Alternative Road Economic Feasibility Study Medan-Berastagi Via Tuntungan Intersection-Sibolangit

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Abstract.
As a sustainable from the research in 2019 regarding the Planning of the Medan-Berastagi Alternative Route that the Researchers have carried out, this year it is planned to conduct research related to the cost of construction and the feasibility of constructing the alternative route as a whole economy. It is important that a study be carried out immediately because of the importance of this alternative route considering the frequent occurrence of severe traffic jams due to accidents or natural disasters along this route in recent times. Knowing the development costs as well as the economic feasibility of this new route will help interested stakeholders in making decisions regarding this new route. The total construction cost which includes construction costs, design and supervision costs and land acquisition costs is IDR 1,171,518,647,736 while the annual routine maintenance costs are IDR 3,114,325,566 and periodic maintenance costs per five years are IDR 87,808,542,710. Calculation of Vehicle Operating Costs (VOC) is carried out by referring to Pacific Consultant International (PCI) standards while the Time Value calculation is adopted from the 2001 Bina Marga "Heavy Loaded Road Improvement Project – Master Plan Review" study (for Buses and Passenger Cars) and "Sumatera Region Road Project" PU (2000) for trucks. The existence of the Medan-Berastagi alternative road will save VOC of IDR 22,120,269,410 and Time Value savings of IDR 57,337,666,839 in 2023. The economic feasibility analysis results can be seen that the value of the Economic Internal Rate of Return is 12,06% greater than the current lending rates are in the range of 8-9%. At the prevailing interest rate of 10%, the Benefit Cost Ratio is 1.16 and the Net Present Values are IDR 204,496,000,000. These results indicate that the construction of the Medan-Berastagi Alternative Road is economically feasible.

Keywords: *Alternative, route, construction, costs, and feasibility*

I. INTRODUCTION

Based on the results of research conducted in 2019 Jalan Medan-Berastagi has a very high traffic flow that exceeds its capacity of 3,580 pcu/hour. With a road capacity of 2,610 pcu/hour and actual travel speed of only 14,625 km/hour, the saturation level or VCR of the road reaches a value [1]. This level of saturation is the most recent level of saturation according to the Regulation of the Minister of Transportation of the Republic of Indonesia No. 96 of 2015 namely the saturation level of the letter F, a condition where the flow is restrained and there are long queues of vehicles with speeds of less than 30 km/hour, very high traffic density and low volume and congestion for quite a long duration and in a state of queue, speed or volume dropped to 0 (zero)[2].As a follow-up to the research results mentioned above, this year it is planned to carry out research related to the amount of development costs and the economic feasibility of developing the alternative route. It is important that a study be carried out immediately because of the importance of this alternative route considering the frequent occurrence of severe traffic jams due to accidents or natural disasters along this route in recent times.

II. RESEARCH OBJECTIVES

a. Calculating the cost of road construction/construction includes planning costs, monitoring costs, development costs and environtmental impact analysis costs as well as land acquisition costs and road maintenance costs including annual routine maintenance costs and periodic maintenance costs every five years.

b. Calculating road benefits/savings includes saving on vehicle operations (VOC) and saving on the difference in travel time in conditions without alternative road construction (without project) and conditions with alternative road construction (with project).
c. Calculating the economic feasibility of roads based on the criteria of Net Present Value, Internal Rate of Return and Benefit Cost Ratio.

III. PROBLEM LIMITATION

Limitations of the problems of this study include:

a. The Pancur Batu-Bandar Baru alternative route for Deli Serdang Regency includes The Tuntungan Intersection - Tuntungan Village - Kutalimbaru-Pasar X Village-Tanduk Benua - Das Lau Belawan - Sibolangit Campground - Sibolangit District National Road Junction;
b. The research only discusses the economic feasibility of the path that has been chosen.

