Feasibility Evaluation of Probolinggo – Banyuwangi Toll Road from Economic and Financial Perspective Using Viability Gap Funding (VGF) Analysis

Adhitya Wijdan Fajramadhani, and Anak Agung Gde Kartika

Department of Civil Engineering, Institut Teknologi Sepuluh Nopember (ITS)
Corresponding Author: kartika@ce.its.ac.id

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ABSTRACT

Roads function as connectivity between regions. Probolinggo and Banyuwangi are areas in East Java province connected by the North Coast route. Toll roads aim to expedite traffic. The construction of the Probolinggo-Banyuwangi Toll Road is planned to connect Probolinggo and Banyuwangi regency. For the planning of the Probolinggo –Banyuwangi Toll Road to be efficient and worthy of investment, it is necessary to evaluate the feasibility of the Probolinggo – Banyuwang Toll Road from economic and financial perspectives. Feasibility evaluation of the Probolinggo – Banyuwangi Toll Road used the Jasa Marga method. Furthermore, this study analyzed Vehicle Operating Costs and time value, and trip assignments were calculated to determine the number of vehicles moving from the Probolinggo – Banyuwangi national road to the planned toll road. Benefit Cost Ratio (BCR), Net Present Value, and Internal Rate of Return parameters were used to analyze the feasibility from the economic aspect so that the savings obtained by road users could be known when passing through the Probolinggo – Banyuwangi Toll Road. Meanwhile, Benefit Cost Ratio, Net Present Value, Internal Rate of Return, and Payback Period parameters were used to analyze the feasibility from the financial aspect. After analysis, it was stated that the Probolinggo – Banyuwangi Toll Road project had a degree of saturation value on the national road *with project* was 0.55 in 2024, while for the national road *without project* was 0.67. The economic feasibility analysis complied with the guidelines reviewed and stated that the project was feasible with an NPVe value of IDR Rp54.972.572.042.962, a BCRe value of 3.189, and EIRR of 6.7%. However, for the financial feasibility analysis was stated that the project was not feasible to carry out, either using interest rates as a reference or the company's MARR as a reference. For interest rates as a reference, it was obtained NPVf of -IDR 10.074.299.894.469, BCRf of 0.599, FIRR of 3.28%, and PP exceeds the concession period of 35 years. For the company's MARR as a reference, it was obtained NPVf of -IDR 17.233.979.248.285, BCRf of 0.31, FIRR 2.23%, and PP exceeds the concession period of 35 years. Then, the Viability Gap Funding was obtained IDR 10.074.299.894, which was allocated for land acquisition costs.

INTRODUCTION

Indonesia is trying to accelerate many infrastructure developments. Infrastructure development in Indonesia must be directed so that connectivity between regions, both physically and virtually, will run well in the future [1]. In addition, infrastructure development is expected to provide services to the community, create equitable development, and make an effort to anticipate disasters or climate change.

Roads are one of the physical connectivity between regions that play an important role in people's lives, both in the economic, social, cultural, environmental, defense, security, and people prosperity [2]. The road's main function is as a traffic or transportation infrastructure to support the smooth flow of goods, services, and community activities. The availability of adequate road network infrastructure will facilitate public access. Thus, it can encourage the smooth running of businesses and increase labor productivity levels which ultimately improves the community's economy. However, traffic jams often occur in urban areas, especially in developing

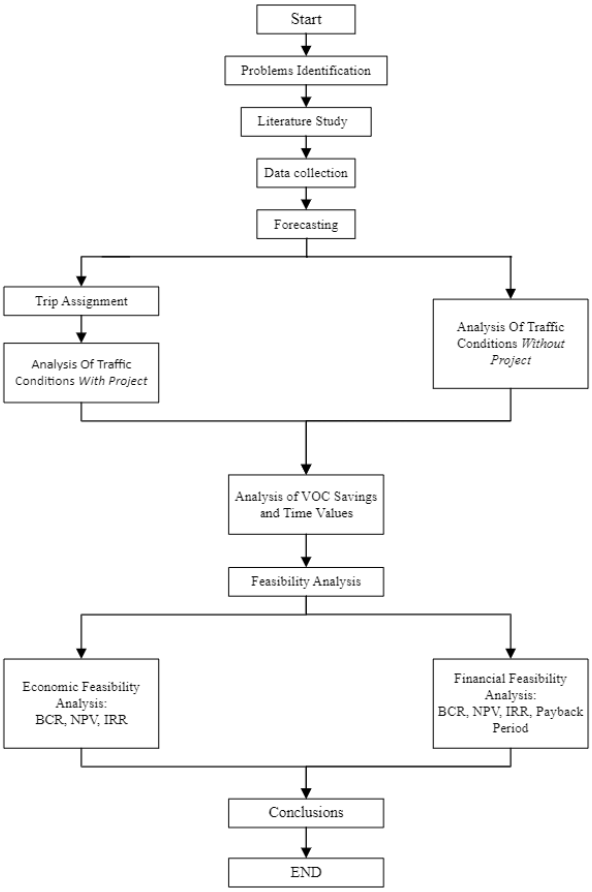

Figure 1. Flowchart

countries like Indonesia.

