

Analytical Hierarchy Process (AHP) Road Handling Priority Analysis for East Java Provincial Road Sections in Gresik Regency Drawing from the Provincial/District Road Management System (PKRMS)

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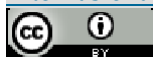
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ABSTRACT

The AHP method used in this study was used. The AHP questionnaire instrument in this study was structured as a table of pairwise comparisons between criteria. Each criterion was compared with the others using a scale of 1 to 9. The PKRMS results without AHP integration indicate that section 112 is the first priority with a TPI of 83.7. Section 110 is the second priority with a TPI of 76.2. Section 111 is the third priority with a TPI of 24.5. Based on the MW value, section 110 has the highest cost requirement, at IDR 77,415.4 million. However, using the TPI as the basis for technical prioritization, section 112 remains the top priority. After the PKRMS-AHP integration, the technical priority order remains with section 112 as the first priority with a TPI of 24.9, followed by section 110 with a value of 22.5, and section 111 with a value of 7.5. However, in terms of five-year cost requirements, section 110 remains the section with the largest MW value, amounting to Rp57,742.9 million, followed by section 111 at Rp22,200.3 million, and section 112 at Rp9,005.9 million. As for the recommendations, determining priorities should not only be based on the amount of work costs required, but also pay attention to the TPI value, AHP criteria weight, road conditions, traffic volume, connectivity function, and the role of the road section in industrial and logistics areas

INTRODUCTION

This research is expected to provide both theoretical and practical contributions. Theoretically, the research will enrich studies on the integration of road management systems using multi-criteria methods. Practically, the research can assist the provincial government in developing more accountable, transparent, and efficient road maintenance programs.

This research aims to compare and integrate the results of prioritization between PKRMS and AHP, with the goal of producing a more comprehensive, accountable, and applicable decision-making model for local governments in planning road maintenance programs.

According to the 2025 Government Agency Performance Report (LKjIP) of the East Java Provincial Public Works and Highways Agency, the provincial road stability rate is 86.51%. This figure is quite high, but certain sections still require immediate attention. In other words, although the quality of the road network continues to improve, road damage issues continue to arise annually and require targeted management strategies.

Furthermore, several road sections are included in priority programs and regional development policy directions, as outlined in the 2027 East Java Provincial Government Work Plan (RKPD).

The main challenge often encountered is budget constraints, preventing all road sections from being addressed within a single budget period. Furthermore, variability in road conditions, traffic volumes, and road functions complicates the task of prioritizing road maintenance (Prayoga et al., 2023).

East Java was chosen as the research location due to its extensive provincial road network, high economic activity, and high population mobility. This places a pressing need for appropriate prioritization methods to ensure road maintenance programs can support economic growth while improving road user safety (BPS, 2024). Specifically, on provincial roads in Gresik Regency, a strategic corridor connecting the Surabaya metropolitan area with industrial and residential areas in Gresik, damage such as potholes, cracks, and subsidence at certain points demonstrates the urgency of priority management (RKPD Jatim, 2027). This is supported by data from the Gresik Regency Public Works and Spatial Planning Agency (DPUTR) in 2025, which recorded that 1,511 to 1,587 road damage points had been addressed, including on provincial roads through coordination with relevant parties. Provincial roads in Gresik Regency are divided into three sections: Surabaya City - Driyorejo - Legundi, Legundi - Mojokerto Regency, and Petiyin (Lamongan Regency) - Karangcangkring (Lamongan Regency).

Research Benefits

The following is a detailed description of the research benefits in two aspects: theoretical and practical:

Theoretical Benefits

1. This research enriches scientific studies in the field of transportation infrastructure management, particularly in the context of provincial road management in Indonesia. By integrating data calculated from the AHP method into the PKRMS, this research provides a concrete example of how a

data-driven road management system can be integrated with a multi-criteria decision-making method.

2. The results of this research contribute to the development of the concept of integrating road information systems (road management systems) with quantitative analysis models, thus serving as a reference for developing theories related to data-driven decision-making.
3. The research findings can serve as a basis for further research that aims to test the effectiveness of the combination of PKRMS and AHP in other regions, both at the provincial and district/city levels, thereby broadening and diversifying the academic literature on the application of multi-criteria methods in the transportation sector.
4. This research also provides a theoretical basis for differences in criteria weighting between regions. This confirms that local context influences the results of multi-criteria analysis, thus enriching theory on the flexibility of AHP in its application.

