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Analysis of Road Preservation Priority Criteria Based on the Provincial/*Kabupaten* Road Management System (PKRMS) on the Arjosari–Purwantoro Road Section, Pacitan Regency

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Road Preservation; Provincial/Kabupaten Road Management System (PKRMS); Analytical Hierarchy Process (AHP); Priority Analysis; Road Asset Management.

Abstract
Road infrastructure plays a strategic role in supporting community mobility, the distribution of goods and services, and regional economic development. However, limited regional budgets require local governments to establish preservation priorities systematically to ensure effective and efficient resource allocation. The Provincial/Kabupaten Road Management System (PKRMS) provides comprehensive technical data on road conditions, yet technical data alone are insufficient for determining preservation priorities when multiple road segments compete for limited funding. This study aims to analyze the criteria influencing road preservation priorities based on PKRMS data for the Arjosari–Purwantoro Road Section in Pacitan Regency. The criteria analyzed include pavement condition, traffic volume, road function, regional connectivity, socio-economic benefits, accessibility to public facilities, and estimated maintenance costs. The Analytical Hierarchy Process (AHP) was employed to determine the relative importance of each criterion through pairwise comparisons, producing a prioritized ranking that supports objective decision-making. The integration of PKRMS and AHP provides a structured framework for evaluating road segments based on both technical and strategic considerations. The results of this study are expected to identify the most influential criteria in determining road preservation priorities and to provide a rational basis for prioritizing preservation programs on the Arjosari–Purwantoro Road Section. Furthermore, the proposed approach is expected to assist local governments in developing road preservation plans that are effective, efficient, transparent, and accountable, while maximizing the socio-economic benefits of limited infrastructure investment.

INTRODUCTION

Road infrastructure plays a vital role in supporting community mobility, facilitating the movement of goods and services, and promoting regional economic development. As a fundamental component of public infrastructure, roads contribute significantly to accessibility, connectivity, and the efficiency of socio-economic activities (Ruiz & Guevara, 2020). Therefore, maintaining road performance through appropriate preservation measures is essential to ensure sustainable transportation services and to support regional growth (Kale, 2024; Tafida et al., 2024).

In practice, local governments face significant challenges in managing road networks due to limited financial resources and the varying conditions of road assets (Caldera et al., 2021). Consequently, not all road segments requiring maintenance can be addressed simultaneously,

making the establishment of preservation priorities a critical aspect of road asset management (AMIR, 2024; Ruiz & Guevara, 2020). Effective prioritization enables available resources to be allocated to road segments that provide the greatest benefits to users and regional development. To support evidence-based road management, the Indonesian government has implemented the Provincial/*Kabupaten* Road Management System (PKRMS), a road management framework designed to collect, process, and analyze road condition data systematically (Arifin et al., 2025; Witjaksana et al., 2025). PKRMS provides comprehensive information regarding pavement condition, types and severity of distress, drainage condition, road geometry, and other functional characteristics associated with road performance (Tama et al., 2026). The availability of such data enhances the objectivity and reliability of road preservation planning by providing a standardized basis for evaluating road conditions (Pamungkas et al., 2017; Prahastyo et al., 2019; Riduan et al., 2026).

However, technical condition data alone are insufficient for determining preservation priorities, particularly under budget constraints. Road segments with severe physical deterioration do not necessarily represent the highest preservation priority if their traffic demand, strategic function, or socio-economic significance is relatively low (Armayadi et al., 2023). Conversely, road sections with moderate deterioration may require higher priority if they serve as critical transportation corridors, support regional connectivity, or provide access to important economic and public service centers. Therefore, road preservation prioritization should incorporate multiple evaluation criteria rather than relying solely on pavement condition. Several criteria are commonly considered in preservation prioritization, including pavement condition, traffic volume, road function, regional connectivity, socio-economic benefits, accessibility to public facilities, and estimated maintenance costs. These factors collectively influence the urgency and effectiveness of preservation interventions, making road preservation prioritization a multi-criteria decision-making problem that requires a systematic and objective analytical approach.

