ANALYSIS OF DETERMINING PRIORITY OF ROAD MAINTENANCE PROGRAM IN THE REGION OF KEDIRI ROAD AND BRIDGE MANAGEMENT DEPARTMENT OF HIGHWAYS EAST JAVA PROVINCE USING MULTI CRITERIA ANALYSIS (MCA) METHOD

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Abstract: Road conditions are vital for smooth land transportation to supporting the economy. Good road management programs, funded by the government through road administrators, are necessary for achieving steady road conditions. The Provincial Government of East Java through the Department of Public Works of Highways has an important role in the process of handling provincial roads. Budget limitations, both Regular APBD funds and special allocation funds and other funds, create a distinct challenge for road administrators in determining an effective and optimal road management program. Based on previous research studies, priority determination of road handling can be carried out using Multi Criteria Analysis. Priority determination criteria used in this study are technical criteria which include: existing traffic conditions, road stability conditions, degree of saturation, travel speed, and travel time; financial and economic criteria which include: Vehicle Operational Costs, Time Value, Benefit Cost Ratio, and Net Present Value. In this study it will be seen based on the results of prioritized maintenance handling found at Link 176 Kediri - Blitar City Boundary for average daily traffic technical criteria has a difference in value of 3,190 cur/hour, with an average road condition of 27.12%, difference in degree of saturation of 0.346, the difference in travel speed is 3.409 km/hour, the difference in travel time is 3.661 minutes and for economic criteria vehicle operational costs has a difference in value of Rp. 8,662,656,168, the difference in the Benefit Cost Ratio is 0.60 and the difference in the Net Present Value is -Rp. 8,382,143,904.

Keywords: *Road handling priority, multi criteria analysis, selection of road handling, benefit cost ratio, net present value*

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INTRODUCTION

Transportation is one of the supporting development for an area. In terms of transportation, roads play an important role in realizing smooth land transportation. In general, roads function to support the smooth movement of people and goods [1]. Steady road conditions determine the smooth running of land transportation to support economic activity. To achieve steady road conditions requires a good road management program. Road handling activities or what is known as the Province/District Road Management System in general consist of data collection; data analysis; evaluation and selection of treatment alternatives; and budgeting for road management. Provincial / District Road Management System is a program designed specifically for planning, programming and budgeting needs at the provincial and district levels [2]. The results of activities are used by decision makers to determine the steps needed to maintenance road conditions so that they can serve them well.

The government, through the agencies appointed as road administrators, needs funds to maintain the stability of the road itself. The process of budgeting funds for the implementation of the road through a process of proposals, discussions and determination of the budget. Determining the priority of the proposal requires a long discussion. This is due to differences in the perceptions of decision makers on priority road management programs and limited funds obtained by a region. These problems require the same perception of decision makers in determining road handling priorities, so that the limited funds owned by a region can run optimally, directed, and transparent.

The East Java Provincial Government has the authority to administer provincial roads which includes regulation, guidance, development, and supervision of provincial roads, this is in accordance with Law number 38 of 2004 concerning Roads and Government Regulation number 34 of 2006 concerning Roads. The Public Works Department of Bina Marga Province of East Java Province has the authority to administer 1,421.00 km of provincial roads in East Java, this is in accordance with the Decree of the Governor of East Java Number 188/128/KPTS/013/2016 dated 12 February 2016 concerning Determination of Road Sections According to its status as a provincial road, which is located in 37 regencies/cities in East Java. The entire length of the Provincial Road is divided into 195 road sections managed by 11 Road and Bridge Management Technical Implementation Units.

Technical Implementation Unit Management of Roads and Bridges is a technical implementing element of the Service that carries out operational technical tasks in the field, led by the Technical Implementation Unit Head who is under and responsible to the Head of Service [3]. The Road and Bridge Management Technical Implementation Unit itself has the task of carrying out some of the Department's duties in handling, managing roads and bridges, administration, and community services. In addition, the functions of the Technical Implementation Unit Management of Roads and Bridges are; a) Implementation of technical administration for handling roads and bridges; b) Implementation of handling roads and bridges; c) Carry out monitoring of road and bridge handling; d) Monitoring the condition of roads and bridges; e) Implementation of administrative tasks; f) Implementation of community service; g) Implementation of other tasks given by the Head of Service.