Banyuwangi Regency is a city located at the easternmost tip of Java island and acts as a traffic center for economic activities, such as trade, services, and industry. Meanwhile, Probolinggo Regency is one of the areas in East Java, about 195 km west of Banyuwangi City. Currently, traffic from Probolinggo City to Banyuwangi City is connected by a national main road classified as the north coast route. This north coast route is a primary arterial road. This route is also often congested because the flow of vehicles exceeds the road capacity, and the road conditions are damaged and have potholes.

Toll roads aim to facilitate traffic connecting between developing regions to reduce congestion and increase economic growth by providing improved services in the distribution of goods and services. For the government, toll roads help ease the burden on government funds through the participation of toll road users themselves. On the other hand, toll roads also benefit road users by providing savings in Vehicle Operating Costs (VOC) and time because toll roads shorten distances and time.

The Probolinggo - Banyuwangi toll road is planned to be built along 171.516 km, divided into three sections. The three sections are Section 1 Probolinggo-Besuki (29.6 km), Section 2 Besuki-Bajulmati (110.875 km), and Section 3 Bajulmati-Ketapang (31.041 km). The Probolinggo-Banyuwangi Toll Road will be the end point of the Trans Java Toll Road network, with a total investment of approximately IDR 23 Trillion [5]. This toll road project construction is expected not to experience losses. Therefore, it is necessary to evaluate the project's feasibility. Project feasibility evaluation is very important for the government, investors, and road users because this feasibility evaluation will be reviewed traffic conditions on the existing crossroads, estimate the number of transitions for moving vehicles from the existing lane to the toll road, and will be obtained large savings in Vehicle Operational Costs (VOC) and the time value. Thus, in the end, it will be known the feasibility of the Probolinggo – Banyuwangi Toll Road from economic and financial perspectives.

A. Main Problem

How is the feasibility of the Probolinggo – Banyuwangi Toll Road viewed from economic and financial perspectives?

B. Problem Details

1. How does the National Roads and Planned Toll Roads Performing?
2. How much is the total savings from Vehicle Operating Costs and Time Value?
3. How does the feasibility of the Probolinggo-Banyuwangi Toll Road from Economic and Financial Perspectives?
4. What is the required Viability Gap Funding (VGF) analysis?

METHODOLOGY

For data collection, the data used in carrying out this

Table 1. QSKR Calculation on the Probolinggo – Banyuwangi National Road Section (Banyuwangi Direction)

Vehicle Types		Average Daily Traffic (ADT)
Motorcycle	SM	21.726
Car	KR	3.594
Opelet	KR	594
Pick up	KR	761
Mini Bus	KR	4
Big Bus	BB	110
2-Axle Truck	KBM	2.138
3-Axle Truck	TB	721
Trailer truck	TB	68
Semi-trailer Truck	TB	60
Total		29.776

feasibility evaluation included as follows:

1. GRDP Probolinggo Regency.
2. GRDP Banyuwangi Regency.
3. Price data of the Vehicle Operating Cost component.
4. Interest rates.
5. Inflation rates.

ANALYSIS AND DISCUSSIONS

A. *Traffic Data Analysis*

1. Determine the vehicles volume at peak hours (peak hour volume)

Determining the highest vehicle flow was done by accumulating the total vehicle volume every one hour and above. Then, it chose the data with the largest volume of vehicles and obtained the highest number of vehicles every 60 minutes, which occurred at 07.00-08.00 with a total of 2225 vehicles.

2. Changing vehicle units into light vehicle units per hour (lvu/hour)

The EKR value for each class of vehicles on the road with the vehicle volume at peak hours (Qph) was 2225 vehicles/hour.

3. Road Performance Analysis
   a. Road Capacity (C)
   a) Probolinggo – Banyuwangi National Road Capacity

After calculating the Probolinggo-Banyuwangi national road capacity (Banyuwangi direction) with the following parameters:

Co = 1900 lvu/hour
FCLJ = 1.00
FCPA = 1.00
FCHS = 0.99
Capacity (C) = 3762 lvu/hour

b) Probolinggo – Banyuwangi Toll Road Capacity

After calculating the Probolinggo-Banyuwangi Toll Roads (Banyuwangi direction) with the following parameters:

Co = 1.900 lvu/hour/lane
FCL = 1
Capacity (C) = 1.881 lvu/hour

B. *Analysis of Traffic Conditions with Project*

1. Degree of Saturation

To calculate the degree of saturation, the formula used are as follows:

Table 2. Degree of Saturation of Probolinggo – Banyuwangi National Road (Banyuwangi Direction) *Without Project*

Flow (Q)	**Capacity (C)**	**Ds**
2.554	3.762	0,6789
2.715	3.762	0,7217
2.886	3.762	0,7671
3.067	3.762	0,8153
3.261	3.762	0,8668
3.465	3.762	0,9211
3.683	3.762	0,9790
3.915	3.762	1,0407
4.161	3.762	1,1061
4.424	3.762	1,1760
4.702	3.762	1,2499
4.998	3.762	1,3285
5.313	3.762	1,4123
5.647	3.762	1,5011
6.004	3.762	1,5960
6.383	3.762	1,6967
6.786	3.762	1,8038
7.215	3.762	1,9179
7.670	3.762	2,0388
8.154	3.762	2,1675
8.669	3.762	2,3044
9.216	3.762	2,4498
9.800	3.762	2,6050
10.419	3.762	2,7695
11.078	3.762	2,9447
11.779	3.762	3,1310
12.524	3.762	3,3291
13.316	3.762	3,5396
14.159	3.762	3,7637
15.056	3.762	4,0021
16.010	3.762	4,2557
17.024	3.762	4,5253
18.103	3.762	4,8121
19.250	3.762	5,1170
20.471	3.762	5,4415
21.769	3.762	5,7865
23.150	3.762	6,1536

$$Ds = Q/C \tag{1}$$

Where:

Ds = Degree of Saturation
Q = Traffic Flow (lvu/hour)
C = Road Capacity (lvu/hour)

Thus, the degree of saturation value is obtained in Table 2.

2. Travel Speed Analysis

The general equation form for determining the free flow speed for roads outside the city can be seen as follows:

$$VB = (VBD + FVB,W) \times FVB,HS \times FVB,KFJ \tag{2}$$

Where:

VB = free flow speed of light vehicles in field conditions (km/h)
VBD = basic free flow of light vehicles on the road and observed alignment (km/h)
FVB,HS = adjustment factor due to side resistance and side width
FVB,KFJ = road function class adjustment factor
FVB,W = Speed adjustment due to road width

3. Trip Assignment Analysis

Trip Assignment is one of the methods used to predict the vehicle movement percentage from the existing road

Table 3. The Average Travel Speed Of Vehicles On The Probolinggo-Banyuwangi National Road (Banyuwangi Direction) *Without Project*

KR	**BB**	**KBM**	**TB**
72,77	75,56	60,64	57,84
57,06	59,30	47,46	45,27
56,02	58,22	46,23	44,16
54,63	56,81	44,78	42,83
52,65	54,28	43,67	41,77
50,26	52,22	41,71	39,55
48,09	50,05	39,95	37,72
42,99	45,75	38,51	36,48
35,66	37,34	29,32	27,92
35,66	37,34	29,32	27,92
35,66	37,34	29,32	27,92
35,66	37,34	29,32	27,92
35,66	37,34	29,32	27,92
35,66	37,34	29,32	27,92
35,66	37,34	29,32	27,92
35,66	37,34	29,32	27,92
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35,66	37,34	29,32	27,92
35,66	37,34	29,32	27,92
35,66	37,34	29,32	27,92
35,66	37,34	29,32	27,92
35,66	37,34	29,32	27,92
35,66	37,34	29,32	27,92

to the Pandaan - Malang Toll Road when the toll road operated in 2019. Several methods were used to conduct trip assignment analysis calculations, namely JICA I Method, Davidson Method, and Smock Method. But in the end, this study chose Smock Method.

C. Analysis of Traffic Conditions With Project

1. Degree of Saturation (Ds)

The degree of saturation is the ratio between traffic flow and the road capacity to describe the level of congestion on the road.

2. Vehicle Operating Costs

a. Vehicle Component Costs

Vehicle Component Costs can be seen in Table 6.

b. Vehicle Operating Costs Calculation

By using the *Jasa Marga* formula, the total VOC is obtained by:

Total VOC = Total Movement Costs (Fuel consumption + Engine oil consumption + tire wear + Depreciation) + Total fixed costs (Capital interest costs + Insurance cost) (3)

And to calculate total operating costs are as follows:

Total = VOC price (IDR/km) x Distance (km) x Vehicle Volume (lvu/year) (4).

3. Time Value Calculation

Time value is the amount of money road users spend to make one unit of travel time economically [5]. The amount of benefit obtained from saving the time value obtained. It is calculated by the formula:

Time Value = Max {(k + Basic Time Value x calibration factor); (Minimum Time Value x calibration factor)} (5).