IV. THEORETICAL BASIS

Determining the feasibility of a development or investment plan to be implemented, in terms of the financial aspect, can be measured by several criteria. Each assessment deserves to be given a standard value for similar businesses by comparing it with industry averages or predetermined targets [3]. The criteria generally used in assessing the feasibility of a development or investment plan are as follows:The Net Present Value (NPV) method, which calculates the difference between the present value of the investment and the present value of net cash receipts (operational and cash flow terminals) in the future. To calculate the present value, it is necessary to first determine the interest rate that is considered relevant [4]. There are several concepts for calculating interest rates that are considered relevant. Basically, the interest rate is the interest rate when we consider that investment decisions are still separate from spending decisions or when we start associating investment decisions with spending decisions [5]. Notice here that this linkage only affects interest rates, not cash flows.

If the present value of income or net cash receipts in the future is greater than the present value of the invested capital, then the investment is said to be profitable (feasible) whereas if it is the other way around, the investment is rejected (not feasible) or feasible if NPV > 0 and Break Even (breakeven).) if NPV = 0 [6].Internal Rate of Return (IRR) method or Discounted Rate of Return, or Discount Rate, or Discounting Factor, which calculates the interest rate that equates the present value of the investment with the present value of net cash receipts in the future. If the IRR is greater than the relevant interest rate (required profit rate), then the investment is said to be profitable (feasible), otherwise the investment is said to be rejected (I is not feasible) or feasible if IRR > Standard Interest Rate (WACC) [7].The Profitability Index (PI) or Benefit Cost Ratio method, which calculates the comparison between the present value of net cash receipts in the future and the present value of the investment. If the Profitability Index is greater than 1, then the investment is said to be profitable (feasible), on the contrary, the investment is said to be rejected (not feasible). The application of this method needs to determine in advance the interest rate that will be used or is appropriate if PI > 1.

Concept Analysis Approach

a. Economic feasibility is defined as feasibility for all parties who take advantage, either directly or indirectly, of a road construction or improvement (Irisberita.com, 2021). In relation to economic analysis, a condition is called feasible if the benefits obtained are greater than the costs incurred. Therefore the calculation of road benefits is a vital factor in deciding whether a road development or improvement is feasible. The calculation of road benefits is also considered to be more sensitive than the calculation of costs which is a civil aspect.
b. In economic studies, the government tends to assess an investment in an economic framework where the main objective of investment policy is used as a tool to provide services to the community. In this case the cost components are examined in terms of the amount of resources that must be spent by the government including construction costs, use of government-owned land, and other cost conveniences.

Meanwhile, the cost recovery component uses a benefit approach, in particular reducing transportation system costs (reducing vehicle operating costs and travel time) and other benefits for the community.

c. The biggest savings as a result of the construction of new roads in general are savings in the value of time on the part of the road users (consumers), where these benefits will make the biggest contribution in assessing feasibility in this study.
d. Economic feasibility is defined as feasibility for all parties who take advantage, either directly or indirectly, of a road network management. In relation to economic analysis, the benefits obtained are greater than the costs incurred. The results of this feasibility analysis will be very decisive in making a decision whether this road segment plan will be implemented or not.
e. In general, the calculation of road benefits is done by calculating directly from road users, namely the reduction of Vehicle Operating Costs (VOC), the time and accident values calculated from the difference with the project and without the project, based on the existing traffic volume. However, this method is only suitable for situations where the normal traffic volume is sufficient and the profit due to reduced VOC is a reliable and reliable measure.
f. In order to evaluate the feasibility of building roads outside the city (rural road) it is necessary to take into account the increase in the economy of the area concerned, because the two are closely related. Areas that were previously isolated will continue to develop their economy since the construction of roads to these areas.