The Arjosari–Purwantoro Road Section in Pacitan Regency is a strategically important corridor that functions as an interregional connection and supports the mobility of people, goods, and economic activities. Based on PKRMS survey data, this road section exhibits several forms of pavement distress, including longitudinal cracking, alligator cracking, raveling, and surface deterioration. These conditions indicate the need for a comprehensive prioritization analysis that considers not only the extent of pavement damage but also the strategic importance of the road and the limitations of available funding. Accordingly, this study focuses on analyzing the criteria influencing road preservation priorities based on PKRMS data for the Arjosari–Purwantoro Road Section in Pacitan Regency. The research aims to identify the most influential factors in preservation decision-making and to provide an objective basis for prioritizing preservation programs. The results are expected to support local governments in developing road preservation strategies that are effective, efficient, transparent, and aligned with regional infrastructure management objectives.

METHOD

The research commenced with a literature review to establish the theoretical foundation related to road preservation, the Provincial/*Kabupaten* Road Management System (PKRMS), and the Analytical Hierarchy Process (AHP) method (Kresnanto, 2022; Sitanggang et al.,

2022). Subsequently, data collection was conducted using both primary and secondary data sources. The primary data were obtained through questionnaire surveys distributed to qualified experts and stakeholders to assess the relative importance of the criteria used in determining road preservation priorities (Togelang & Manoppo, 2021). Meanwhile, the secondary data consisted of PKRMS survey data, AHP assessment data, as well as traffic volume data represented by the Average Daily Traffic (ADT) and road inventory data. The collected data were then analyzed using the PKRMS framework to identify the existing road conditions and preservation requirements based on available technical parameters. The results of the PKRMS analysis were subsequently integrated with the AHP method to determine the weights and priority levels of the preservation criteria. Furthermore, a consistency test was performed on the pairwise comparison matrix using the Consistency Ratio (CR). If the CR value exceeded 0.10, the assessment process was repeated until an acceptable level of consistency was achieved. Conversely, if the CR value was less than or equal to 0.10, the weighting results were considered consistent and suitable for further analysis. Based on the established priority rankings, a maintenance cost analysis was conducted to estimate the budget requirements for preserving the prioritized road segments. Finally, conclusions and recommendations were formulated based on the findings of the priority criteria analysis for road preservation using PKRMS on the Arjosari–Purwantoro Road Section in Pacitan Regency. The results are expected to provide a rational basis for decision-making in road preservation planning and resource allocation.

RESULTS AND DISCUSSION

PKRMS Operational Procedure

The operation of the Provincial/*Kabupaten* Road Management System (PKRMS) in this study was conducted after the availability of road condition survey data, road section data, road inventory data, and other supporting information. PKRMS was utilized as a decision-support tool to process road condition data and generate information regarding road condition ratings, Trafficability and Traversability Index (TTI), Surface Distress Index (SDI), recommended preservation treatments, and analytical reports that served as the basis for establishing road preservation priorities. In general, the PKRMS operational procedure adopted in this study consisted of several stages. The process began with opening the PKRMS application and database, followed by verifying the road network information to ensure that the road section data were complete and accurate. Subsequently, road condition data were entered or imported into the system. International Roughness Index (IRI) data were also imported when available to enhance the accuracy of pavement condition assessment. After the data input process, data validation was performed to identify and correct inconsistencies, missing values, or errors within the database. Once the data had been validated, the analysis module was executed to evaluate pavement conditions and determine the required preservation treatments for each road segment. The system then generated analytical outputs, including road condition indicators and maintenance recommendations. Finally, the reporting module was accessed to obtain the analysis results, particularly the TTI and SDI values, which were recorded and further analyzed as key parameters in the road preservation prioritization process.

PKRMS Analysis Results

The PKRMS analysis was conducted to evaluate the technical condition of the Arjosari–Purwantoro Road Section (Central Java Provincial Boundary). The PKRMS data served as the primary basis for identifying road preservation requirements and establishing preservation priorities. The analysis considered several parameters, including road section length, pavement type, road condition based on the Treatment Trigger Index (TTI), road condition based on the Surface Distress Index (SDI), and the level of road serviceability.