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The Technical Implementation Unit Management of Roads and Bridges in Kediri is one of 11 Technical Implementation Unit for the Management of roads and bridges for the East Java Office of Department of Bina Marga which oversees the implementation of provincial roads in the areas of Kediri City, Kediri Regency, Tulungagung Regency, Blitar City, Blitar Regency and Nganjuk Regency. The Kediri Road and Bridge Management Technical Implementation Unit itself has a total length of 167,770 KM which is divided into 35 provincial road sections [4].

Government Regulation no. 34 of 2006 Challenging Roads defines road network handling programming as the preparation of a road segment management activity plan which is the responsibility of the road administrator according to their authority which includes determining the plan for the level of performance achieved and the estimated costs required. The road network management program includes a road maintenance program, a road improvement program, and a new road construction program. Road handling consists of routine maintenance activities, periodic maintenance, rehabilitation and reconstruction [3]. Routine maintenance activities include: road shoulder maintenance; filling of surface gaps/cracks; asphalt paving; and hole patching. Periodic maintenance activities include: road shoulder repairs; filling of surface gaps/cracks; hole patching; wave repair; non structural coating; and thin asphalt coating. Rehabilitation activities include: road shoulder repair; asphalt paving; structural resurfacing; pavement structure work; basic soil preparation; excavation work; and stockpiling work [5]. Reconstruction activities consisted of: road shoulder repair; pavement structure work; basic soil preparation; excavation work; backfill work; and recycling work [6].

Some of the main points in the East Java Province Public Works Department of Highways' strategic plan for 2019-2024, namely: 1) Maintain road stability with routine road maintenance, periodic road maintenance, road reconstruction; 2) Completion of handling roads with Vehicle Capacity Ratio > 1 by increasing road capacity; 3) widening the road to a standard 7 meters; 4) Completion of damage handling whose planned age has exceeded with periodic road rehabilitation/maintenance and road structure reconstruction/improvement. To achieve this, in 2021 the Public Works Department of Highways of East Java Province is proposing several packages of road and bridge handling activities, including: Road Widening and Reconstruction activities, Bridge Reconstruction activities, Road Widening activities with Hardened Road Shoulders, and Road Periodic Maintenance activities. The purpose of these activities is none other than to provide safe, comfortable and smooth provincial road infrastructure in supporting the welfare of the people of East Java Province.

The limited funds owned by a region, both regular APBD funds, special allocation funds, and loan funds are a challenge for the Public Works Department of Highways in carrying out provincial road management activities. In this research, the sample to be taken is the scope of activities at Technical Implementation Unit Management of Roads and Bridges in Kediri. In 2021 the Technical Implementation Unit Management of roads and bridges proposes that as many as 8 sections are planned to receive a road widening activity program with hardened shoulders, and 4 sections with a road reconstruction activity program. These sections include: Bts Kab. Nganjuk - Bts Kota Kediri (Link 175), Bts.Kota Kediri - Bts.Kab. Blitar (Link 176), Bts. Kab. Jombang - Bts. Kota Pare (Link 177), Bts. Kota Pare - Bts. Kota Kediri (Link 181), Kandangan - Bts. Kota Pare (Link 180), Bts. Kab. Jombang – Kandangan (Link 178), Ngantru - Bts. Kab. Blitar (Link 182), Bts. Kab. Kediri - Srengat (Link 183), Bts. Kab. Tulungagung - Srengat (Link 184), Srengat - Bts. Kota Blitar (Link 185), Bts. Kab. Bojonegoro (Pajeng) - Bts. Kab. Nganjuk (Guyangan) (Link 172), dan Bts. Kota Nganjuk (Simpang Empat Candi) - Bts. Kab. Kediri (Link 174).

RESEARCH SIGNIFICANCE

This research was able to find out the order of priority levels for handling roads on roads in the Technical Implementation Unit area of Kediri Road and Bridge Management at the Provincial Bina Marga Public Works Service which was proposed in the program package for road handling activities in 2021. The benefits expected in this research are for the community, especially the people of Java Province East namely getting the right provincial road management activities to support the economy by increasing the mobility of safe and comfortable movement of people and goods. In addition, the benefits expected from this research are to find out what road handling activities are appropriate to be carried out with limited funds owned by a region.