Feasibility Analysis Process

a. Comparison of costs (cost) and benefits/returns (benefit/revenue) is the basis for determining the economic and financial feasibility of the construction and operation of transportation facilities. Comparison of costs and benefits/returns is carried out between the two conditions, namely for scenarios without treatment (base case or without project) and with treatment (with project).
b. The feasibility analysis process is carried out in 3 stages, namely (1) the process of estimating handling costs (land acquisition costs, construction costs, and maintenance costs) (in this case, for the assumption of a without project condition, there are no costs incurred related to the construction of alternative routes). Meanwhile, process (2) is to estimate the benefits resulting from the road network simulation process with and without handling in the review years, in this case it is reviewed in 2022-2043. After these two processes have been carried out, then in process (3) a feasibility analysis is carried out to issue a number of feasibility indicators such as EIRR/IRR, NPV, and BCR.

Savings In Vehicle Operating Costs And Time Value Costs

The benefits of a road network development can be grouped into direct benefits and indirect benefits (direct and indirect benefits). The direct benefit components include savings in vehicle operating costs (VOC) and savings in travel time converted to a time value.

The VOC calculation is carried out by referring to the Pacific Consultant International (PCI) standard [8] where the VOC component consists of:

- Fuel consumption (liters/1000 km)
- Engine oil consumption (liters/1000 km)
- Vehicle tires (tyres/1000 km)
- Depreciation (shrinkage/1000 km)
- Mechanic/mechanic (work hours/1000 km)
- Traveling time (work hours/1000 km)

Time value, or time-saving value, is defined as the amount of money a person is willing to spend to save one unit of travel time [9]. The time saved/lost is assumed to have an opportunity cost for production activities, so that the value of time for a person can be approximated from the level of income concerned. Time value savings (Rp/year) are calculated by the following equation:

Time value saving = Time value (Rp/veh-hour) x Difference Travel Time (hours) x LHRT (vehicle/day) x 365 days

In this study, Time Value was adopted from the 2001 Bina Marga "Heavy Loaded Road Improvement Project – Master Plan Review" study (for Buses and Passenger Cars) and the "Sumatera Region Road Project" PU (2000) for Truck vehicles[10]. The time value is adjusted to the current condition based on the average inflation rate in 2021 and 2022 in North Sumatra Province of 5.0%/year. The following presents the Time Value for 2022:

- Group I (passenger cars) : Rp. 43,006.90/hour
- Class IIA (large buses and medium trucks) : Rp. 200,879.05 / hour
- Group IIB (large trucks) : Rp. 40,156.86/hour

Equation of Vehicle Operating Costs

a. Fuel Consumption Equation
   Arterial Road :
   1) Class I vehicles: Y = 0.05693 V2 – 6.42593 V + 269.18567
   2) Class II A vehicles: Y = 0.21692 V2 – 24.15490 V + 954.78624
   3) Group II B vehicles: Y = 0.21557 V2 – 24.17699 V + 947.80862

   Y = Fuel consumption (Lt/1000 km)
   V = Travel speed (kph)

b. Engine Oil Consumption Equation
   Arterial Road :
   1) Class I vehicles: Y = 0.00037 V2 – 0.04070 V + 2.20403
   2) Class II A vehicles: Y = 0.00209 V2 – 0.24413 V + 13.29445
   3) Group II B vehicles: Y = 0.00186 V2 – 0.22035 V + 12.06486

   Y = Fuel Consumption (Lt/1000 km)
   V = Travel speed (kph)

c. Tire Usage
   1) Class I vehicles: Y = 0.0008848 V + 0.0045333
   2) Class II A vehicles: Y = 0.0012356 V + 0.0065667
   3) Group II B vehicles: Y = 0.0015553 V + 0.0059333

   Y = Use of one tire per 1000 km

d. Equation of Maintenance Costs (Spare Parts)
   1) Class I vehicles: Y = 0.0000064 V + 0.0005567
   2) Class II A vehicles: Y = 0.0000332 V + 0.0020891
   3) Group II B vehicles: Y = 0.0000191 V + 0.0015400