D. Economic Feasibility Analysis

In economic feasibility analysis, the benefits are viewed from its usefulness perspective to the community as road users. In this analysis, feasibility is assessed from BCR (Benefit Cost Ratio), NPV (Net Present Value), and IRR (Internal Rate of Return) parameters over the existing plan age. Meanwhile, the benefit value is obtained from the total savings of Vehicle Operational Costs (VOC) and time value before and after the Probolinggo – Banyuwangi Toll Road construction project.

1. Vehicle Operating Costs Saving

Vehicle Operating Costs Saving is a comparison of the VOC value in conditions *without project* and *with project*. The calculation of VOC savings is obtained from:

Total VOC *without project* = VOC existing road *without project*
Total VOC *with project* = VOC existing road *with project* + VOC toll road
VOC Saving = VOC *without project* – VOC *with project*

It obtained the vehicle operating costs saving in 2058 of IDR 17.436.399.970.753,40.

2. Time Value Saving

Time value savings are a comparison between the amount of time value in conditions without project and with project. Savings from time value project can be calculated by the formula:

Time Value Saving = Time value *without project* – Time value *with project*

It obtained vehicle operating costs saving in 2058 of IDR 14.613.579.523.185,50.

3. BCR, NPV, Economic Analysis

The results of this economic feasibility calculation were projected for 35 years and will produce profit or loss calculations in each plan year. The investment value and maintenance costs for the Probolinggo – Banyuwangi Toll Road are as follows:

a. Investment value = IDR 24.515.860.000.000
b. Maintenance costs = IDR 26.795.000.000,00
c. Interest rate = 4.28%

Then, the results were obtained after calculating:

a. Benefit = IDR 80.084.309.473.779
b. Cost = IDR 25.111.737.430.818
$\frac{B}{C}$ = 3.189

and NPV value:

NPV = Benefit – cost
= IDR54.972.572.042.962

Based on the calculations obtained, it can be concluded that the Probolinggo – Banyuwangi Toll Road construction was economically feasible.

E. Financial Feasibility Analysis

To determine how to analyze financial feasibility, it can

Table 4. Vehicle Movements Percentage Based on Smock Method

Types	Car	Opelet	Pick up	Mini Bus	Big Bus	2-Axle Truck	3-Axle Truck	Trailer Truck	Trailer Truck
	KR	**KR**	**KR**	**KR**	**BB**	**KBM**	**TB**	**TB**	**TB**
Existing Road									
Volume in 2021	1.486.270	218.658	312.648	1.474	40.49	878.371	296.214	27.938	24.651
Volume after there is toll road in 2021	1.094.626	161.040	230.263	1.086	29.82	646.914	218.160	20.577	18.156
Toll Road									
Vehicle volume on Toll	391.644	57.618	82.385	388	10.670	231.457	78.054	7.361	6.495
Exit in section 1 (Leces-Besuki)	103.852	15.279	21.846	103	2.829	61.376	20.698	1.952	1.722
Exit in section 2 only (Besuki-Bajulmati)	144.776	21.299	30.455	143	3.944	85.561	28.854	2.721	2.401
Exit in section 3 only (Bajulmati-Ketapang)	155.118	22.821	32.630	154	4.226	91.673	30.915	2.915	2.572

be determined from several indicators, such as Benefit Cost Ratio (BCR), Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period.

1. Probolinggo-Banyuwangi Toll Tariff

It was assumed that the tariff from the Probolinggo – Banyuwangi Toll Roads are as follows:

a. Class I = IDR 1.000/km/vehicle
b. Class II = IDR 1.500/km/vehicle
c. Class III = IDR 2.000/km/vehicle
d. Class IV = IDR 2.500/km/vehicle
e. Class V = IDR 3.000/km/vehicle

Then, the total toll tariff revenue in 2058 is obtained as in Table 10.

2. BCR, NPV, IRR Analysis

The results of this financial feasibility calculation were projected for 35 years and will produce profit or loss calculations in each plan year. The investment value and maintenance costs for the Probolinggo – Banyuwangi Toll Road are as follows:

a. Investment value = IDR 24.515.860.000.000
b. Maintenance costs = IDR 26.795.000.000,00
c. Interest rate = 4.23%

Then, the results were obtained after calculating:

a. Benefit = IDR 15.037.155.804.707
b. Cost = IDR 25.111.455.699.176

$$\frac{B}{C} = \frac{\text{IDR } 15.037.155.804.707}{\text{IDR } 25.111.455.699.176} = 0.599 \text{ (unfeasible)}$$

and NPV value:

NPV = Benefit – cost
= -IDR10.074.299.894.469 (unfeasible)

meanwhile for IRR:

I1 = 3.28% → NPV1 = IDR 1.526.378
I2 = 3.29% → NPV2 = -IDR 40.970.318.519

$$I = 3.29\% + \frac{0 - IDR1.526.378}{-IDR455.514.766.108 - IDR1.526.378} \text{ x } (3.29\%-3.28\%)$$

i = 3.28% < 4.23% (unfeasible)

3. *Payback Period* Analysis

When using the interest rate as the discount rate, the NPV value = 0 still has yet to happen the 35th time after the toll road was operated. So from these calculations, it was known that the NPV = 0 or the BEP (Break Even Point) condition occurs after the concession year ends. It means that the BEP condition occurs after the concession period ends (35th year).