METHODOLOGY

A. PROBLEM IDENTIFICATION AND RESEARCH DESIGN

Identification of the most important problem in this study is to determine the order of priority for the road management program that has been proposed. In the midst of the challenge of limited funds and costs owned by a road management agency, this research is needed to determine the handling needs so that it is effective and optimal.

In addition, this research is expected to be able to answer the question of how the road performance conditions are on the sections that will be proposed in the road handling program package in the Unit Management of Roads and Bridges Kediri area, answer the question what are the economic feasibility conditions for the proposed road handling program package in the Unit Management of Roads and Bridges Kediri area, and answer the question of what is the order of priority for handling roads in the Unit Management of Roads and Bridges Kediri area with the condition of existing budget constraints.

B. DATA COLLECTION

Identification of the most important problems in the data collection method in this study was carried out in two ways, each for collecting primary data and secondary data. For primary data, a survey method was used, in which Survey Data for Existing Road Conditions was taken on all sections proposed for the Technical Implementation Unit Management of Roads and Bridges Kediri road handling program package for the Office of Department of Bina Marga, East Java Province in 2021. Meanwhile, for secondary data, data on the proposed road handling work

package price was used. proposed for the 2021 Technical Implementation Unit Management of Roads and Bridges Kediri Road handling program package for the Public Works Department of Bina Marga, East Java Province. The proposed price data for the road handling work package is presented in Table 3.1 which includes Average Daily Traffic data for the period 2017 to 2020 for all segments proposed in the handling program package. Technical Implementation Unit Management of Roads and Bridges Kediri road Public Works Department of Bina Marga East Java Province in 2021, population data around the Technical Implementation Unit Management of Roads and Bridges Kediri road handling program package in 2021. If this road handling program package is not implemented, then the road handling program in the Technical Implementation Unit Management of Roads and Bridges in Kediri area will be carried out on a routine maintenance basis.

Table 1 Proposed road handling program in the technical implementation unit management of roads and bridges Kediri region for the 2021 fiscal year

Road Link	Length of Section Handled (km)	Fund Budget (Rp.)
172	5,13	15.500.000.000
174	2,12	3.100.000.000
175	10,00	45.315.300.000
176	9,65	20.824.940.000
177	5,50	7.800.000.000
178	3,58	6.850.000.000
180	5,26	8.300.000.000
181	5,00	6.700.000.000
182	7,65	19.800.000.000
183	5,80	7.000.000.000
184	9,50	12.400.000.000
185	5,45	6.600.000.000
Total	74,64	160.190.240.000

(Source: Technical Implementation Unit Management of Roads and Bridges J Kediri Bina Marga, 2021)

C. ROAD PERFORMANCE ASSESSMENT

The road performance assessment was carried out on the road sections proposed for the 2021 road handling package program in the Kediri Road and Bridge Management Technical Implementation Unit Management of Roads and Bridges area. The purpose of assessing road performance is the assessment of technical criteria which will later be quantified into a score for determining road management priorities. The technical criteria to be measured are all matters that include technical aspects in the design of road management activities, including the following.

- Average Daily Traffic
  The average daily traffic is one of the secondary data obtained from the Public Works Department of Highways, East Java Province.
- Road Stability Conditions
  Road stability condition is one of the secondary data that must be taken in this study. Road Stability conditions on the road sections proposed for the 2021 road handling package program in the Kediri Road and Bridge Management Technical Implementation Unit area will be assessed visually based on the Provincial / District Road Management System method.

$$UP = 17 - (Class\ of\ Average\ Traffic + Value\ of\ Road) \quad (1)$$

- *Volume Capacity Ratio* (VCR)
  The volume capacity ratio (VCR) is the ratio between the passing volume (pcu) and the capacity of a particular road section (pcu).

$$VCR = V / C \quad (2)$$

- Travel Speed
  Vehicle Travel Speed in a segment will be calculated based on the equation. The speed used is the free flow speed.

$$FV = (FV0 + FVW)\ x\ FFVSF\ x\ FFVRC \quad (3)$$

- Traveling time
  Vehicle Travel Time in a section will be calculated when the existing conditions are in place and will also be calculated when the work package conditions have been implemented.

