AN ECONOMIC ANALYSIS OF ARTERIAL ROAD PROJECT IN INDONESIA: A CASE STUDY

By

DARSONO, Dody

THESIS

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

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ABSTRACT

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Over the last decade Indonesia has been facing a lack of Infrastructures development. The rapid growth of population, increasing vehicle ownership, and increasing traffic has created the negative externalities such as: air pollution, road noise, congestion and accidents. It has been argued that infrastructure projects provide a great opportunity for economic growth and development on a regional or national basis. It provides people with to access to workplace, social and education services. The Asia Development Bank guidance mentioned the importance of the decision making on road transport development by the integration of the total costs including negative externalities. The decision maker has been aware of the necessity of an economic analysis or evaluation on road investment project. This thesis will examine one case study on road investment project in East Java, Indonesia. This study will present the economic evaluation of road project, using costs and benefits analysis to Indonesian context. Our result shows that compared to existing road, the using alternative road gives better system condition, reduce maintenance cost, accident, travel time saving, more overall net benefit from economic viewpoint, and this project is economically viable. The government of Indonesia should adopt such economic analysis for investment in the road sector and other infrastructure.

Key words:

Road Project, net present value (NPV), internal rate of return (IRR), cost benefit analysis, appraisal methodology, environmental impact

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This work is gratefully dedicated to:

Memory of My Mother: your sincere care was beyond any measures,

The My Father: your memory will not be forgotten,

My Sisters: your trust is unbelievable, My Wife: your support is incredible,

And My Son: your love is fantastic

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ABBREVIATIONS

CBA----Cost Benefit Analysis

ERR-----Economic Rate of Return

IRR-----Internal Rate of Return

MOT------Ministry of Transportation

MPWH---Ministry of Public Work and Housing

NPV----Net Present Value

PB------Payback Method

SI------ Sensitivity Analysis

SV------ Switching Value

Chapter one

I.1.Background

This study is to carry out an economic analysis of road project and find the most efficient alternatives. The present study is going to quantify benefit of the road project comparing to the project investment cost, to evaluate the economic viability of the project.

As developing country Indonesia has a long list of investment needs in the road sector. However, technical issue such as budget constraints and acquiring land are the main problem in the road sector. Investment in road sector is very important to support regional economic and social development. Government and people in Indonesia are eager to improve the living standards of the people. For this Indonesia needs to make investment in infrastructure, especially in the road sector. However, the Government does not use a rational and systematic method of analysing and comparing the economic viability of competing project alternatives.

In response to these problem, many cities and national government began implementing project to improve road network and mobility efficiencies. Lesson from the cost and benefit Road transport infrastructure is crucial also a key to promote economic growth and development. The main reason is relying on the simple logic road transport can be as access to markets. This belief based on the observation and historical evidence from the infrastructure construction in Europe, Japan and the United States, where railroad is considered as main infrastructure for mobility of goods and people during the period of economic growth.

Nowadays, many policymakers are concerned about the distributional effects of development infrastructure, which obvious investment for road transport infrastructure increases the access from rural regions to cities. There is some benefit in road infrastructure development such as transportation has a direct influence on the general price levels in the economic, good road infrastructure network contributes to poverty reduction.

Generally, road infrastructure is the responsibility of the public sector, and majority of road projects are set up by public services. Transport infrastructure impacts on both transport users and nonusers. It is therefore necessary for the eminence of transport proposals to be evaluated by their potential effect on all members of society and not only on transport users. This implies that project road transport investment should also be studied.

Indonesia as developing country are facing problem due lack of capability in providing road infrastructure, many road transports were built during the 80 to90's when the road network expanded in rapidly. However, having an infrastructure asset does not only mean a large capital investment but also requires ongoing operation, maintenance, upgrading and disposal. These roads network are approaching the end of their service lives and will require necessary actions to continue the function and economical for society. Decisions taken in planning and design of infrastructure will impact users and management for many decades and generations after construction. To solve these problems, the government should adopt an economic analysis framework for selecting the most efficient and viable project proposal among many alternatives. One of economic analysis methods used by many advanced countries is the cost-benefit analysis and investment criteria. So, this thesis will demonstrate how to apply this method in the road sector in Indonesia.

In the present study, we have two investment alternatives: One is to use the existing road with good maintenance. The other is develop a new arterial road from Siring to Porong, which has a very important role for the development of the nation and the region. The objective of development arterial road project is to enhance transportation capacity, increasing efficiency, and safety of passenger also cargo mobility.

To test the road project economic viability, this study will conduct a cost benefit analysis by computing the net present value (NPV), internal rate of return (IRR), and benefit cost ratio (B/C). Additionally, to check the uncertainty and sustainability of the project, the sensitivity and the environmental degradation test also conducted.