Based on the calculations obtained, it can be concluded that the Probolinggo – Banyuwangi Toll Road construction was financially infeasible.

4. *Viability Gap Funding* (VGF) Analysis

Based on the analysis of each financial eligibility criteria (BCR, NPV, IRR, Payback Period), the results were obtained that the Probolinggo-Banyuwangi Toll Road was not financially feasible when using interest rates as a discount rate and also not financially feasible when using the company's MARR. Thus, there is a possibility that the government will provide feasibility support (viability gap funding) for the Probolinggo-Banyuwangi Toll Road project. MARR value was obtained from Bank Persero data, which is 9.82%. Then, for its eligibility support fund was a difference between the MARR and the IRR, which is 6.54%. On the Probolinggo-Banyuwangi toll road, there were three segments with a planned total acquisition of 11.249 land parcels and an estimated total area of land acquisition of 14.803.530 m^2. Furthermore, the value of government support funds was obtained IDR 10.074.299.894.469, which was used for land acquisition purposes.

CONCLUSIONS

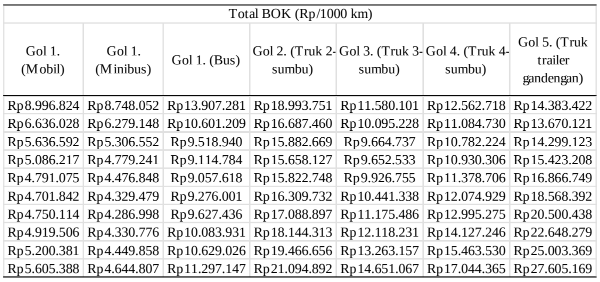
A. Kuningan 2 Toll Gate Capacity

Based on the results of the analysis and calculations in chapter IV, it can be concluded as follows:

1. Based on the analysis of traffic volume calculations in conditions *without project*, the degree of saturation

Table 5. Degree of Saturation of Probolinggo - Banyuwangi Toll Road (Banyuwangi Direction) *With Project*

No.	Year	Flow (Q)	Capacity (C)	Ds
1	2024	5	4.655	0,000992
2	2025	5	4.655	0,001032
3	2026	1	4.655	0,000284
4	2027	1	4.655	0,000296
5	2028	1	4.655	0,000308
6	2029	1	4.655	0,000321
7	2030	1	4.655	0,000196
8	2031	2	4.655	0,000349
9	2032	7	4.655	0,001471
10	2033	7	4.655	0,001558
11	2034	8	4.655	0,001649
12	2035	8	4.655	0,001649
13	2036	8	4.655	0,001649
14	2037	8	4.655	0,001649
15	2038	8	4.655	0,001649
16	2039	8	4.655	0,001649
17	2040	8	4.655	0,001649
18	2041	8	4.655	0,001649
19	2042	8	4.655	0,001649
20	2043	8	4.655	0,001649
21	2044	8	4.655	0,001649
22	2045	8	4.655	0,001649
23	2046	8	4.655	0,001649
24	2047	8	4.655	0,001649
25	2048	8	4.655	0,001649
26	2049	8	4.655	0,001649
27	2050	8	4.655	0,001649
28	2051	8	4.655	0,001649
29	2052	8	4.655	0,001649
30	2053	8	4.655	0,001649
31	2054	8	4.655	0,001649
32	2055	8	4.655	0,001649
33	2056	8	4.655	0,001649
34	2057	8	4.655	0,001649
35	2058	8	4.655	0,001649