D. ECONOMIC FEASIBILITY ASSESSMENT

Assessment of the economic feasibility of the road handling program package (existing condition) (do something condition). The Benefit Cost Ratio assessment is calculated for each road management program package that has been proposed in 2021 by the Technical Implementation Unit Management of Roads and Bridges Kediri Office of Department of Bina Marga, East Java Province. The economic feasibility criteria referred to are the Benefit Cost Ratio which is calculated in each work package considering the Net Present Value, Vehicle Operational Costs, Time Value.

E. SELECTION OF PRIORITY ROAD HANDLING PROGRAMS

To determine the order of priority for road maintenance, it is necessary to analyze the criteria that will be used as assessment parameters. Criteria analysis referred to here is to analyze technical criteria and economic criteria. Technical criteria which include assessing road performance on each section in the existing conditions (before the road handling program package) and in conditions after the road management program package was available. Variables on road performance assessment. The economic criterion is an assessment of the economic feasibility of the road management program package (Benefit Cost Ratio Analysis). These criteria are analyzed for each section proposed in the road handling program package in the Kediri Road and Bridge Management Technical Implementation Unit area in 2021. Furthermore, when an analysis of all these criteria has been carried out, then each road handling program package and its criteria are carried out by Multi Criteria Analysis to get the order of priority for road handling according to the score on each of these sections.

RESULTS AND DISCUSSIONS

In the results and discussion chapter, the data from the results of data collection and analysis of the data used will be explained. Furthermore, the results of the calculation analysis are used to determine the economic feasibility conditions for the proposed road handling program package for the Technical Implementation Unit Management of Roads and Bridges Kediri area. To

determine the condition of the economic feasibility of the road used primary and secondary data. Primary data was obtained from the survey method and secondary data was obtained from price data for the road handling program package Technical Implementation Unit Management of Roads and Bridges Kediri Public Works Department of Bina Marga, East Java Province in 2021. From the results of data collection, the collected data is then processed to evaluate road performance, assess economic feasibility. To achieve a road performance assessment, the data collected is processed into average daily traffic data, road stability conditions, volume capacity ratio, travel speed, travel time. The data that has been collected will then be used in calculations for selecting priority road management programs.

A. ROAD PERFORMANCE ASSESSMENT

Road performance assessment is an assessment of technical criteria that is quantified into a score for determining road handling priorities. Assessment of road performance uses Provincial / District Road Management System where the damage data is data from the Provincial Highways survey. Recapitulation of Technical Implementation Unit Management of Roads and Bridges Kediri Regional Road Performance Evaluation.

Table 2 Recapitulation of technical implementation unit management of roads and bridges Kediri area road performance conditions

Road Link	Damage Type			
	Good	Medium	Light Damage	Heavy Damage
172	30,43%	40,10%	20,29%	9,18%
174	62,00%	34,00%	4,00%	0,00%
175	69,44%	23,15%	5,56%	1,85%
176	13,01%	36,99%	15,75%	34,25%
177	26,56%	65,63%	6,25%	1,56%
178	36,11%	63,89%	0,00%	0,00%
180	16,39%	77,05%	4,92%	1,64%
181	99,36%	0,64%	0,00%	0,00%
182	58,33%	41,67%	0,00%	0,00%
183	75,61%	24,39%	0,00%	0,00%
184	18,45%	67,96%	12,62%	0,97%
185	76,19%	21,90%	1,90%	0,00%
Average	48,49%	41,45%	5,94%	4,12%

(Source: Technical Implementation Unit Management of Roads and Bridges Kediri Bina Marga, 2021)

B. TECHNICAL CRITERIA

B.1. ROAD CAPACITY BEFORE MAINTENANCE

Calculation of road capacity is used to determine the ability of the road to accommodate traffic flow per hour (cur/hour) on the existing road prior to the construction of road widening maintenance. In this thesis, the existing road at the study site is an undivided two-lane two-way road, so the capacity is defined for two-way traffic. Next, we will describe the calculation of the capacity of the existing road that affects the development of maintenance of road widening.