1.2. Organization of the study.

The study is organized as follows: chapter one briefly explains about motivation of the study and introduction; chapter two give the theoretical and empirical literature reviews from text book, journal; Chapter three provides data and methodology of the study and overview of road infrastructure and economic development in Indonesia, while in chapter four presents results and findings of the study. Finally, chapter five conclusion and policy recommendation

Chapter two

Literature review

2.1 Project Evaluation

The decision-making process for project investment has a long history. However, there is no universal method that is collectively agreed upon. In general, there are many differences decision making tool that can be applied in project evaluation, for example a Cost Benefit Analysis (CBA), Economic Impact Assessment (EIA) and Cost Effectiveness Analysis (CEA). The common method for project assessment is using CBA, which sometime this method to be used together with MCA (Multi-Criteria Analysis). Increasing number of study demonstrated that CBA has been largest tools for infrastructure project evaluation. As can be seen in fig 2.1 for road projects, the CBA is not the only method for appraisal but also definitely the most widely used, in some cases this method combined with MCA or other quantitative method.

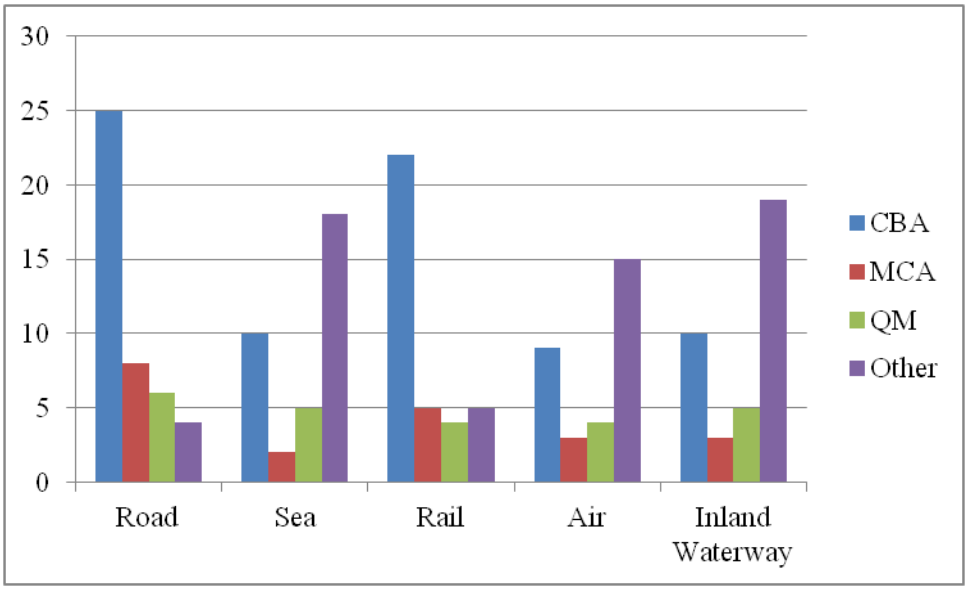


Fig. 1. Methodology used for transport project appraisal in EU.

CBA: cost–benefit analysis; MCA: multi-criteria analysis; QM: quantitative measurements; Other: other combination of appraisal method, mainly qualitative. If (for example) both CBA and MCA are used, the figure reflects CBA. (source)

However, the utilized of CBA does not mean that the countries do the same things in the same way. There is some suggestion in CBA guidance especially for infrastructure project, but there is no strict regulation, as a result, many countries implemented different benefits. As Tab. 1 shows, the differences are not rare.

Table 1. Project Evaluation method for transportation systems in several countries

	United Kingdom	**France**	**Japan**	**USA**	**Germany**	**Indonesia**
Method criterion	CBA (COBA, NATA)	CBA	CBA with MCA	CBA(MCA)	CBA	CBA
Parameter/ Scope impact	Maintenance costs, vehicle operating costs, time savings, safety (environmental without explicit costs)	Vehicle operating costs, time savings, safety, noise, air pollution (local and global)	Time and costs savings, safety, (additionally regional impacts, global and local environment impacts, living standards, back up function for emergencies)	Time and costs savings, safety, induced demand, environmental pollution and noise	Maintenance costs, Operating costs, vehicle operating costs, time savings, safety, noise, air pollution – local, severance, economic development, employment, international traffic, regional policy	Travel and operating costs, travel time, safety,

Generally, there are four common criteria were used and monetized in the large-scale transport infrastructure projects appraisal such as: saving travel time, maintenance and operating costs, safety, environmental costs.

For most developing countries, road is primary mode of transportation system. High dependency on road sector, which caused high investment on road sector. However, the common problem that occurred is caused by an insufficient budget. Consequently, the road improvement project is essential and also main priority program of government of Indonesia for connectivity, since it would drive economic activity.