Practical Benefits

1. For local governments, particularly the East Java Provincial Government, the results of this study can be used as a basis for prioritizing road maintenance. The integration of PKRMS with AHP enables more objective, transparent, and efficient decision-making.
2. This research helps infrastructure practitioners optimize budget constraints. With a systematic prioritization model, maintenance budgets can be allocated more precisely to road sections that truly require urgent attention.
3. The research findings can be used as a reference by the Ministry of Public Works and Public Housing (PUPR) and Public Works and Public Housing Agencies in other regions to replicate similar models, thus creating more accountable and uniform road maintenance planning standards.
4. This research indirectly benefits the community, as its implementation has the potential to improve the quality of road infrastructure services, streamline mobility, reduce transportation costs, and enhance road user safety.

THEORETICAL REVIEW

Analysis of Infrastructure Development to Support Asol Water Tourism in the Haruku Island Area, Maluku: A Planning and Design Approach Using the AHP Method. The AHP method is used to determine the priority of development criteria through analysis of pre-construction, construction and post-construction aspects. (Ony Frengky Rumihin, 2025).

Analysis of Road Conditions on Cokroaminoto Bojonegoro Road Section Based on PKRMS Survey. This study uses AHP to prioritize maintenance of Cokroaminoto Road, identifying 79% of the road in good condition, 21% in need of maintenance, and optimizing resource allocation. (Arifin dkk., 2025).

METHODOLOGY

Analytical Hierarchy Process (AHP)

The Analytical Hierarchy Process (AHP) is a method created by Saaty in 2008. It helps people make decisions when there are many factors to consider. In this study, the AHP method was used to determine the importance of different

factors that affect road maintenance priorities, like the physical state of the road, how much traffic it handles, and how well it connects economic and agricultural regions. AHP helps decision-makers compare different criteria in pairs and then figure out the importance weights from those comparisons. This process gives a number that shows how important each factor is in making the decision.

AHP is especially helpful for this study because it mixes numbers-based information, like road damage and traffic levels, with things that are harder to measure, like how important roads are for the area's growth. Earlier studies by Siswanto et al. (2019) and Pangestu et al. (2023) showed that AHP works well for setting priorities in road maintenance at both the district and provincial levels. AHP helps turn complicated information into clearer, more organized choices that are easier to understand. So, AHP gives a solid foundation for making decisions that help set road management priorities in a more accurate and fair way.

1. The process of implementing AHP includes:

a. Defining the problem and determining objectives;

Defining the problem and determining objectives. The first thing you need to do is figure out what the problem is, because this will decide if the AHP method is suitable for solving it.

b. Determining the hierarchical structure;

Saaty explains that AHP is a complicated problem with several levels, starting with objectives at the top, then moving to factors, criteria, sub-criteria, and so on, until reaching the last level which includes the different alternatives (Supriyadi, 2018).

Table 1. Priority Value Scale

Comparative Scale of Importance	Definition
1	Both elements have the same level of importance (equal importance).
3	one element is slightly more important than the other elements (moderate importance)
5	one element is more important than another element (strong importance)
7	one element is clearly absolutely more important than the other elements (very strong importance)
9	one element is absolutely more important than the other elements (extreme importance)
2, 4, 6, 8	If in the assessment there is doubt between two adjacent levels of interest (values in-between)
The opposite	If element A gets one number compared to element B, then element B has the opposite value of element A.

c. Assign a value to each criterion;

In principle, AHP uses the Saaty 1-9 scale AHP questionnaire approach, which compares element X with element Y to determine the importance of each element.

d. Calculate priority values;

e. Synthesize to obtain a total priority value;

f. Modify criteria;

g. Calculate the maximum Lambda value;

h. Calculate and measure the Consistency Index (CI) and Consistency Ratio (CR) values.

Provincial/Regency Road Management System (PKRMS)

The PKRMS, which stands for Public Works and Housing, is a system created by the Ministry of Public Works and Public Housing (PUPR) to handle information about road conditions at both provincial and district levels. This system is meant to give correct details about the state of roads, how much traffic is on them, and when roads need fixing or repair. As part of road infrastructure management, PKRMS offers information about road inventory, the condition of the road surface, how much weight the road can handle, daily traffic amounts, and how roads are used. This information helps in making better choices for maintaining the roads.

According to the Directorate General of Highways (2021), using PKRMS is expected to help reduce uncertainty in planning road maintenance and make sure that maintenance programs are more focused and effective. This system also allows you to use decision-making techniques like AHP, which helps make more fair and based-on-data choices. PKRMS is a helpful tool that helps map the condition of roads throughout the province and find sections of road that need quick repairs, using current technical and functional standards. Therefore, PKRMS is the main source of information used in this study to identify which roads in Gresik Regency need maintenance first.