Based on the PKRMS data for Semester I of 2026, the Arjosari–Purwantoro Road Section has a surveyed length of 46.39 km and is entirely surfaced with asphalt pavement. This indicates that the preservation analysis for this road section focuses on the maintenance and rehabilitation of flexible pavement structures. The use of a uniform pavement type facilitates a more consistent assessment of pavement performance and deterioration characteristics along the entire road corridor.

The PKRMS analysis provides an overview of the existing pavement condition through the evaluation of TTI and SDI values. These indicators are used to assess the functional and structural performance of the pavement and to determine the appropriate preservation treatments required for each road segment. Furthermore, the analysis of road serviceability levels enables the identification of segments requiring immediate intervention and supports the prioritization process within the road preservation program. Consequently, the PKRMS outputs constitute an essential technical foundation for subsequent analyses aimed at determining preservation priorities on the Arjosari–Purwantoro Road Section.

Road Condition Based on the TTI Parameter

The Treatment Trigger Index (TTI) parameter is used to indicate road conditions based on preservation and maintenance requirements. TTI values classify road conditions into four categories: good, fair, minor damaged, and severely damaged. The PKRMS results for the Arjosari–Purwantoro Road Section are presented in Table below.

Table 1. Road Condition Based on the TTI Parameter

Road Condition	Length (km)	Percentage (%)
Good	13,29	28,65
Fair	19,80	42,68
Minor Damaged	12,90	27,81
Severaly Damaged	0,40	0,86
Total	46,39	100

Source: Analysis Results

Based on Table 1, the road condition is predominantly classified as fair, covering 19.80 km or 42.68% of the total road length. The minor damaged category accounts for 12.90 km or 27.81%, while roads in good condition represent 13.29 km or 28.65% of the surveyed section. The severely damaged category constitutes only 0.40 km or 0.86% of the total length.

When the fair and minor damaged categories are combined, they account for 32.70 km, equivalent to approximately 70.49% of the road section. This finding indicates that a substantial portion of the Arjosari–Purwantoro Road Section requires preservation attention. Therefore, road management efforts should not be limited to routine maintenance activities but should also emphasize preventive and periodic maintenance strategies to prevent further deterioration

and reduce the risk of pavement conditions progressing to severe damage. Such an approach is essential for maintaining the serviceability of the road network and optimizing long-term preservation costs.

Road Condition Based on the SDI Parameter

In addition to the Treatment Trigger Index (TTI), the Provincial/*Kabupaten* Road Management System (PKRMS) also evaluates road conditions using the Surface Distress Index (SDI). This parameter reflects the extent of pavement surface deterioration and is used to assess surface damage conditions in greater detail. The SDI classification results for the Arjosari–Purwantoro Road Section are presented in Table 2.

Table 2. Road Condition Based on the SDI Parameter

SDI Condition	Length (km)
Good	13,29
Fair	19,80
Minor Damaged	12,90
Severaly Damaged	0,40
Total	46,39

Source: Analysis Results

Based on Table 2, the road section is predominantly classified as having a good SDI condition, covering 26.69 km of the total surveyed length. The fair condition category accounts for 13.20 km, while minor damaged pavement represents 6.40 km. Only 0.10 km of the road section is categorized as severely damaged according to the SDI assessment.

These results indicate that the pavement surface condition along the Arjosari–Purwantoro Road Section is generally dominated by good and fair categories, suggesting that the majority of the pavement remains in a serviceable condition. Consequently, the appropriate preservation strategy should focus on maintaining the existing pavement performance through routine and preventive maintenance measures. Such an approach is essential to prevent further deterioration, extend pavement service life, and minimize the need for more extensive and costly rehabilitation treatments in the future.

Initial Treatment Recommendations Based on PKRMS Results

The PKRMS analysis indicates that the Arjosari–Purwantoro Road Section does not require a uniform treatment approach across all segments. Instead, preservation measures should be selected according to the condition category of each segment. Road segments classified as being in good condition are more appropriately managed through routine maintenance activities. Segments categorized as fair and minor damaged are recommended for preventive periodic maintenance to prevent further deterioration and maintain pavement performance. Meanwhile, severely damaged segments should be directed toward limited minor rehabilitation treatments.