Table 3 Recapitulation of road capacity before maintenance

Road Link	Capacity	=	Result	Unit
172	C	=	2370	skr/jam
174	C	=	2370	skr/jam
175	C	=	2341	skr/jam
176	C	=	2341	skr/jam
177	C	=	2341	skr/jam
178	C	=	2341	skr/jam
180	C	=	2370	skr/jam
181	C	=	2370	skr/jam
182	C	=	2370	skr/jam
183	C	=	2370	skr/jam
184	C	=	2341	skr/jam
185	C	=	2341	skr/jam

B.2. DEGREE OF SATURATION BEFORE ROAD MAINTENANCE

The degree of saturation value indicates the density or level of congestion of a road by comparing the volume of traffic flow with the capacity of the road. The degree of saturation is calculated for 10 years since the road repair maintenance plan in 2021. The following is an example of calculating the degree of saturation before the construction of road maintenance for all Technical Implementation Unit Management of Roads and Bridges Kediri area links in 2021.

Table 4 Recapitulation of road saturation degree before maintenance

Road Link	Total Flow (Q) (skr/hour)	Capacity (C) (skr/hour)	DS
172	3189	2370	1,346
174	3237	2370	1,366
175	3239	2341	1,383
176	3190	2341	1,362
177	2973	2341	1,270
178	3075	2341	1,313
180	2784	2370	1,175
181	3177	2370	1,341
182	2222	2370	0,938
183	1812	2370	0,765
184	1967	2341	0,840
185	2388	2341	1,020

B.3. TRAVEL SPEED BEFORE ROAD MAINTENANCE

The main measure of road segment performance is travel speed, because it is easy to understand and measure, but it is also an important input to road user costs in economic analysis. To determine the travel speed of the vehicle, it is necessary to calculate the free flow speed of the vehicle first. Free flow speed is defined as the speed when the current level is zero or in other words the condition where the driver drives a motorized vehicle without being hindered by other motorized vehicles. For the analysis of free flow speed and travel speed before the existing road is based on the 2014 Indonesian Road Capacity Guidelines for roads outside the city.

Table 5 Recapitulation of vehicle free flow speed before maintenance

Road Link	Free Flow Speed (km/jam)				
	LV	MHV	MC	LB	LT
172	44,80	39,28	47,55	37,90	37,21
174	44,80	39,28	47,55	37,90	37,21
175	35,81	39,28	47,55	37,90	37,21
176	35,81	39,28	47,55	37,90	37,21
177	35,81	39,28	47,55	37,90	37,21
178	35,81	39,28	47,55	37,90	37,21
180	35,81	39,28	47,55	37,90	37,21
181	44,80	39,28	47,55	37,90	37,21
182	44,80	39,28	47,55	37,90	37,21
183	44,80	39,28	47,55	37,90	37,21
184	35,81	39,28	47,55	37,90	37,21
185	35,81	39,28	47,55	37,90	37,21

B.4. ROAD CAPACITY AFTER ROAD MAINTENANCE

Calculation of road capacity is used to determine the ability of the road to accommodate traffic flow per hour (cur/hour) on the existing road after the construction of road widening maintenance. In this thesis, the existing road at the study site is an undivided two-lane two-way road, so the capacity is defined for two-way traffic. Next, we will describe the calculation of the capacity of the existing road that affects the development of maintenance of road widening.

Table 6 Road capacity recapitulation after maintenance

Road Link	Capacity	=	Result	Unit
172	C	=	3244	skr/jam
174	C	=	3244	skr/jam
175	C	=	3137	skr/jam
176	C	=	3137	skr/jam
177	C	=	3137	skr/jam
178	C	=	3137	skr/jam
180	C	=	3244	skr/jam
181	C	=	3244	skr/jam
182	C	=	3244	skr/jam
183	C	=	3244	skr/jam
184	C	=	3137	skr/jam
185	C	=	3137	skr/jam

B.5. DEGREE OF SATURATION AFTER ROAD MAINTENANCE

The degree of saturation value indicates the density or level of congestion of a road by comparing the volume of traffic flow with the capacity of the road. The degree of saturation is calculated for 10 years since the road repair maintenance plan in 2021. The following is an example of calculating the degree of saturation after the construction of road maintenance for all Technical Implementation Unit Management of Roads and Bridges Kediri area links in 2021.