Total BOK (Rp/1000 km)						
Gol 1. (Mobil)	Gol 1. (Minibus)	Gol 1. (Bus)	Gol 2. (Truk 2-sumbu)	Gol 3. (Truk 3-sumbu)	Gol 4. (Truk 4-sumbu)	Gol 5. (Truk trailer gandengan)
Rp8.996.824	Rp8.748.052	Rp13.907.281	Rp18.993.751	Rp11.580.101	Rp12.562.718	Rp14.383.422
Rp6.636.028	Rp6.279.148	Rp10.601.209	Rp16.687.460	Rp10.095.228	Rp11.084.730	Rp13.670.121
Rp5.636.592	Rp5.306.552	Rp9.518.940	Rp15.882.669	Rp9.664.737	Rp10.782.224	Rp14.299.123
Rp5.086.217	Rp4.779.241	Rp9.114.784	Rp15.658.127	Rp9.652.533	Rp10.930.306	Rp15.423.208
Rp4.791.075	Rp4.476.848	Rp9.057.618	Rp15.822.748	Rp9.926.755	Rp11.378.706	Rp16.866.749
Rp4.701.842	Rp4.329.479	Rp9.276.001	Rp16.309.732	Rp10.441.338	Rp12.074.929	Rp18.568.392
Rp4.750.114	Rp4.286.998	Rp9.627.436	Rp17.088.897	Rp11.175.486	Rp12.995.275	Rp20.500.438
Rp4.919.506	Rp4.330.776	Rp10.083.931	Rp18.144.313	Rp12.118.231	Rp14.127.246	Rp22.648.279
Rp5.200.381	Rp4.449.858	Rp10.629.026	Rp19.466.656	Rp13.263.157	Rp15.463.530	Rp25.003.369
Rp5.605.388	Rp4.644.807	Rp11.297.147	Rp21.094.892	Rp14.651.067	Rp17.044.365	Rp27.605.169

Figure 2. Vehicle Operating Costs Calculation

(Ds) obtained on the Probolinggo – Banyuwangi National Road in 2024 before the Probolinggo – Banyuwangi Toll Road construction in the first year, which can be seen as follows:

a. Probolinggo – Banyuwangi National Road (Banyuwangi Direction) = 0.67
b. Probolinggo – Banyuwangi National Road (Probolinggo Direction) = 0.75

2. Based on the analysis of traffic volume calculations in conditions *with project*, the degree of saturation (Dj) obtained on the Probolinggo - Banyuwangi National Road and Probolinggo – Banyuwangi Toll Road in 2024 after the Probolinggo – Banyuwangi Toll Road construction in the first year, which can be seen as follows:

a. Probolinggo – Banyuwangi National Road (Banyuwangi Direction) = 0.55
b. Probolinggo – Banyuwangi National Road (Probolinggo Direction) = 0.47

Table 6. Assumptions of Each Type of Class

Class	**Component**	**Brand**	**Price**	**Unit**	Number of Tires
I (KR) Passenger Car	Vehicle	Honda CR-V 1.5 A/T	IDR480.000.000,00	IDR/Vehicle	
	Fuel	Pertamina Pertamax	IDR9.300,00	IDR/Liter	
	Engine Oil	E Pro Turbo Honda Genuine	IDR125.000,00	IDR/Liter	
	Tire	Bridgestone Dueler D470 225/65	IDR1.176.000,00	IDR/Tire	4
	Maintenance Costs	Mechanic wages	IDR15.000,00	IDR/Hour	
Class	**Component**	**Brand**	**Price**	**Unit**	Number of Tires
I (KBM) Mini Bus	Vehicle	Toyota Hiace 1GD-FTV VN Turbo	IDR545.720.000,00	IDR/Vehicle	
	Fuel	Biodiesel	IDR5.150,00	IDR/Liter	
	Engine Oil	Cartago	IDR50.000,00	IDR/Liter	
	Tire	Bridgestone Duravis R624/8PR Type	IDR975.000,00	IDR/Tire	4
	Maintenance Costs	Mechanic wages	IDR15.000,00	IDR/Hour	
Class	**Component**	**Brand**	**Price**	**Unit**	Number of Tires
I (BB) Big Bus	Vehicle	Scania K360Ib	IDR820.000.000,00	IDR/Vehicle	
	Fuel	Biodiesel	IDR5.150,00	IDR/Liter	
	Engine Oil	Pertamina Meditran	IDR299.000,00	IDR/Liter	
	Tire	295/80 R22.5	IDR8.050.000,00	IDR/Tire	6
	Maintenance Costs	Mechanic wages	IDR15.000,00	IDR/Hour	
Class	**Component**	**Brand**	**Price**	**Unit**	Number of Tires
II (KBM) 2-Axle Bus	Vehicle	Volvo FH16	IDR1.550.000.000,00	IDR/Vehicle	
	Fuel	Biodiesel	IDR9.300,00	IDR/Liter	
	Engine Oil	Pertamina Meditran	IDR299.000,00	IDR/Liter	
	Tire	Bridgestone MRN 7.50-16 14PR	IDR1.375.000,00	IDR/Tire	6
	Maintenance Costs	Mechanic wages	IDR15.000,00	IDR/Hour	
Class	**Component**	**Brand**	**Price**	**Unit**	Number of Tires
III (TB) 3-Axle Bus	Vehicle	Hino FL235JW	IDR702.000.000,00	IDR/Vehicle	
	Fuel	Biodiesel	IDR5.150,00	IDR/Liter	
	Engine Oil	Pertamina Meditran	IDR299.000,00	IDR/Liter	
	Tire	Bridgestone EMSA 1000-20 16PR	IDR2.925.000,00	IDR/Tire	10
	Maintenance Costs	Mechanic wages	IDR15.000,00	IDR/Hour	
Class	**Component**	**Brand**	**Price**	**Unit**	Number of Tires
IV (TB) 4-Axle Bus	Vehicle	Hino SG 285	IDR800.000.000,00	IDR/Vehicle	
	Fuel	Biodiesel	IDR5.150,00	IDR/Liter	
	Engine Oil	Pertamina Meditran	IDR299.000,00	IDR/Liter	
	Tire	Bridgestone EMSA 1000-20 16PR	IDR2.925.000,00	IDR/Tire	14
	Maintenance Costs	Mechanic wages	IDR15.000,00	IDR/Hour	
Class	**Component**	**Brand**	**Price**	**Unit**	Number of Tires
V (TB) 5-Axle Bus	Vehicle	Hino FM 260	IDR935.000.000,00	IDR/Vehicle	
	Fuel	Biosolar	IDR5.150,00	IDR/Liter	
	Engine Oil	Pertamina Meditran	IDR299.000,00	IDR/Liter	
	Tire	Bridgestone TBR R172 1100-20 16PR	IDR5.868.000,00	IDR/Tire	18
	Maintenance Costs	Mechanic wages	IDR15.000,00	IDR/Hour	

