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FEASIBILITY OF NORTH TANGERANG TOLL ROAD CONSTRUCTION

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Abstract:
In order for an investment to be efficient, an economic and financial feasibility study is needed so that all parties involved, the government, banks as lenders and investors (Toll Road Business Entities) understand the risks that will occur. Economic studies are needed to determine the magnitude of the benefits of this project for the surrounding community. From the results of the economic feasibility analysis, EIRR = 17.87% > 6.75% ID Govt. Yield 10 years-2021, NPV (MARR 6.75%) = IDR 27,874,162 (million) and B/C ratio = 5.46 > 1, while financial feasibility obtained FIRR = 13.63% > MARR 10%, NPV = IDR 3,594,555. (million), B/C ratio = 1.58 > 1, Payback Period = 7.92 and Total operating loans = Rp. 5,298,231 (million) for 11 years. The variables that greatly affect IRR are the initial construction cost variable of -72.3%, then traffic volume of 48.5% and loan interest of -15.5%. Based on the results of the study and analysis, it can be said that the North Tangerang toll road project is economically feasible and financially feasible, however, in its implementation, it is necessary to control the cost plan and the time and quality of its implementation, so that the feasibility calculation will not change much from what has been planned.

Keywords: *Economic Analysis; Financial Analysis; Feasibility Study; North Tangerang toll road.*

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INTRODUCTION

Infrastructure development is needed to spur the growth and economic development of a region (Pradhan et al., 2019). At this time the ability of government funds is very limited, while basic infrastructure is still very much needed, for that the Government needs the role of the private sector to accelerate infrastructure development through Public Private Partnership Presidential Regulation No. 5 of 2015 concerning Procedures for Implementing Government Cooperation with Business Entities in the provision of infrastructure, including the construction of toll roads. Toll road investment involves, the Government in this case the Ministry of PUPR, Local Government, Banks and Toll Road Business Entities (BUJT) private parties as investors.

With the existence of toll roads, the logistics costs of goods and people will be cheap and smooth and support the development and economic development of the area that will be passed by toll roads, which in the end will benefit all parties (Wijaya & Yudhistira, 2020). the community as users and business entities as investors who will invest large enough funds, considerable risks in terms of land acquisition, Licensing is time-consuming and long-term return on investment where the macroeconomic situation (inflation rate, bank interest) is difficult to predict and beyond the control of investors, the appropriate source of funds for infrastructure funding must be a long-term and cheap source of funds. Given the importance of the above and the many parties involved in this toll road business investment, it is therefore very necessary to Study Toll Road Investment, Economic and Financial Feasibility (Das, 2017).

Possible problems that occur are that certain toll road sections are not economically feasible and not financially feasible, for this section the construction will be delayed, the section is certainly economically feasible but not financially feasible, for this the role of the government through State-Owned Enterprises (SOEs) is needed to carry out development such as toll roads on the island of Sumatra, while toll road sections that are economically feasible and financially feasible can be offered to the private sector to become a Toll Road Business Entity as an investor.

Economic feasibility means that toll road sections are feasible and profitable for the community and the state, on the other hand as an investment toll road business must also be financially feasible or profitable for toll road business entities as investors, thus the infrastructure investment business becomes attractive to the private sector so that the fulfillment of toll road infrastructure development will be more quickly available to support economic growth (Riyanto & Joesoef, 2020). This paper will analyze whether the North Tangerang Toll Road is economically and financially feasible.

For the types of vehicles that pass through toll roads, they are divided into 5 (five) groups, namely: (a) Group I; Sedan, Jeep, Pick Up, Small Bus, Medium Truck. (b) Group II: Large trucks and large buses with 2 axles. (c) Group III: Large trucks and large buses with 3 or more axles. (d) Group IV: Large trucks with 4 axles. (e) Group V: Large trucks with 5 axles, Source: Kepmen PU No 370 Year 2007

The classification of vehicle types is determined on the basis of current operations. In addition to the type of vehicle, another important factor that greatly affects toll road revenue is the amount of toll road tariffs and payment systems.