   Y = The cost of maintaining spare parts, multiplied by the value of the vehicle depreciated, per 1000 km.

e. Vehicle crew cost equation
   1) Group I vehicles: Y = 0.00362 V + 0.36267
   2) Vehicles Group II A : Y = 0.02311 V + 1.97733
   3) Group II B vehicles: Y = 0.01511 V + 1.21200

   Y = Vehicle crew cost per 1000 km.

f. Depreciation Equation
   1) Class I vehicles: Y = 1/(2.5 V + 125)
   2) Group II A vehicles: Y = 1/(9.0 V + 450)
   3) Group II B vehicles: Y = 1/(6.0 V + 300)

   Y = Depreciation per 1000 km, multiplied by ½ of the vehicle's depreciated value

g. The Equation for Travel Expenses
   1) Vehicles Group I : Y = -
   2) Class II A vehicles: Y = 1000/ V
   3) Vehicles Group II B : Y = 1000/ V

   Y = Travel Cost per 1000 km, multiplied by Wages

V. METHODS

a. Preparation phase

This stage is related to research administration and preparing the survey design to be conducted, the literature to be used, and the initial study of the study area.

Some of the activities carried out at this stage are described as follows:

- Strengthening of methodology
  Strengthening the research methodology related to the basic matters of implementing this study. This is done related to the effectiveness and efficiency of research.
- Design of Data Collection
  This stage is the stage of designing data collection methods through primary and secondary surveys and making questionnaires.

b. Data Collection Stage

At this stage, primary data and secondary data will be obtained through survey activities, both site surveys, primary data surveys and agency surveys.

c. Analysis and Planning

Analysis and Planning is intended to analyze the existing conditions and also plan ahead for both the existing and planned lines.

1) Data Analysis
   Data analysis will include:
   a) Preliminary Analysis
      Preliminary analysis was carried out to get the interpretation of the data obtained from the primary survey. Initial analysis includes:
      (1) Verification and validation of the quality and type of data obtained;
      (2) Identification of a number of problems and needs that exist in the current Medan-Berastagi transportation system.
      (3) Creating an operative database to be used in planning and analysis processes.
   b) Demand Analysis
      Demand analysis includes analysis of origin and destination data and traffic surveys at several points on the track under review.
   c) Feasibility Analysis
      The feasibility analysis process is carried out in 3 stages, namely:
      (1) the process of estimating handling costs (land acquisition costs, construction costs, which include planning costs, monitoring costs, development costs and EIA analysis costs, and routine and periodic maintenance costs) (in this case, for the assumption of a without project condition, no costs are incurred associated with the construction of alternative routes).
      (2) While the second process is to estimate the benefits resulting from the road network simulation process with and without handling in the review years, in this case it is reviewed in 2022-2042.
      (3) After these two processes have been carried out, then in the third process a feasibility analysis is carried out to issue a number of feasibility indicators such as EIRR/IRR, NPV, and BCR.

VI. ANALYSIS AND DISCUSSION

Traffic Survey Results

The results of the traffic survey at the two survey posts on Jalan Jamin Ginting, namely the Sibolangit Post and the Pancur Batu Post as well as the Golf Course-Medan Tuntungan Road, can be seen in Table 1 below.