B.6. TRAVEL SPEED AFTER ROAD MAINTENANCE

The main measure of road segment performance is travel speed, because it is easy to understand and measure, but it is also an important input to road user costs in economic analysis. To determine the travel speed of the vehicle, it is necessary to calculate the free flow speed of the vehicle first. Free flow speed is defined as the speed when the current level is zero or in other words the condition where the driver drives a motorized vehicle without being hindered by other motorized vehicles. For the analysis of free flow speed and travel speed after the existing road is based on the 2014 Indonesian Road Capacity Guidelines for out-of-town roads.

Table 7 Degree of saturation after road maintenance

Road Link	Total Flow (Q) (skr/hour)	Capacity (C) (skr/hor)	DS
172	3189	3244	0,983
174	3237	3244	0,998
175	3239	3137	1,033
176	3190	3137	1,017
177	2973	3137	0,948
178	3075	3137	0,980
180	2784	3244	0,858
181	3177	3244	0,979
182	2222	3244	0,685
183	1812	3244	0,559
184	1967	3137	0,627
185	2388	3137	0,761

Table 8 Recapitulation of Vehicle Free Flow Speed After Maintenance

Road Link	Free Flow Speed (km/hour)				
	LV	MHV	MC	LB	LT
172	50,71	44,47	53,83	42,91	42,13
174	50,71	44,47	53,83	42,91	42,13
175	41,81	44,47	53,83	42,91	42,13
176	41,81	44,47	53,83	42,91	42,13
177	41,81	44,47	53,83	42,91	42,13
178	41,81	44,47	53,83	42,91	42,13
180	41,81	44,47	53,83	42,91	42,13
181	50,71	44,47	53,83	42,91	42,13
182	50,71	44,47	53,83	42,91	42,13
183	50,71	44,47	53,83	42,91	42,13
184	41,81	44,47	53,83	42,91	42,13
185	41,81	44,47	53,83	42,91	42,13

C. ECONOMIC CRITERIA

C.1. VEHICLE OPERATIONAL COST

Vehicle operating costs are the total costs required to operate a vehicle under certain traffic and road conditions for a particular type of vehicle per kilometer of distance traveled. The value of the benefits (benefit) from the vehicle operating costs is obtained from calculating the value of saving vehicle operating costs by comparing the Vehicle Operating Costs value before the road widening maintenance construction with the vehicle operating costs value after the construction of road widening maintenance. The vehicle operating costs calculation is done by using the Jasa Marga method. In the Jasa Marga method, vehicle operating costs components are divided into several categories, namely: fuel consumption, lubricating oil consumption, tire consumption, maintenance costs, depreciation, insurance, and capital interest.

C.2. TIME VALUE

Time value analysis is calculated based on Jasa Marga's formula by considering studies on past time value. The time value is used to calculate the total time value per year both before and after the construction of road widening

Table 9 Recapitulation of total vehicle operating costs savings

Road Link	Total Vehicle Operating Costs Before Project	Total Vehicle Operating Costs After Project	Saving Vehicle Operating Costs
172	Rp124.520.976.436	Rp119.302.075.436	Rp5.218.901.000
174	Rp51.403.944.183	Rp49.806.522.823	Rp1.597.421.360
175	Rp53.763.802.587	Rp51.844.093.386	Rp1.919.709.201
176	Rp242.790.966.262	Rp234.128.310.094	Rp8.662.656.168
177	Rp129.031.495.291	Rp122.432.728.429	Rp6.598.766.861
178	Rp87.521.016.023	Rp84.125.570.905	Rp3.395.445.118
180	Rp39.813.737.247	Rp38.674.208.895	Rp1.139.528.352
181	Rp133.767.819.360	Rp128.018.120.839	Rp5.749.698.522
182	Rp118.548.352.484	Rp107.796.268.303	Rp10.752.084.182
183	Rp52.017.828.128	Rp46.834.087.975	Rp5.183.740.153
184	Rp129.873.641.504	Rp121.099.939.192	Rp8.773.702.311
185	Rp106.449.074.592	Rp96.511.820.493	Rp9.937.254.098