Table 2. Growth of road infrastructure at national, provincial and country level (source: Soehodo, 2016)

Year	**Length of road (km)**				**Growth**
	National	Province	Local	Total	**(%)**
2010	38570	53291	395453	487314	
2011	38570	53642	404395	496607	1.191%
2012	38570	53642	411972	504184	1.53%
2013	38570	53872	414305	506747	0.51%

For many years the road network infrastructure in Indonesia is very slow, and some cities has showed poor road network maintenance. These conditions generate not only traffic congestion but also higher number of traffic accident. Table 2 Growth of road infrastructure at national, provincial and country level. Another problem that occurs due to poor road condition and substandard public transportation services is increases in traffic. The most common form of public transportation in most Indonesian cities is the buses, whose systems range from small to large in size. However, railway and waterway give smaller proportion. The

dependency on road based transport mode have made traffic situation worse due to poor traffic performance and safety. Table 3 provides some figures on the modal shares for passengers and freight.

Fundamental reasoning behind this study is provided deep insight to evaluate transport road project. The main purpose of evaluating road project investment is to select the project with high economic returns. From the economic perspective, usually project evaluation is determined how much to invest and economic returns to expect. The amount of investment is determined by the cost (construction and maintenance) and the economic return can be obtained from of saving in road user (operational cost, time saving).

Table 3. Growth of transportation modes in Indonesia

Year	Passenger Vehicle (units)	Bus (units)	Truck (units)	Motor bike (units)	Total (units)	Growth (all vehicle)
2004	4,231,901	933,251	2,315,781	23,061,021	30,541,954	14.8%
2005	5,076,230	1,110,255	2,875,116	28,531,831	37,623,432	23.2%
2006	6,035,291	1,350,047	3,398,956	32,528,758	43,313,052	15.1%
2007	6,877,229	1,736,087	4,234,236	41,955,128	54,802,680	26.5%
2008	7,489,852	2,059,187	4,452,343	41,955,128	61,685,063	12.6%
2009	7,910,407	2,160,973	4,452,343	52,767,093	67,336,644	9.2%
2010	8,891,041	2,250,109	4,687,789	61,078,188	76,907,127	14.2%
2011	9,548,866	2,254,406	4,958,738	68,839,341	85,601,351	11.3%
2012	10,432,259	2,273,821	5,286,061	76,381,183	94,373,324	10.2%
2013	11,484,514	2,286,309	5,615,494	41,955,128	104,118,969	10.3%

2.2. Road Project Appraisal

The primary objective of road project appraisal is to calculate the costs such as: road construction, maintenance and user costs for a specified period of time. The project appraisal can be used to assist decision maker in the selection of appropriate design and maintenance standards which minimize the total transport cost. When proposed project investments are made, all cost must also be measured at particular point: i.e, at the intial investment time. Also, all financial costs and benefit must be converted into economic cost and benefit by using shadow exchange rate factor or conversion factor since economic analysis must use the shadow prices, instead of market prices which are used in financial analysis. This is because the market prices are often distorted from the perfectly competitive market prices, which will maximize social welfare of the total economy.

Some of the commonly used methods for evaluating investments in road infrastructure development are the Net Present Value Method (NPV), Internal Rate of Return (IRR), and the Payback Method (PB).

2.2.1. Net Present Value (NPV)

The Net Present Value (NPV) is can be defined as the difference between the discounted benefits and costs of a project). Brealey & Myers cited by Amamoo (2000) define NPV as a project's net contribution to wealth and that is, present values minus initial investment. The calculation result of the net present value can be positive, then project will be accepted; however, if the result is negative, it should be rejected. If the projects under consideration are mutually exclusive the one with the highest net present value should be chosen. Method According to Francis (1992), proposed that the

discounted cash flow should involves calculating the sum of the present values of all cash flows associated with a project.

$$NPV = \sum \frac{B_t}{(1+i)^t} - \sum \frac{C_t}{(1+i)^t}$$

Where

B_t, C_t : Benefit and Cost in year t of the project

i: Discount rate

Conclusion:

If NPV> 0, The project is economically viable

If NPV= 0, remain indifferent to the investment;

If NPV <0, the project is not economically viable

2.2.2 Internal Rate of Return (IRR)

The IRR of a project is defined as the discount rate at which the present value of costs equals the present value of benefits i.e. when NPV is zero. According to Francis (1992), the IRR (sometimes referred to as the "yield") of a project is the value of the discount factor that gives an NPV of zero. Projects with higher IRR values are generally preferred as this will give positive NPV at high discount rates. In general, the calculated IRR should be greater than the standard discount rate used to assess government funded projects. Where the IRR is used to assess projects, the decision rule is that only projects with an IRR above a predetermined hurdle rate would be accepted: where projects are

competing, the project with the higher IRR is selected. According to Wood (1990), in the majority of cases both the NPV and the IRR methods give the same results.

$$\sum_{t=0}^{n} \frac{B_{t-}C_t}{(1+i)^t} = 0$$

2.2.3 Payback (PB)

Payback is concept where the project is able to pay back the original investment. Projects are normally selected on the basis that they will be able to pay back the original investment within a predetermined period. The PB can take the form of a simple payback method which does not consider the time value of money. A discounted payback method on the other hand considers the time value of money. Future cash flows are discounted and compared with the initial investment before arriving at the relevant payback period. Payback is often used as a first screening method.

