value	Weighting
1	0,1% of contract value	0.602503

2	0,3% of contract value	0.733555
3	0,5% of contract value	0.751578
4	0,7% of contract value	0.609743
5	1% of contract value	0.773500
6	2% of contract value	0.588654
7	3% of contract value	0.510345
8	4% of contract value	0.587191
9	5% of contract value	0.728714

Conclusion

Based on the SAW results described previously, it can be concluded that the financing of non-technical issues in the implementation of fieldwork has a maximum tolerance of 0.77% of the total work value. This approach guarantees the quality, quantity, and schedule of the work implementation. Furthermore, managing non-technical issues in the field can be achieved by involving local residents as workers, purchasing building materials from nearby sources, and engaging community members to ensure the safety of the work implementation.

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