Traffic volume prediction

The construction of road sections will result in a division of traffic volume on the existing road network (Jamroz et al., 2014). In this case, motorists will choose a travel route by considering travel time factors, travel costs, comfort, safety, and service levels (Krizek & El-Geneidy, 2017). The basic assumption used in the assignment process is that people will choose a route with minimum travel time (Soltani-Sobh et al., 2016). Therefore, it is assumed that the total travel time on the selected route will be less than or equal to the total time on all unused routes with the exception of saturated routes (Yang & Jiang, 2014). This traffic assignment calculation is needed to forecast or predict the volume of traffic that will pass through toll roads in the future (Saw et al., 2015).

There is also a similar study conducted by Ibrahim (2016), in his research entitled “The Role of Bogor, Depok, Tangerang, Bekasi, and Cianjur (Bodetabekjur) in Supporting the Development of Jakarta City" in his research resulted that every city in Jabodetabekjur and Cianjur Regency has a base sector dominated by the tertiary sector. The remaining districts have leading sectors in the primary sector and the secondary sector. The main role of districts/cities in Bodetabekjur is the development of mass transportation, increasing road capacity.

The purpose of the analysis of traffic volume prediction in the future is to get a predictive picture of the performance of the amount of traffic volume that will pass through toll roads that are planned in accordance with regulatory standards in Indonesia. The analysis of traffic volume prediction will determine in the toll road business investment study where the amount of tariff and traffic volume will be the main income or income in the toll road business investment study where all vehicles will be charged in accordance with what has been determined and regulated by ministerial decree.

METHOD

This activity includes 2 (two) types of data collection, namely primary data collection and secondary data. Primary data is obtained from direct surveys in the field while secondary data is obtained from local agencies such as Bappeda, BPS and related agencies. Secondary data required include: (a) Interpretation of socioeconomic and socio-cultural data. (b) Land use data. (c) While primary data includes. (d) Traffic Volume Data. (e) Travel Destination-Origin Data. (f) Vehicle Speed and Travel Time. (g) Public Perception.

RESULTS AND DISCUSSION

A. Performance Analysis of Toll Road Sections

Analysis of toll road performance level in the form of performance and needs for the number of lanes and the number of toll booths in accordance with applicable standards (Abdelwahab, 2017). The reference used to determine the number of lanes is used as follows Syaiful (2022): (a) Geometric Planning Standard for Urban Roads, Directorate General of Highways, 1992. (b) Geometric Planning Procedures for Intercity Roads, Directorate General of Highways, 1997. (c) Indonesian Highway Capacity Manual (IHCM), Directorate General of Highways, 1997 or Indonesian Road Capacity Manual (MKJI). (d) Highway Capacity Manual (HCM), Transportation Research Board, 2010. (e) Guidelines for Building Planning of Toll Facilities, Planning Division of PT Jasa Marga, November 1999. (f) Appendix III Decree of the Board of Directors of PT Jasa Marga (Persero) Tbk Number 150/KPTS/2013 concerning Amendments to the Decree of the Board of Directors of PT Jasa Marga (Persero) Tbk Number 225/KPTS/206 concerning Standard Calculation of Toll Collection Personnel Needs.

B. Road Capacity

The current road section capacity is calculated based on the Indonesian Road Capacity Manual. Toll road capacity is further differentiated for Toll Roads (Throughway) and Connecting Roads (Rampway) (Syed & Sonparote, 2020). Capacity is defined as the maximum current passing through a point on a freeway (toll road) that can be maintained within hours under prevailing conditions. According to Widarto (2022), toll road capacity is calculated according to the following formula:

C = C0 x FCW x FCSP (smp/jam)

Where :

C = capacity

C0 = Base Capacity

FCW = Toll Road Width Adjustment Factor

FCSP = directional separation adjustment factor (for undivided highways only)

Table 1.
Toll Road Capacity (*Throughway*)