Table 3. Initial Treatment Recommendations Based on PKRMS Results

Road Condition	TTI Segment Length (km)	Recommended Treatment Method
Good	13,29	Routine maintenance
Fair	19,80	Preventive periodic maintenance

Road Condition	TTI Segment Length (km)	Recommended Treatment Method
Minor Damaged	12,90	Preventive periodic maintenance/ minor rehabilitation

Source: Analysis Results

Table 3. Initial Treatment Recommendations Based on PKRMS Results (Continued)

Road Condition	TTI Segment Length (km)	Recommended Treatment Method
Severaly Damaged	0,40	Limited minor rehabilitation
Total	46,39	Progressive preservation according to segment condition

Source: Analysis Results

Based on Table 4.9, the PKRMS results suggest that the dominant preservation strategy for the Arjosari–Purwantoro Road Section is preventive periodic maintenance. This recommendation is supported by the fact that road segments classified as fair and minor damaged account for 32.70 km of the total road length. Routine maintenance remains necessary to preserve segments that are currently in good condition, while minor rehabilitation is only required for limited sections categorized as severely damaged.

These findings demonstrate that most preservation needs along the road section can be addressed through timely preventive interventions rather than extensive rehabilitation measures. Implementing preventive maintenance strategies at an early stage is expected to slow pavement deterioration, extend service life, improve road performance, and optimize the allocation of preservation budgets. Consequently, the PKRMS recommendations provide an important technical basis for establishing preservation priorities and developing cost-effective road management programs for the Arjosari–Purwantoro Road Section.

Development of AHP Criteria and Alternatives

The Analytical Hierarchy Process (AHP) framework in this study was developed to determine the priority of road preservation treatment methods for the Arjosari–Purwantoro Road Section (Tun et al., 2024). The AHP structure was designed based on four primary criteria that significantly influence preservation decision-making, namely road condition, traffic volume, maintenance cost, and socio-economic impact. These criteria were selected to represent technical, economic, and social considerations in the prioritization process.

Table 4. AHP Criteria for Determining Preservation Treatment Priorities

Code	Criteria	Description
K1	Road Condition (Level of Deterioration)	Evaluates the degree of pavement deterioration based on pavement condition indicators
K2	Traffic Volume	Assesses the intensity of vehicle movements utilizing the road section
K3	Maintenance Cost	Evaluates the efficiency and financial requirements of each preservation treatment alternative
K4	Socio-Economic Impact	Assesses the influence of road conditions on community mobility and regional economy activities

Source: Analysis Results

The preservation treatment alternatives were subsequently defined based on the characteristics of road condition categories identified through the PKRMS analysis. Three

preservation alternatives were considered in this study, representing different levels of intervention according to the severity of pavement deterioration.

Table 5. Road Preservation Treatment Alternatives

Code	Alternative	Description
A1	Routine maintenance	Minor maintenance activities, such as pothole patching, drainage celaning, and localized pavement repairs
A2	Preventive periodic maintenance	Surface treatment measures aimed at preventing the progression of pavement deterioration and extending pavement service life
A3	Minor Rehabilitation	Rehabilitation treatments applied to road segments experiencing more severe pavement deterioration requiring structural improvement

Source: Analysis Results

Unlike studies that compare multiple road sections, this research focuses on comparing preservation treatment alternatives for a single road corridor. Therefore, the final output of the AHP analysis is a prioritized ranking of preservation treatment methods that are most suitable for the Arjosari–Purwantoro Road Section. The resulting priority ranking serves as a decision-support tool for selecting the most appropriate preservation strategy based on the relative importance of the established criteria.

Matrix Normalization and Criteria Priority Weights

Matrix normalization was performed to obtain the proportional value of each criterion within the pairwise comparison matrix. The priority weight of each criterion was calculated based on the average value of the normalized matrix in each row. The results of the normalization process and the corresponding priority weights are presented in Table

Table 6. Matrix Normalization and Criteria Priority Weights

Criteria	K1	K2	K3	K4	Total	Weight	Percentage	Rank
K1	0,561	0,591	0,419	0,468	1,994	0,498	49,84%	1
K2	0,188	0,215	0,258	0,303	0,963	0,241	24,08%	2
K3	0,121	0,082	0,098	0,069	0,371	0,093	9,27%	3
K4	0,175	0,113	0,225	0,159	0,672	0,168	16,81%	4
Total	1,000	1,000	1,000	1,000	1,000	1,000	100%	

Source: Analysis Results

Based on Table 4.14, K1 (Road Condition or Level of Deterioration) obtained the highest priority weight of 0.498 (49.84%), indicating that pavement condition is the most influential factor in determining road preservation priorities. This result highlights the importance of addressing road deterioration as the primary consideration in selecting appropriate preservation treatments.