RESULTS AND DISCUSSION

PKRMS Analysis with AHP Integration

The PKRMS analysis, integrated with AHP, was conducted to obtain more comprehensive road management priority results. At this stage, the priority weights calculated from the AHP are used as the MCA values in the PKRMS application. These MCA values influence each criterion used in determining road management priorities. Thus, the PKRMS results are not only based on road technical data but also consider the level of importance of the criteria as perceived by respondents.

The priority weights obtained from the AHP method are then converted into percentages. These percentages are used as MCA values in the PKRMS data processing process. These values indicate the level of contribution of each criterion to road management priorities. The higher the percentage of a criterion, the greater its influence in determining the priority results.

Table 2. AHP Criteria Weight as MCA Value in PKRMS

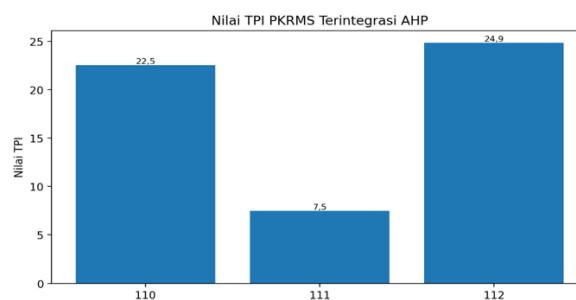
No.	Criteria	Percentase
K1	Road conditions and traffic volume	29,30%
K2	Road connectivity / connections between regions	23,20%
K3	Industrial development area	18,90%
K4	Goods/services logistics area	18,20%
K5	Economic areas and residential development	10,40%

Based on the table, criterion K1, namely road conditions and traffic volume, has the highest percentage, at 29.30 percent. This indicates that road technical conditions and traffic intensity are the most dominant factors in the priority determination process. Criterion K2 has a score of 23.20 percent, so road connectivity, or the connecting function between regions, is also an important consideration. Criteria K3 and K4 have relatively close scores, at 18.90 percent and 18.20 percent, respectively. This means that industrial development areas and logistics areas for goods or services continue to play a strategic role in road maintenance. Meanwhile, K5 received a score of 10.40 percent, making it the least influential compared to the other criteria.

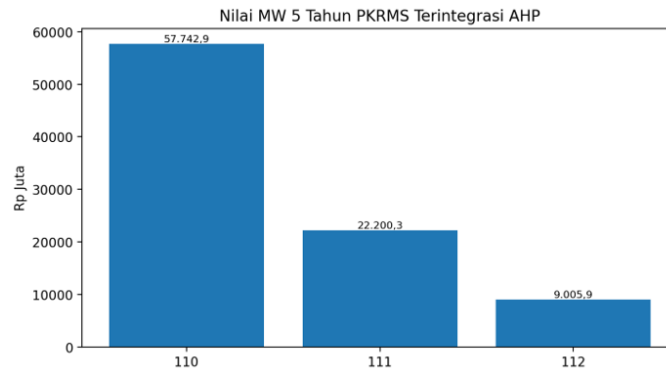
The results of this processing yield a five-year Maintenance Work value, a TPI value, and the type of work on each road section. The MW value indicates the cost required for road maintenance, while the TPI value indicates the priority level of maintenance based on the integration of PKRMS technical data and AHP criterion weights.

Table 3. PKRMS Analysis Results with AHP Integration

Road Section	Section Name	MW 5 Years (Rp Million)	TPI	WorkType
111	LEGUNDI - BTS. MOJOKERTO REGENCY	22.200,3	7,5	2MW
110	BTS. SURABAYA CITY - DRIYOREJO - LEGUNDI	57.742,9	22,5	2MW
112	PETIYIN (BTS. LAMONGAN REGENCY) - KARANGCANGKRING (BTS. LAMONGAN REGENCY)	9.005,9	24,9	2MW