Table 1. Traffic Survey Results on Jalan Jamin Ginting and Jalan Lapangan Golf

No	Location	Date	Day	Time	Traffic Flow Type	Pavement Width (m)	Shoulder Width (m)	ADT (pcu/hr)	Cap (pcu/hr)	VCR	Spot speed (kph)
1	Jl. Jamin Ginting Pos Pancur Batu	17/08/2019	Saturday	11.00-12.00	2 arah	7	2	3580	2755	1,30	14,63
2	Jl. Jamin Ginting Pos Pancur Batu	07/08/2022	Sunday	17.00-18.00	2 arah	7	2	3439	2755	1,25	
3	Jl. Jamin Ginting Pos Pancur Batu	14/08/2022	Sunday	16.00-17.00	2 arah	7	2	4200	2755	1,52	13,00
4	Jl. Jamin Ginting Pos Sibolangit	05/08/2022	Friday	09.00-10.00	2 arah	7	2	1139	2755	0,41	
5	Jl. Jamin Ginting Pos Sibolangit	06/08/2022	Saturday	15.00-16.00	2 arah	7	2	1514	2755	0,55	
6	Jl. Jamin Ginting Pos Sibolangit	07/08/2022	Sunday	16.00-17.00	2 arah	7	2	1437	2755	0,52	
7	Jl. Jamin Ginting Pos Sibolangit	14/08/2022	Sunday	17.00-18.00	2 arah	7	2	1702	2755	0,62	42,06
8	Jl. Lap Golf - Medan Tuntungan	06/08/2022	Saturday	17.00-18.00	2 arah	7	2	1335	2680	0,50	31,94
9	Jl. Lap Golf - Medan Tuntungan	07/08/2022	Sunday	08.00-09.00	2 arah	4-6	1-2	760	2680	0,28	
10	Jl. Lap Golf - Medan Tuntungan	08/08/2022	Monday	17.00-18.00	2 arah	4-6	1-2	2209	2680	0,82	

From the results of the traffic survey above, it can be seen the characteristics of Jalan Jamin Ginting on weekends at two different points. These results show that the character of the traffic on Jalan Jamin Ginting Pos, Sibolangit tends to be able to flow traffic well compared to the character of the traffic on Jalan Jamin Ginting Pos, Pancur Batu at the same time (Sunday, 07 and 14 August 2022). This is due, among other things:

a. The traffic flow monitored at Jamin Ginting Pos Sibolangit on Sunday was dominated by tourist vehicles visiting the cities of Berastagi, Sibolangit, Sidebuk-debuk and its surroundings.
b. The traffic flow monitored at Jamin Ginting Pos Pancur Batu on Sunday was dominated by a combination of tourist vehicles visiting Berastagi City and its surroundings plus tourist vehicles visiting tourist areas before Sibolangit which were quite numerous such as the Park Zoo tourist area, Sembahe Beach, Peken Tebu Beach, Sayum Saba Beach and others.

Jalan Jamin Ginting is the only connecting road that is feasible to pass on the current Medan-Berastagi route. The alternative route through Durian Jangak Village, Pancur Batu District, which is currently often used for traffic jams on Jalan Jamin Ginting, actually also cannot solve the problem because it is a detour and exits before the Sibolangit point, so drivers often don't use it.The calculation of traffic flow to see the economic feasibility of the Medan-Berastagi alternative road is based on the traffic flow that occurs at the Sibolangit Survey Post as the starting point for the alternative route plan for Berastagi. This traffic flow occurred on Sunday, August 14 2022 which is then estimated for each review year as can be seen in Table 2 below.

However, it is also necessary to look at the flow of traffic via the Tuntungan alternative route (Simpang Tuntungan-Desa Suka Makmur Sibolangit) and the current is quite high, so it is necessary to plan for adequate road width so that it can accommodate the maximum traffic flow.

Table 2. Traffic Flow in the direction of Berastagi-Medan on August 14 2022 at the Sibolangit Survey Post

Year	Light Vehicle	Medium heavy vehicle	Large Bus	Large Truck	Motor Cycle	Rickshaw Motor	Total (pcu/day)
2022	750	70	65	90	325	2	1301
2023	788	73	68	94	341	2	1366
2027	957	89	82	114	415	3	1660
2032	1222	113	105	146	529	3	2119
2037	1559	145	134	186	675	4	2704
2042	1990	185	171	238	862	5	3451