The second most influential criterion is K2 (Traffic Volume), with a weight of 0.241 (24.08%), demonstrating that the level of road utilization significantly affects preservation decision-making. Road sections carrying higher traffic volumes generally require greater attention due to their broader impact on transportation efficiency and user mobility.

Meanwhile, K4 (Socio-Economic Impact) ranked third, with a weight of 0.168 (16.81%), indicating that the contribution of a road section to community mobility and regional economic

activities also plays an important role in preservation prioritization. In contrast, K3 (Maintenance Cost) received the lowest weight of 0.093 (9.27%), suggesting that although budget considerations remain relevant, they are less influential than technical and socio-economic factors in determining preservation priorities for the Arjosari–Purwantoro Road Section.

Overall, the results indicate that technical considerations, particularly road condition, dominate the decision-making process, while traffic demand and socio-economic benefits provide additional support in establishing preservation priorities. These findings demonstrate that the selected preservation strategy should primarily focus on maintaining and improving pavement conditions while also considering the operational and socio-economic significance of the road corridor.

The results indicate that road condition (K1) is the most influential criterion in determining road preservation priorities on the Arjosari–Purwantoro Road Section, with a weight of 49.84%, followed by traffic volume (24.08%), socio-economic impact (16.81%), and maintenance cost (9.27%). This finding suggests that preservation decisions are primarily driven by the physical condition of the pavement, while traffic demand and socio-economic benefits serve as supporting considerations. The dominance of road condition is consistent with the principles of road asset management and the PKRMS framework, which emphasize condition-based decision-making in preservation planning. The PKRMS analysis showed that approximately 70.49% of the road section falls within the fair and minor damaged categories, indicating a substantial need for preservation interventions. Consequently, preventive preservation measures are considered more appropriate than major rehabilitation for most segments.

These findings are consistent with previous studies. Masagung et al. (2023) found that the integration of PKRMS and AHP improves the objectivity of road maintenance prioritization by considering road condition and traffic volume. Similarly, Halich et al. (2023) and Arifin et al. (2025) concluded that combining PKRMS and AHP provides an effective framework for determining preservation priorities based on technical and functional criteria. This study is limited by its focus on a single road section and the reliance on expert judgment in the AHP assessment. In addition, only four criteria were evaluated, whereas other factors such as road safety, connectivity, and environmental conditions may also influence preservation priorities.

In conclusion, the integration of PKRMS and AHP effectively identified road condition as the primary criterion for preservation prioritization on the Arjosari–Purwantoro Road Section. The results support the implementation of preventive preservation strategies and provide an objective basis for road asset management and budget allocation in Pacitan Regency.

CONCLUSION

Based on the analysis of road preservation priority criteria using the Provincial/*Kabupaten* Road Management System (PKRMS) and the Analytical Hierarchy Process (AHP), road condition (level of deterioration) was identified as the most influential criterion in determining preservation priorities on the Arjosari–Purwantoro Road Section, with a weight of 49.84%. This was followed by traffic volume (24.08%), socio-economic impact (16.81%), and maintenance cost (9.27%). These findings indicate that preservation decision-

making should primarily be based on the physical condition of the pavement while also considering road utilization and its contribution to regional socio-economic activities. The PKRMS analysis revealed that the majority of the road section is classified within the fair and minor damaged categories, indicating the need for timely preservation interventions. The integration of PKRMS and AHP proved effective in providing an objective and systematic framework for evaluating preservation priorities, consistent with previous studies that highlighted the importance of combining technical and functional criteria in road asset management. Overall, the study concludes that the integration of PKRMS and AHP can support more effective and efficient road preservation planning by prioritizing interventions based on actual road conditions and strategic needs, thereby improving the allocation of limited maintenance resources on the Arjosari–Purwantoro Road Section.

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