Road Type and Capacity Factor		**Unit**	**Note**
Divided Four and Six Lanes	Value		
C_0	2300	Smp/jam/lajur	
FC_W	1		Wide Strip = 3,6 m
FC_{SP}	1		Does not apply to split roads
Capacity (C)	**2300**	**Smp/jam/lajur**	

Source *: MKJI,1997*

Assuming the saturation degree (DS) value required for lane addition is 0.8, the need for the number of lanes can be determined as follows:

<3680 smp/jam = 2 strip
3680 – 7360 smp/jam = 4 strip
7361 – 13800 smp/jam = 6 strip

If the toll road is only designed for 6 lanes 2 directions (6/2 D), then the maximum capacity of the road section is 13,800 smp/jam.

C. Connecting Road Capacity

According to MKJI 1997, the capacity of connecting roads is calculated according to the following formula:

C = C0 x FCW x FCSP x FCSF (smp/jam)

Where:

C= capacity

C0 = Base Capacity (smp/jam)

FCW = Adjustment factors due to traffic lane width

FCSP = Adjustment factors due to directional separation

FCSF = Adjustment factors due to side obstacles

Table 2
Capacity of Toll Connecting Road (Rampway)

Road Type and Capacity Factor		**Unit**	**Note**
Divided Four and Six Lanes	**Value**		
C_0	1900	Smp/jam/strip	
FC_W	1		Lane width = 3,5 m
FC_{SP}	1		Does not apply to split roads
FC_{SF}	1		Shoulder width = 1,0 m Side resistance = very low
Capacity (C)	**1900**	**Smp/jam/strip**	

Source: MKJI,1997

In addition, according to HCM 2010, the capacity of a ramp is as shown in Table 3. as follows:

Table 3
Ramp Capacity According to HCM 2010

Free-Flow Speed of Ramp	**Capacity (pc/h)**	
	Single-Lane Ramps	**Two-Lane Ramps**
> 80	2200	4400
> 65 – 80	2100	4100

> 50 – 65	2000	3800
≥ 30 – 50	1900	3500
< 30	1800	3200

Source : HCM, 2010

Based on ramp design standards, data was obtained that the planned speed on the ramp is: 40 km / h, so that the capacity used by HCM 2010 is the same as MKJI 1997, which is 1900 junior high school / hour (one-lane ramp) and 3500 junior high school / hour (two-lane ramp).

D. Traffic Volume Prediction Analysis

Analysis of future traffic predictions using the most optimal toll road route by taking into account: (a) Road network system. (b) Road network development plan. (c) Land use plan. Traffic volume predictions are obtained based on outputs from transportation system modeling. The predicted traffic volume on this toll road section is calculated under capacity limitation conditions with the number of lanes 2 x 2 as the initial stage. To calculate the maximum capacity, the inputs required are as follows: (a) The peak hour factor is 7%. Peak hour volume is 7% of daily volume (24 hours). (b) The proportion of the number of vehicles per group. (c) Passenger car equivalence factor (emp).

Based on the survey results and secondary data, the estimated composition of vehicles for each group that will use toll road sections is as follows: (a) Group I: 93%. (b) Group II: 4%. (c) Group III: 1.55%. (d) Group IV: 0.85%. (e) Group V: 0.6 %. (f) Total vehicles: 100.0%. In accordance with the Indonesian Road Capacity Manual (MKJI) of 1997, the passenger car equivalence values (emp) for each vehicle class are as follows: (a) Group I: 1.0. (b) Group II: 1,3. (c) Group III: 1,6. (d) Group IV: 2.5. (e) Group V: 2.5

Based on the data mentioned above, the conversion factor from passenger car units (junior high school) to vehicle units is 0.958. Or 1 junior high = 0.958 vehicles. From this value can be determined the maximum capacity of the road section. The table below shows the maximum capacity on a road section. The maximum capacity on a road section can be seen in the table below.