Table 10 Recapitulation of total time value savings

Road Link	Total Pre-Project Time Value	Total Post-Project Time Valume	Saving Time Value
172	Rp22.813.009.302	Rp29.679.784.940	Rp6.866.775.638
174	Rp22.484.870.480	Rp26.959.450.034	Rp4.474.579.555
175	Rp15.721.029.251	Rp20.111.460.747	Rp4.390.431.496
176	Rp15.769.317.238	Rp20.173.234.180	Rp4.403.916.943
177	Rp14.846.833.332	Rp21.400.103.617	Rp6.553.270.285
178	Rp15.443.762.745	Rp20.282.822.585	Rp4.839.059.840
180	Rp15.866.986.007	Rp29.533.242.902	Rp13.666.256.895
181	Rp29.999.467.408	Rp39.029.385.785	Rp9.029.918.378
182	Rp22.105.083.415	Rp44.363.674.354	Rp22.258.590.939
183	Rp15.842.678.294	Rp27.664.064.521	Rp11.821.386.227
184	Rp17.801.805.392	Rp28.301.168.875	Rp10.499.363.483
185	Rp15.842.845.753	Rp34.395.165.501	Rp18.552.319.747

maintenance by multiplying it with the results of the analysis of travel time and vehicle volume per year. Value of travel time before construction of road widening maintenance and after construction of road widening maintenance.

C.3. INVESTMENT COST

The investment costs in this thesis are obtained from the results of adjustments to the investment costs for road widening maintenance construction which are calculated from the construction costs for road widening maintenance in the Technical Implementation Unit Management of Roads and Bridges Kediri Region. After doing the calculations, the results of the investment costs in the construction of road widening maintenance are obtained.

Table 11 Details of development costs maintenance of road widening

Road Link	Total Cost
172	Rp 15.500.000.000,00
174	Rp 3.100.000.000,00
175	Rp 45.315.300.000,00
176	Rp 20.824.940.000,00
177	Rp 7.800.000.000,00
178	Rp 6.850.000.000,00
180	Rp 8.300.000.000,00
181	Rp 6.700.000.000,00
182	Rp 19.800.000.000,00
183	Rp 7.000.000.000,00
184	Rp 12.400.000.000,00
185	Rp 6.600.000.000,00

(Source: Technical Implementation Unit Management of Roads and Bridges Kediri Bina Marga, 2021)

C.4. BENEFIT COST RATIO

Benefit Cost Ratio analysis aims to determine the feasibility of building maintenance of road widening from an economic perspective by comparing the amount of savings that occur (benefit) with investment costs (cost). As for the data that has been known in previous analyses.

Table 11 Recapitulation of benefit cost ratio calculations from the economic aspect

Link	Benefit Cost Ratio	> 1 Worthy
172	0,74	Not Worthy
174	1,87	Worthy
175	0,13	Not Worthy
176	0,60	Not Worthy
177	1,61	Worthy
178	1,14	Worthy
180	1,70	Worthy
181	2,10	Worthy
182	1,59	Worthy
183	2,31	Worthy
184	1,48	Worthy
185	4,11	Worthy

C.5. NET PRESENT VALUE

The net present value is the difference between the Present Value Benefit minus the Present Value Cost. The Net Present Value result of a project that is said to be economically viable is one that produces a positive Net Present Value.

Net Present Value is the benefit obtained during a project period which is measured at a certain interest rate.

Table 12 Net present value calculation recapitulation from economic aspect

Road Link	Net Present Value	> 0 Worthy
172	-Rp3.991.273.970	Not Worthy
174	Rp2.682.133.436	Worthy
175	-Rp39.306.395.189	Not Worthy
176	-Rp8.382.143.904	Not Worthy
177	Rp4.724.180.217	Worthy
178	Rp991.403.042	Worthy
180	Rp5.798.981.064	Worthy
181	Rp7.374.061.951	Worthy
182	Rp11.634.799.012	Worthy
183	Rp9.193.329.218	Worthy
184	Rp5.953.000.881	Worthy
185	Rp20.529.527.782	Worthy