c. Probolinggo – Banyuwangi Section I Toll Road (Banyuwangi Direction) = 0.13
d. Probolinggo – Banyuwangi Section I Toll Road (Probolinggo Direction) = 0,12
e. Probolinggo – Banyuwangi Section II Toll Road (Banyuwangi Direction) = 0.12
f. Probolinggo-Banyuwangi Section II Toll Road (Probolinggo Direction) = 0.12
g. Jalan Tol Probolinggo-Banyuwangi Seksi III (Arah Banyuwangi) = 0.002
h. Probolinggo – Banyuwangi Section III Toll Road (Probolinggo Direction) = 0.002

Tabel 7. Nilai Waktu Dasar

Year	1996		2020	
	Basic Time Value			
Class I	IDR 12.287,00	/hour/vehicle	IDR 73.914,19	/hour/vehicle
Class II	IDR 18.534,00	//hour/vehicle	IDR 111.493,90	//hour/vehicle
Class III	IDR 13.768,00	/hour/vehicle	IDR 82.823,35	/hour/vehicle
Class IV	IDR 13.768,00	/hour/vehicle	IDR 82.823,35	/hour/vehicle
Class V	IDR 13.768,00	/hour/vehicle	IDR 82.823,35	/hour/vehicle

3. Based on the results of trip assignment analysis and calculation using several methods, it can be obtained as follows:
   a. Smock Method, obtained vehicles moving from the Probolinggo – Banyuwangi National Road to the Probolinggo – Banyuwangi Toll Road are as follows:
      a) On Section 1
      KR (Car, Opelet, Pickup, Mini Bus) = 141.080
      BB (Big Bus) = 10.670
      KBM (2-Axle Truck) = 231.457
      TB (3-Axle Truck, Trailer Truck, Semi-Trailer Truck) = 91.910
      b) On Section 2
      KR (Car, Opelet, Pickup, Mini Bus) = 196.673
      BB (Big Bus) = 2.829
      KBM (2-Axle Truck) = 61.376
      TB (3-Axle Truck, Trailer Truck, Semi-Trailer Truck) = 24.372
      c) On Section 3
      KR (Car, Opelet, Pickup, Mini Bus) = 210.722
      BB (Big Bus) = 3.944
      KBM (2-Axle Truck) = 85.561
      TB (3-Axle Truck, Trailer Truck, Semi-Trailer Truck) = 33.976
   b. JICA 1 Method, obtained vehicles moving from the Probolinggo – Banyuwangi National Road to the Probolinggo – Banyuwangi Toll Road are as follows:
      a) ΔT KR (Car) = -200,81
      b) ΔT KR (Transport) = -200,81
      c) ΔT BB (Big Bus) = -205,38
      d) ΔT KBM (2-Axle Truck) = -188,42
      e) ΔT TB (3-Axle Truck) = -403,12
      f) ΔT TB (Trailer Truck) = -523,71
      g) ΔT TB (Semi-Trailer Truck)= -644,30

   From the calculation results, it can be seen that all $\Delta T < 0$, so it can be said that JICA 1 calculation results are undefined.
   c. Davidson Method, obtained vehicles moving from the Probolinggo – Banyuwangi National Road to the Probolinggo – Banyuwangi Toll Road are as follows:
      a) Probolinggo Direction = 13%
      b) Banyuwangi Direction = 23%
   d. Diversion Curve Method, obtained vehicles moving from the Probolinggo - Banyuwangi National Road to the Probolinggo - Banyuwangi Toll Road was 50.51%.
4. Based on the results of Vehicle Operating Costs (VOC) calculation in conditions without project and with project, total savings in the first year of 2024, was IDR 789.642.615.459,47. At the end of the plan age, namely in 2058, VOC savings reach IDR 1.699.894.810.660,06.
5. Based on the results of time value calculation in conditions without project and with project, the total savings in the first year of 2024 was – IDR51.155.924.167,84. At the end of the plan year of 2058, the time value savings reach IDR 17.375.518.839.745,10.