Table 4
Maximum capacity of road sections

No	Information	Hourly capacity (smp/hour)	Capacity per day (smp/day)	Capacity per day (kend/ day)
1	1 Lajur	2300	32857	31,507
2	4 Lajur 2 arah (4/2 D)	9200	115000	106,950
3	6 Lajur 2 arah (6/2 D)	13800	172500	160,425

From the results of the traffic study conducted, the need for the number of lanes on this toll road is as in the table below, where in the initial stage it is 4 lanes 2 ways (4/2D), in 2030 it is necessary to increase lanes to 6 lanes 2 ways (6/2D).

Table 5

The need for the number of toll road lanes

No	Year	Volume Per Day (Kendr/Day)	Lane Needs (2 Way Total)
1	2024	55,708	4
2	2025	61,699	4
3	2030	99,428	6
4	2035	123,187	6
5	2040	137,634	6
6	2045	161,037	6
7	2050	178,660	6
8	2055	178,660	6
9	2060	178,660	6
10	2063	178,660	6

The results of the traffic volume prediction analysis can be seen in the table below.

Table 6

Estimated Average Daily Traffic Volume on Toll Roads

No	Tahun	Gol I	Gol II	Gol III	Gol. IV	Gol. V	Jumlah
1	2024	45,603	6,125	2,324	1,200	456	55,708
2	2025	50,507	6,784	2,574	1,329	505	61,699
3	2026	56,684	7,613	2,889	1,492	567	69,245
4	2027	62,861	8,443	3,203	1,655	629	76,790
5	2028	69,038	9,273	3,518	1,817	690	84,336
6	2029	75,215	10,102	3,833	1,980	752	91,882
7	2030	81,392	10,932	4,148	2,142	814	99,428
8	2031	87,569	11,761	4,462	2,305	876	106,973
9	2032	93,746	12,591	4,777	2,468	937	114,519
10	2033	96,111	12,909	4,898	2,530	961	117,408
11	2034	98,476	13,226	5,018	2,592	985	120,298
12	2035	100,842	13,544	5,139	2,654	1,008	123,187
13	2036	103,207	13,862	5,259	2,717	1,032	126,077
14	2037	105,572	14,179	5,380	2,779	1,056	128,966
15	2038	107,937	14,497	5,500	2,841	1,079	131,855
16	2039	110,303	14,815	5,621	2,903	1,103	134,745
17	2040	112,668	15,133	5,742	2,966	1,127	137,634
18	2041	115,033	15,450	5,862	3,028	1,150	140,524
19	2042	117,398	15,768	5,983	3,090	1,174	143,413
20	2043	122,207	16,414	6,228	3,217	1,222	149,288
21	2044	127,016	17,060	6,473	3,343	1,270	155,162
22	2045	131,825	17,706	6,718	3,470	1,318	161,037
23	2046	136,634	18,351	6,963	3,597	1,366	166,911
24	2047	141,443	18,997	7,208	3,723	1,414	172,786
25	2048	146,252	19,643	7,453	3,850	1,462	178,660
26	2049	146,252	19,643	7,453	3,850	1,462	178,660
27	2050	146,252	19,643	7,453	3,850	1,462	178,660
28	2051	146,252	19,643	7,453	3,850	1,462	178,660
29	2052	146,252	19,643	7,453	3,850	1,462	178,660
30	2053	146,252	19,643	7,453	3,850	1,462	178,660
31	2054	146,252	19,643	7,453	3,850	1,462	178,660
32	2055	146,252	19,643	7,453	3,850	1,462	178,660
33	2056	146,252	19,643	7,453	3,850	1,462	178,660
34	2057	146,252	19,643	7,453	3,850	1,462	178,660
35	2058	146,252	19,643	7,453	3,850	1,462	178,660
36	2059	146,252	19,643	7,453	3,850	1,462	178,660
37	2060	146,252	19,643	7,453	3,850	1,462	178,660
38	2061	146,252	19,643	7,453	3,850	1,462	178,660
39	2062	146,252	19,643	7,453	3,850	1,462	178,660
40	2063	146,252	19,643	7,453	3,850	1,462	178,660