Integrated AHP PKRMS TPI Value Graph



MW Value Graph for 5 Years of Integrated AHP PKRMS

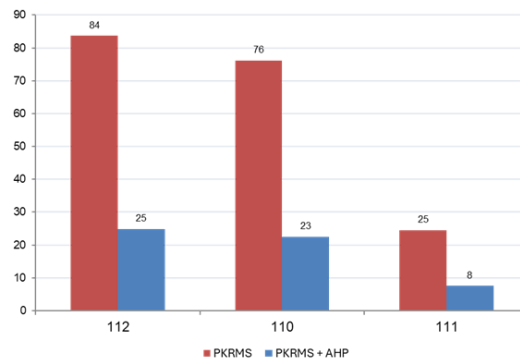
Based on the results of the PKRMS analysis with AHP integration, the Surabaya City - Driyorejo - Legundi section has the highest MW value, at IDR 57,742.9 million, with a TPI of 22.5. This high MW value indicates that this section requires the highest maintenance costs. The Petiyin - Karangcangkring section has a MW value of IDR 9,005.9 million, but has the highest TPI of 24.9. This indicates that despite its lower maintenance costs, this section has a higher technical priority after considering the MCA weighting. Meanwhile, the Legundi - Mojokerto Regency section has a MW value of IDR 22,200.3 million and a TPI of 7.5, making it the lowest priority section compared to the other two sections.

The results of the AHP and PKRMS integration indicate that road maintenance priorities are not determined solely by the value of Maintenance Work. The TPI value also needs to be considered because it reflects the results of the technical assessment that has been influenced by the weighting of the MCA criteria. With this integration, prioritization becomes more objective because it combines PKRMS technical data with the importance weighting results of the AHP. Therefore, the Petiyin - Karangcangkring section can be considered the section with the highest priority based on the TPI value, while the Surabaya City - Driyorejo - Legundi section is the section with the highest handling costs.

Table 4. Comparison of Analysis Results of PKRMS and AHP Integrated PKRMS

Road Section	Section Name	PKRMS MW 5 Years Rp Million	PKRMS TPI	PKRMS Rating	PKRMS + AHP MW 5 Years Rp Million	PKRMS + AHP TPI	PKRMS + AHP Ranking
112	Petiyin (Bts. Lamongan Regency) - Karangcangkring (Bts. Lamongan Regency)	10.998,4	83,7	1	9.005,9	24,9	1
110	Surabaya City, Driyorejo, Legundi BTS	77.415,4	76,2	2	57.742,9	22,5	2

111	Legundi, Mojokerto Regency	28.950,0	24,5	3	22.200,3	7,5	3
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Comparison Chart of PKRMS Analysis Results and AHP Integrated PKRMS

The problem formulation can be answered through the comparison results between PKRMS and PKRMS integrated with AHP. After the AHP weights were entered as MCA values, the priority order did not change. Section 112 remained at first priority, section 110 at second priority, and section 111 at third priority. The difference is seen in the MW and TPI values, which were adjusted. This indicates that the AHP integration did not change the direction of the main priorities, but strengthened the PKRMS results by incorporating the importance weights of the criteria based on respondents' assessments.

Table 5. Synthesis of Answers to Problem Formulation

Formulation of the problem	Findings	Interim Conclusion
How does PKRMS compare and integrate with AHP?	Integration of AHP into PKRMS does not change the priority order, but adjusts the TPI and MW values based on the criteria weights.	The integration of AHP and PKRMS produces stronger prioritization because it combines technical data and criteria importance weights.

CONCLUSION AND RECOMMENDATION

The comparison and integration of PKRMS results with the AHP method shows that the handling priorities become more comprehensive because they combine PKRMS technical data with the importance weights of the criteria from expert respondents. After the PKRMS-AHP integration, the technical priority order still shows that section 112 is the first priority with a TPI value of 24.9, followed by section 110 with a value of 22.5, and section 111 with a value of 7.5. However, in terms of five-year cost requirements, section 110 remains the section with the largest MW value, namely Rp. 57,742.9 million, followed by section 111 with Rp. 22,200.3 million, and section 112 with Rp. 9,005.9 million. These results indicate that the integration of PKRMS and AHP can help produce more objective decisions, because priorities are determined not only by the amount of work

costs, but also by the level of technical urgency, road conditions, traffic volume, connectivity, and the strategic function of the section for industrial areas, logistics, and regional development.

Based on the conclusions above, the following recommendations can be made in this study.

1. For the East Java Provincial Government and related technical agencies, the results of this study can be used as considerations in prioritizing provincial road maintenance programs in Gresik Regency.
2. For businesses and industries around the Gresik Regency provincial road corridor, especially those using sections 110 and 111 for goods distribution, support is needed to improve road performance by complying with vehicle dimensions and load requirements.
3. For further research, the integrated AHP and PKRMS model can be developed by adding other variables, such as accident rates, regional economic impact, road service levels, flood or drainage risks, and heavy vehicle load data.

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