Cost Component Estimation

The unit price of work used in calculating the cost components for the construction of the Medan-Berastagi alternative road is based on the calculation of the standard costs for the special flexible pavement road implementation of the Province of North Sumatra carried out by the Ministry of Public Works in 2011[11], the costs considered in the feasibility analysis are as follows :

a. Road construction costs (construction cost) IDR 22,547,799,000 per km (Public Works, 2011a), bridge construction costs are assumed to be IDR 309,990,885/m (Public Works, 2011b), the total cost of road and bridge construction is estimated to be IDR 932,206,241,528 ,
b. Engineering and supervision costs (design and supervision), it is estimated that the amount of engineering and supervision costs is around 0.5% - 1% of construction costs, design and supervision costs are IDR 4,661,031,208,
c. Maintenance costs, the unit cost of routine maintenance per year for roads is estimated at IDR 3,014,127,910 per m and the unit cost for routine maintenance of bridges is IDR 100,197,656 per m, periodic road maintenance costs per 5 years are estimated at IDR 86,243,913,521 per m and periodic bridge maintenance costs IDR 1,564,629,189 per m3,
d. Cost of land acquisition (land acquisition), The cost of land acquisition for the construction of the Medan-Berastagi alternative road is assumed to be IDR 1,000,000,-/m2. The total cost of land acquisition is IDR 234,651,375,000.

Benefit Component Estimation

The estimated benefit component consists of savings in Vehicle Operating Costs (VOC) and time value savings, namely:

a. The amount of VOC without the construction of alternative roads in 2023 is estimated to be IDR 75,690,177,199. If an alternative road is built, then the VOC in 2023 is estimated at IDR 53,569,907,789. So that the Medan-Berastagi alternative road will save Rp. 22,120,269,410 in VOC in 2023. For the following years, up to 20 years to come, can be seen in Table 3 below.

Table 3. Vehicle Operating Cost

Year	Without Project VOC (IDR/Year)	With Project VOC (IDR/Year)	VOC Savings (IDR/Year)
2023	75,690,177,199	53,569,907,789	22,120,269,410
2027	92,001,883,449	65,114,557,729	26,887,325,720
2032	117,420,307,562	83,104,509,480	34,315,798,081
2037	149,861,373,604	106,064,753,210	43,796,620,394
2042	191,265,308,062	135,368,488,953	55,896,819,108

b. The cost of the time value without the construction of alternative roads in 2023 is estimated at IDR 65,499,154,934 while the time value with the construction of alternative roads in 2023 is estimated at IDR 8,161,488,096. So that the time value savings amounted to IDR 57,337,666,839. For subsequent years up to 2042 can be seen in Table 4 below.

Table 4. Time Value Saving

Year	Wtihout Project	With Project	Total Time value savings (IDR/Year)
	Time value savings (IDR/Year)	Time value savings (IDR/Year)	
2023	65,499,154,934	8,161,488,096	57,337,666,839
2027	102,421,545,333	12,762,183,326	89,659,362,007
2032	179,095,988,510	22,316,162,394	156,779,826,115
2037	313,170,173,287	39,022,406,377	274,147,766,910
2042	547,614,484,574	68,235,217,711	479,379,266,862

Economic Feasibility Resume

In Table 5 and Table 6 an analysis of the economic feasibility of the construction of the Medan-Berastagi alternative road is presented. From the results of the economic feasibility analysis above, it can be seen that the value of the Economic Internal Rate of Return, which is 12.06%, is greater than the current loan rate, which is in the range of 8-9%[12]. At the prevailing interest rate of 10%, the Benefit Cost Ratio is 1.17 and the Net Present Values are IDR 204,496,000,000, - or IDR 204.496 billion. These results indicate that the construction of the Medan-Berastagi Alternative Road is economically feasible.