E. Evaluation of existing arterial roads

Judging from the survey results on existing roads and predictions of future traffic and considering the development of the surrounding area, it can be concluded that: (a) The

surrounding conditions of the arterial roads on the left and right of the road are dense residential areas and warehouses and factories, very difficult to widen. (b) In the future the average daily traffic volume on arterial roads will exceed its capacity. (Prediction in 2024 average daily volume of 32,521 > 31,507) as well as subsequent years. (c) Speed on arterial roads is currently low (15 - 25 Km/H) even often congested and damaged road conditions in some parts. (d) As an old road, the horizontal alinyement of the arterial road strongly turns turns not allowing to support as good access to an independent city. (e) With the presence of toll roads, the load on arterial roads will be reduced, so that it is also beneficial for arterial road users.

F. Vehicle Operating Cost Capability (BKBOK)

A toll road fare is a certain amount of money that will be paid for the use of toll roads. Toll road tariffs are calculated based on the ability to pay road users, the Vehicle Operating Cost Expediency (BKBOK), which is the savings obtained from the difference in Vehicle Operating Costs (BOK) and the difference in time through non-toll roads with toll roads. In principle, toll road tariffs must be less than the savings obtained by toll road users (BOK) compared to using non-toll roads (Wang et al., 2014). The value of these savings includes: (a) Fuel costs. (b) Vehicle maintenance costs. (c) Cost of spare parts. (d) Lubricant fees. (e) Time cost. (f) Tyre usage fee. (g) Overhead costs (non-operational/incidental costs). (h) Insurance. (i) Capital interest. (j) Depreciation of the vehicle. Vehicle Operating Cost is a function of speed and is differentiated for old arterial road BOK and BOK for new roads (toll roads). For BOK calculations, the PCI model formula is used.

Toll road tariffs greatly affect the amount of toll road traffic and in turn will affect the amount of toll road revenue (Carpintero et al., 2015). For this reason, in determining the amount of toll road tariffs, you must consider WTP (willingness to pay) and BKBOK (Large Profit of Vehicle Operating Costs). Thus, to determine toll road tariffs, they must be lower than WTP and lower than BKBOK (Maximum 70% BKBOK).

Fare (Rp/km) < WTP (Rp/km)

< 70 % BKBOK (Rp/km)

Tariffs are calculated based on each vehicle class and must also pay attention to toll tariff increases referring to Law No.38 of 2004 concerning Toll Roads and Government Regulation No.15 of 2005 concerning Toll Roads. So that by paying attention to this, the tariff used will be in accordance with the actual conditions.

Table 7.
Large Cost of Profit Vehicle Operating Cost (BKBOK)

Group	BOK + Time Value Per th 2022	Fare Rp/Km th 2022
Gol I	2,460	1,830
Gol II	5,235	3,484

Gol III	5,313	3,484
Gol IV	5,544	3,778
Gol V	5,623	3,778

G. Time Value

Time value or time saving value is defined as the amount of money a person is willing to spend to save a unit of travel time. The approach in calculating the value of time is done with the assumption that the driver of the vehicle will use the better road to avoid congestion. This calculation is based on Herbert Mohring's theory, whereby motorists tend to look for routes with minimum vehicle operating costs from the few road alternatives available.

Table 8.
Initial Toll Operational Tariff

Group	Initial Toll Rates Oprs.(Rp/Km)	Increase according to inflation
Gol I	2,180	Per 2 th
Gol II	4,150	Per 2 th
Gol III	4,150	Per 2 th
Gol IV	4,500	Per 2 th
Gol V	4,500	Per 2 th

H. Components of Investments Financing and Toll Road Operation

The investment financing and operation component of toll roads consists of the following cost budgets: (a) Project initial investment cost budget plan. (b) Toll road operating and management costs. (c) Routine maintenance costs. (d) Periodic maintenance costs. (d) Overlay fees and road capacity upgrades.