Table 8. Minimum Time Value

Minimum Time Value				
Class I	IDR 6.000,00	/hour/vehicle	IDR 36.093,85	/hour/vehicle
Class II	IDR 9.051,00	//hour/vehicle	IDR 54.447,57	//hour/vehicle
Class III	IDR 6.723,00	/hour/vehicle	IDR 40.443,16	/hour/vehicle
Class IV	IDR 6.723,00	/hour/vehicle	IDR 40.443,16	/hour/vehicle
Class V	IDR 6.723,00	/hour/vehicle	IDR 40.443,16	/hour/vehicle

Table 9. Toll Road Revenues

Toll Road Revenues		
Year		
2058	Section I	IDR 529.775.090.410
2058	Section II	IDR 1.983.073.392.718
2058	Section III	IDR 721.006.213.505

6. Based on the results of calculation and feasibility analysis from the economic aspect, the results can be seen as follows:
   a. Present worth benefit = IDR80.084.309.473.779
   b. Present worth cost = IDR 5.112.069.350.101

   Thus, the results were obtained as follows:
   a. BCR = 3.189 > 1 (Feasible)
   b. NPV = IDR 54.972.572.042.962 > 0 (Feasible)
   c. IRR = 6.7% > Interest rate (Feasible)

   Based on the feasibility analysis results, it can be concluded that the Probolinggo – Banyuwangi Toll Road construction was economically feasible.
7. Based on the results of calculations and feasibility analysis from the financial aspect, when using the interest rate (4.23%) as the discount rate, the results can be obtained as follows:
   a. Present worth benefit = IDR38.367.968.861.385
   b. Present worth cost = IDR25.111.775.909.885

   Thus, the results were obtained as follows:
   a. BCR = 0.599 < 1 (Unfeasible)
   b. NPV =IDR10.074.299.894.469 < 0 (Unfeasible)
   c. IRR = 3.28 % > Interest rate (Unfeasible)
   d. PP =Over the 35th year (After the concession period ends)

   Meanwhile, when using MARR (9.82%) as the discount rate, the results can be obtained as follows:
   a. Present worth benefit = IDR 2.471.352.838.662
   b. Present worth cost = IDR 5.400.014.191.042

   Thus, the results were obtained as follows:
   a. BCR = 0.31 < 1 (Unfeasible)
   b. NPV = -IDR17.233.979.248.285 < 0 (Unfeasible)
   c. IRR = 2.23% < MARR (Unfeasible)
   d. PP =Over the 35th year (After the concession period ends)

   Based on the feasibility analysis results, it can be concluded that the Probolinggo – Banyuwangi Toll Road construction was not financially feasible when using the interest rate as the discount rate or when using MARR as the discount rate.
8. *Viability Gap Funding* (VGF) Analysis

   Since it was stated as feasible from an economic perspective but financially unfeasible, the government may consider providing viability gap funding to support the Probolinggo – Banyuwangi Toll Road project. It obtained that government support funds amounted to

IDR 10.074.299.894.469, which were planned for land acquisition purposes.

B. *Suggestions*

The research results show that the Probolinggo – Banyuwangi Toll Road was economically feasible. However, from a financial perspective, when it was calculated using interest rates or the company's MARR as a discount rate, the Probolinggo – Banyuwangi Toll Road was declared financially infeasible. Therefore, things that can be a solution is the existence of Viability Gap Funding (VGF) or support from the government so that this project is expected to be completed and can overcome problems that may exist, as well as realize infrastructure development in Indonesia.

REFERENCES

[1] Kementrian PPN/Bappenas, "Rencana Pembangunan Jangka Menengah Nasional 2020-2024," 2019.

[2] Departemen Pekerjaan Umum, "Pra Studi Kelayakan Proyek Jalan dan Jembatan," 2005.

NOTES:

Figure 2. Vehicle Operating Costs Calculation

- Total VOC (IDR/1000 km)
- Class 1 (Car)
- Class 1 (Minibus)
- Class 1 (Bus)
- Class 2 (2-Axle Truck)
- Class 2 (3-Axle Truck)
- Class 2 (4-Axle Truck)
- Class 5 (Trailer Truck)