Table 13 Weight of each criterias determined in a pairwise comparation matrix

Criteria	**LHR**	**Road Condition**	**V/C R**	**Travel Time**	**Travel Speed**	**BOK**	**Time Value**	**BCR**	**NPV**	***Eigenvector***	**Weight**
LHR	**1**	0,33	2	4	4	5	5	7	8	**2,909**	**0,215**
Road Condition	3	**1**	4	5	5	6	6	8	9	**4,514**	**0,334**
V/C R	0,5	0,25	**1**	3	3	4	4	6	7	**2,089**	**0,154**
Travel Time	0,25	0,2	0,33	**1**	0,5	2	2	4	5	**0,956**	**0,071**
Travel Speed	0,25	0,2	0,33	2	**1**	3	3	4	5	**1,22**	**0,09**
BOK	0,2	0,17	0,25	0,5	0,33	**1**	2	3	4	**0,685**	**0,051**
Time Value	0,2	0,17	0,25	0,5	0,33	0,5	**1**	3	4	**0,587**	**0,043**
BCR	0,14	0,13	0,17	0,25	0,25	0,33	0,33	**1**	2	**0,326**	**0,024**
NPV	0,13	0,11	0,14	0,2	0,2	0,25	0,25	0,5	**1**	**0,238**	**0,018**
				Total						**13,525**	**1**

Net Present Value can also be interpreted as the present value of a cash flow obtained from an investment made.

C.6. SELECTION OF PRIORITY ROAD HANDLING PROGRAMS

Priority selection for the road handling program uses the multi-criteria analysis method to determine priority road management in the Technical Implementation Unit Management of Roads and Bridges Kediri area in the maintenance development plan. The analysis is carried out by using a simple matrix with predetermined criteria with a certain scoring system that will produce a value or weight which is then used as the basis for selecting priority for handling road maintenance. In the multi-criteria analysis, the weight of each assessment criteria is determined in a pairwise comparison matrix. The value of each comparation based on a survey of 28 respondents among the Department of Bina Marga, East Java Province.

In the pairwise comparison matrix, it is known that the criteria with the highest weight is the road condition, which means the road condition is the most influential factor to determine road handling priority.

To determine the selection of priorities for road handling maintenance in the Technical Implementation Unit Management of Roads and Bridges Kediri area, there are several considerations that must be considered. These considerations are then used as criteria and sub-criteria in the assessment of each road link so that the selected handling priority will be obtained in the development plan for maintaining road.

Table 14 Recapitulation of multi criteria analysis (MCA) results for each alternative

Alternative	Road Link	Value	Ranking
1	172	250,57	2
2	174	188,86	6
3	175	176,80	7
4	176	253,69	1
5	177	211,10	4
6	178	207,28	5
7	180	215,68	3
8	181	147,38	11
9	182	174,92	9
10	183	127,91	12
11	184	164,40	10
12	185	175,57	8

CONCLUSIONS

The priority level for road handling on the road sections proposed for the road handling package program in the Technical Implementation Unit Management of Roads and Bridges Kediri area which is proposed for the 2021 road handling activity program package is a priority order of rank 1 for road widening maintenance development is alternative 4 Link 176 (Bts. Kota Kediri - Bts. Blitar Regency) with a score of 253.69; for rank 2 is alternative 1 Link 172 (Bts. Kab. Bojonegoro (Pajeng) - Nganjuk (Guyangan)) with a score of 250.57; for rank 3 is alternative 7 Link 180 (Kandangan - Bts. Kota Pare) with a score of 215.68; for rank 4 is alternative 5 Link 177 (Bts.

Jombang Regency - Bts. Kota Pare) with a score of 211.10; for rank 5 is alternative 6 Link 178 (Bts. Jombang City – Kandangan) with a score of 207.28; for rank 6 is alternative 2 Link 174 (Bts. Nganjuk City (Simpang Empat Temple) - Bts. Kab. Kediri) with a score of 188.86; for rank 7 is alternative 3 Link 175 (Bts. Kab. Nganjuk - Bts. Kota Kediri) with a score of 176.80; for rank 8 is alternative 12 Link 185 (Srengat - Bts. Kota Blitar) with a score of 175.57; for rank 9 is alternative 9 Link 182 (Ngantru - Bts. Kab Blitar) with a score of 174.92; for rank 10 is alternative 11 Link 184 (Bts. Tulungagung Regency – Srengat) with a score of 164.40; for rank 11 is alternative 8 Link 181 (Bts. Kota Pare - Bts. Kota Kediri) with a score of 147.38; and for the last rank / rank 12 is alternative 10 Link 182 (Ngantru - Bts. Kab Blitar) with a score of 127.91.

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