I. Budget Plan Project initial investment costs

The initial investment cost budget plan of the project, is the entire budget cost of toll road construction, consisting of: (a) Land acquisition costs. (b) The cost of physical construction of toll roads. (c) Cost of toll road equipment and equipment. (d) Detail Engineering Design (DED) Fee. (e) Supervision consultant fees. (f) Value Added Tax (VAT). (g) Project administrative costs and overhead. (h) Escalation charges. The estimated costs are as shown in the table on the following sheet calculated based on 2022 unit prices.

Table 9.
Investment Cost Budget

No	Description	%	Sum (Rp. Million)
1	Soil	55.75%	3,748,631.46
2	Design	0.24%	16,285.66

3	Construction (excluding VAT)	28.07%	1,887,627.00
4	Toll Equipment	0.45%	30,065.84
5	Supervision	0.28%	18,876.27
6	Escalation	4.26%	286,618.83
7	VAT 10%	3.33%	223,947.36
8	Overhead	0.46%	30,890.41
9	Provision	0.65%	43,700.60
10	IDC	6.50%	437,006.00
	Total Investment	**100.00%**	**6,723,649.4**
	Funding Sources		
1	- Own Funds 30%	30%	2,017,094.8
2	- Bank funds 70%	70%	4,706,554.6
			6,723,649.4

J. Toll Road Maintenance

Toll road maintenance includes activities, namely: (a) Routine maintenance consists of toll road maintenance, toll road equipment maintenance and toll road facility maintenance. (b) Periodic maintenance includes activities to maintain the pavement structure up to the planned life, in the form of non-structural resurfacing. (c) Special maintenance includes maintenance activities against damage caused by natural disasters, including earthquakes, landslides and floods.

In the implementation of maintenance and equipment replacement activities, pay attention to the order, smoothness, safety and comfort of toll road traffic. Maintenanceactivities are prioritized to prevent damage or reduced function of toll roads and all buildings/their auxiliary facilities and handle damage as early as possible. Toll roadsare measured to keep the road able to serve traffic according to Minimum Service Standards (SPM), one of which is the IRI (International Roughness Index), which is a parameter to determine the unevenness of the road surface. The Directorate General of Highways uses the IRI parameter in determining road construction conditions, which are divided into 4 groups.

Table 10.
Determination of toll road handling conditions and needs

Condition Jan	IRI (m/km)	Pen Needs Nganan
Good	IRI average < 4.5	Maintenance
Keep	4.5 < IRI average < 8.0	Maintenance
Broken	8.0 < IRI average < 12	Increased Rod
Heavily Daged	IRI average > 12	Increased Jaan

In maintaining that road sections can still meet Minimum Service Standards (SPM), namely with IRI < 4 m / Km in accordance with the Minister of Public Works Regulation No. 392 / PRT / M / 2005. Therefore, activities in maintaining SPM are carried out routine maintenance programs every year and periodic maintenance every certain periods (3 years, 5th, 8 years and 10 years).

K. Tool Road Feasibility Study Evalution

There are several economic and financial feasibility evaluation indicators commonly used by analysts in assessing whether a project is healthy or not economically or financially, which include indicators as follows:

1. NPV (Net Present Value)

NPV is the difference between expenses and income calculated by the Present Value (PV) using a minimum discount factor of Minimum Acceptable Rate of Return (MARR), or in other words is the expected cash flow in the future calculated by the current PV (Present Value). To calculate NPV, data on estimated costs incurred are required which include investment costs, operating and maintenance costs as well as estimated benefits / benefits of planned and projected projects in cash flows multiplied by the Discount factor with the interest rate in accordance with MARR. The formulation of the Discount factor is:

Where:

Df= Discount factor.

r= Interest rate (%).

n= Year.

NPV = Net Present Value.

ΣPV income = Present Value of income i.e., the multiplication of the income component in the cash flow multiplied by Discount factor (Df).

ΣPV expenditure = Present Value of expenditure i.e., the component of expenditure in cash flow multiplied by the Discount factor (Df). Regarding the investment (capital) to be invested, guidelines are needed to be able to wisely assess the investment, and these guidelines can be used as a guide.