Table 5. Calculation of the Present Value of the Medan-Berastagi Alternative Road

No.	Year	Differences		Present Value dengan Discount Rate					
				5.0%		10.0%		15.0%	
		Project Cost (Million IDR)	VOC & Time Value Savings (Million IDR)	Cost (Million IDR)	Benefit (Million IDR)	Cost (Million IDR)	Benefit (Million IDR)	Cost (Million IDR)	Benefit (Million IDR)
FS	**2020**								
DED	**2021**	**DED**							
Const.	**2022**	1,171,519		1,171,519		1,171,519		1,171,519	
1	2023	3,114	79,458	2,966	75,674	2,831	72,234	2,708	69,094
2	2024	3,114	88,730	2,825	80,481	2,574	73,331	2,355	67,093
3	2025	3,114	98,002	2,690	84,658	2,340	73,631	2,048	64,438
4	2026	3,114	107,274	2,562	88,255	2,127	73,270	1,781	61,335
5	2027	87,809	116,547	68,800	91,317	54,522	72,366	43,656	57,944
6	2028	3,114	131,456	2,324	98,095	1,758	74,204	1,346	56,832
7	2029	3,114	146,366	2,213	104,020	1,598	75,109	1,171	55,024
8	2030	3,114	161,276	2,108	109,158	1,453	75,236	1,018	52,721
9	2031	3,114	176,186	2,008	113,571	1,321	74,720	885	50,083
10	2032	87,809	191,096	53,907	117,316	33,854	73,676	21,705	47,236
11	2033	3,114	216,465	1,821	126,563	1,092	75,870	669	46,528
12	2034	3,114	241,835	1,734	134,663	992	77,056	582	45,201
13	2035	3,114	267,205	1,652	141,704	902	77,400	506	43,428
14	2036	3,114	292,575	1,573	147,770	820	77,044	440	41,349
15	2037	87,809	317,944	42,237	152,937	21,021	76,113	10,791	39,074
16	2038	3,114	361,411	1,427	165,566	678	78,654	333	38,622
17	2039	3,114	404,877	1,359	176,647	616	80,103	289	37,624
18	2040	3,114	448,343	1,294	186,296	560	80,639	252	36,228
19	2041	3,114	491,810	1,232	194,626	509	80,415	219	34,557
20	2042	87,809	535,276	33,094	201,740	13,052	79,565	5,365	32,706
Total		1,572,582	4,874,133	**1,401,345**	**2,591,057**	**1,316,139**	**1,520,635**	**1,269,639**	**977,117**

Table 6. Results of the Economic Feasibility Analysis for the Construction of the Medan-Berastagi Alternative Road

Medan Berastagi Alternative Road Economic Feasibility Items	Discount Rate		
	5.0%	10.0%	15.0%
Net Present Value - NPV (Million IDR)	1,189,712	204,496	-292,522
Benefit Cost Ratio - BCR	1.85	1.16	0.77
Economic Internal Rate of Return - EIRR (%)		12.06%	

VII. CONCLUSION

There are several conclusions from the calculations that have been carried out in the previous chapter, namely:

1. The total construction cost which includes development costs, design and supervision costs and land acquisition costs is IDR 1,171,518,647,736.
2. The amount of VOC without the construction of alternative roads in 2023 is estimated to be IDR 75,690,177,199. If an alternative road is built, then the VOC in 2023 is estimated at IDR 53,569,907,789. So that the Medan-Berastagi alternative road will save Rp. 22,120,269,410 in VOC in 2023.
3. The cost of the time value without the construction of alternative roads in 2023 is estimated at IDR 65,499,154,934 while the time value with the construction of alternative roads in 2023 is estimated at IDR 8,161,488,096. So that the time value savings amounted to IDR 57,337,666,839.
4. From the results of the economic feasibility analysis, the value of the Economic Internal Rate of Return, which is 12.06%, is greater than the current loan rate, which is in the range of 8-9%. At the prevailing interest rate of 10%, the Benefit Cost Ratio is 1.17 and the Net Present Values are IDR204,496,000,000, - or IDR 204.496 billion. These results indicate that the construction of the Medan-Berastagi Alternative Road is economically feasible.

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