The difference between the present value of cash inflows and of NPV cash outflows is used in capital budgeting to analyze the profitability of an investment or project by taking into account the value of money in relation to time (TVM). In general, Time Value of Money (TVM) is taken by measuring commercial interest rates at banks and used by investors as MARR. NPV analysis is sensitive to the reliability of future cash flows that an investment or project will yield.

Formula:

If NPV = 0 means, the total amount of Present Value (PV) of income is equal to the total amount of Present Value (PV) of expenditure which means also in the condition NPV = 0 is where obtained on the Discount factor with a certain interest rate (r) called the Internal Rate of Return

(IRR). Rate (r) is expected to be greater than MARR. In the table below, it is shown the meaning of NPV calculation on investment decisions to be made.

Table 12.
NPV calculation of investment decisions.

If	Mean	So
NPV > 0 At *r* =MARR	The investment made provides benefits for the company.	The project can be run.
NPV < 0 At *r* = MARR	The investment made will result in losses for the company.	The project was rejected.
NPV = 0 At *r* = MARR	The investment made does not cause the company to profit or lose.	If the project is implemented or not implemented, it has no effect on the company's finances. Decisions should be made using other criteria such as the impact of investment on the company's positioning.

2. IRR (Internal Rate Of Return)

Internal Rate of Return or abbreviated IRR is an indicator of the level of efficiency of an investment. A project investment can be made if the rate of return is greater than the rate of return when compared to investing elsewhere (interest on bank deposits, mutual funds and others). IRR is used in determining whether an investment is carried out or not, for that it is usually used as a reference that the IRR obtained from investment activities must be higher than the Minimum Acceptable Rate of Return or Minimum Attractive Rate of Return (MARR), where MARR is the minimum rate of return of an investment that an investor dares to make.

IRR is defined as the discount rate value that makes the project's NPV = 0. This means that profits are equal to the costs incurred. To calculate IRR can be done by trial and error (trail and error) entering several interest rates (rate) until NPV = 0 is obtained. There are two ways to get the IRR value through a graphical calculation approach, namely Interpolation if 2 NPVs of trial results are marked unequal (positive and negative), and Extrapolation if 2 NPVs of trial results are marked equally.

The calculation of this approach will be appropriate if the function is a straight-line equation, but in the case of interpolation and extrapolation to find the IRR this is a rank-of-rank function that forms a curved line so that in sampling the interest rate (r) is carried out at intervals as close as possible and obtained NPV close to zero, so that the deviation of the interpolation and extrapolation approaches is not too far away.

Cara Interpolasi, dalam proses uji coba dengan r1 diperoleh NPV 1 (positif) dan dengan r2 diperoleh NPV2 (negatif).

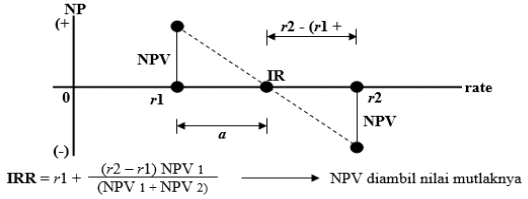

Figure 1. Graphical calculation of the way of interpolation.

Extrapolation method, in the trial process with r1 obtained NPV 1 (positive) and with r2 obtained NPV2 (positive).

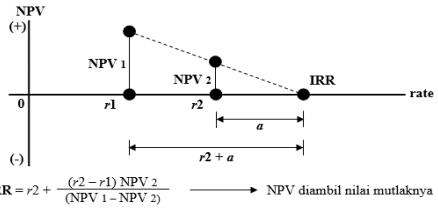

Figure 2. Graphical calculation of extrapolated ways.

The conditions used as a measure in decision making are:
IfIRR≥ MARR then the project "Feasible".
If IRR < MARR then the project is "Not Feasible".
If IRR= MARR then "Impas".

3. PP (Payback Period)

Payback Period is, the number of years it takes to return the investment that has been spent. Investors certainly want a payback period that is as short as possible, especially when associated with the risk of business uncertainty that always exists in the future. How to calculate Payback Period (n), is:

$$\Sigma \text{ Acceptance} - \Sigma \text{ Expense} = 0$$

The formula means in what year (n years) an investment where the amount of receipts is able to cover the amount of expenses. The criterion for decision making is to look at the value of the Payback Period with the shortest span of years.

L. Risk sensitivity and analysis

Sensitivity analysis is carried out to determine the extent of investment sensitivity to changes in several variables. The results of this sensitivity analysis can be a consideration for making investment decisions in which the level of risk that may occur can be known. In the case of this toll road feasibility study, an analysis of the sensitivity of the IRR value will be carried out to changes in toll road investment variables that may occur, including initial investment costs, traffic volume and bank interest, obtained from several calculation scenarios.

M. Result of Economic and Financial Feasibility Analysis

Financial feasibility as a benefit is calculated from toll road operating income while economic feasibility (EIRR) as an element of benefit is calculated from BKOK (Vehicle Operating

Benefit Cost) both on toll roads and on arterial roads after toll roads. Investment time schedule and assumptions used.

Table 13
Investment Schedule

No	Description	Design Period			Construction Period			Operating Period	
		2021	2022	2023	2024	2030	2031	2040	2063
1	Initial investment								
	Construction								
2	Overlay								
3	Line Addition								

Table 14
Assumptions used

No.	Description	Magnitude (%)
1	Loan Interest	10%
2	Inflation Rate	5%
3	Composition : Own Capital	30%
	Loan	70%
4	Loan Term (Th)	20
5	Tariff increase every 2 th	6%

From the calculation of economic feasibility, the Economic Internal Rate of Return (EIRR) is 17.87% > ID Govt 10Y Yield in 2021 (6.75%), Net Present Value (NPV) of Rp. 27,874,162 (million) > 0, B/C Ratio of 2.78 > 1. In the next financial feasibility calculation with additional operating fund loans, the Financial Internal Rate of Return (FIRR) of 13.63% was obtained, the FIRR was above the assumption of a commercial interest rate of 10%, B/C ratio of 1.58 >1, Net Present Value (NPV) of Rp. 3,594,555. (Million) And NPV (ID Govt 10Y Yield in 2021, 6.75%) of Rp. 11,308,982. (Million), Payback Period 7.92 years. And the total operational loan for 11 years is Rp. 5.29 trillion.

CONCLUSION

Based on the results of the evaluation of the financial and economic feasibility of this toll road plan, it is considered economically feasible but not financially feasible without additional operational funds, where EIRR 17.87%, NPV (MARR 6.75%) = 27,874,162, and FIRR 9.96% < MARR 10%, NPV Rp. – 51,937 (negative), B/C ratio 0.99 < 1. Because this toll road is needed to support the development of an independent city, where good and easy and fast access is needed and arterial road conditions do not allow it to accommodate traffic volume in the future, this toll road must be built with the support of operational loan funds. So in the next feasibility calculation with additional operational fund loans, this toll road is financially feasible FIRR 13.63%, the FIRR is above the assumption of a commercial interest rate of 10%, B/C ratio of 1.58 >1, NPV of Rp.

3,594,555. (Million) And NPV -ID Govt 10Y Yield in 2021 (6.75%) of Rp. 11,308,982. (Million), Payback Period 7.92 years. And the total operational loan for 11 years is Rp. 5.29 trillion.

Based on the results of sensitivity analysis that of the variables reviewed and the variables that have the greatest influence on the amount of Financial IRR (FIRR) are the initial cost of construction, then the variable volume of traffic and variable interest on loans from banks. From the calculation of variable traffic volume and investment costs have a major effect on the amount of operating loans, where an increase in construction costs of 5% will result in an increase in operating loans by 23%, and a decrease in traffic volume of 5% will increase operating loans by 26%. Plans or programs for development and development in the area that will be supported by this toll road must be consistent so that high traffic generation and growth can immediately be formed.

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