Payback period= Number of years to recover investment

2.3 Costs-Benefit Analysis (CBA)

This is a general approach to appraise project proposals by comparing total expected benefits and costs of the project. This approach includes three or four investment decision criteria: IRR, NPV, C-B ratio, and Payback period. These investment decision criteria are all belong to CBA.

The Cost-benefit Analysis is a method refers to a process which involves, weighing the total expected costs against the total expected benefits of one or more actions in order to choose the best or most viable option. Park (2002), explained cost benefit analysis " a decision making tool used to develop systematically useful information about desirable and

undesirable effect of public project", He also defines three type of benefit cost analysis problems:

1. Maximizing the benefit for any given set of cost
2. Maximizing the net benefit when both benefit and cost vary
3. Minimizing cost to obtain any given of benefit

Cost Benefit Analysis is typically used public sector to evaluate in order to achieve at a current state of social welfare. According to Anthony E. Boardman et al., (2011) "Cost-benefit analysis is a policy assessment method that quantifies in monetary terms the value of all policy consequences to all members of society.

The net social benefits measure the value of the policy. Social benefits (B) minus social costs (C) equal net social benefits (NSB): NSB = B - C".

Anthony E. Boardman et al., (2011) define the following major steps of CBA:

1. Select the set of alternative projects to achieve a set objective.

2. Decide whose benefits and cost count (standing)

3. Catalogue the impacts and select measurement indicators (unit)

4. Making prediction the impacts quantitatively over the life of the project

5. Monetize (attach dollar values to) all impacts

6. Discount benefits and cost to obtain present values

7. Calculate the net present value (NPV) of each alternative

8. Check sensitivity analysis

9. Recommendation based on the NPV and sensitivity

Benefit and cost ratio can be calculated using equation below

$$BCR = \frac{\sum_{t=0}^{n} \frac{B_t}{(1+i)^t}}{\sum_{t=0}^{n} \frac{C_t}{(1+i)^t}}$$

Where

B_t = Benefit at the end of period n, $B_t \geq 0$;

C_t= Expense at the end of the period n, $C_t \geq 0$;

N= Project life

I = Interest rate

2.4 Sensitivity Analysis

The final stage in calculation of Cost Benefit Analysis is evaluating a sensitivity analysis. Hanley and Splash (1993) suggested, the analysis should make prediction [which] concerning in future relative value. This method introduces a process of varying input parameters of a model within allowed area and observing the resulting changes in the model solution. The reason why sensitivity analysis should be conducted is because it is an important method for testing the quality of a given model, and it is also used for checking the reliability of the analysis. The following parameter are usually changed:

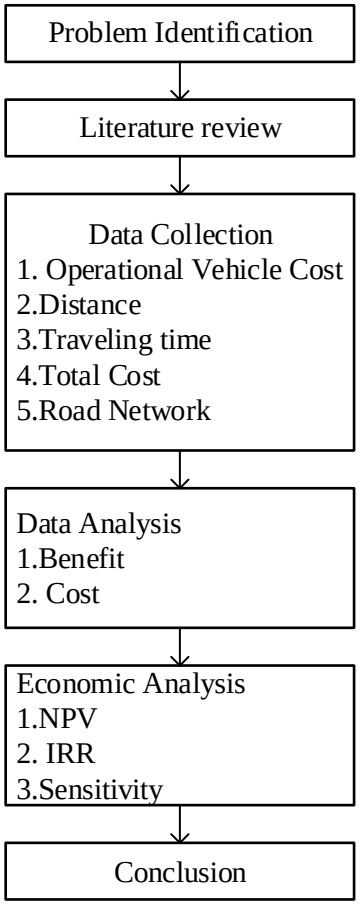
- The discount rate;
- Physical input (quantities and quality)
- Shadow Prices (input and output)
- Physical output (quantities and quality)
- Project period

Chapter 3

Methodology and Data

3.1. Research Framework

Cost benefit analysis (CBA) is one economic method to evaluate cost and benefit of the project or investment. Normally this process or procedure is conducted before project implemented or chosen. In Indonesia, road transport is public facility and provided by local and central governments, this analysis is therefore partly observed using primary and secondary data. Since the main objective of CBA is to evaluate alternative road the projects are is viable or not. As noted earlier to answer the research question, and we proposed simply a flow chart as framework research methodology figure 3.1.



3.2 Project Background

In 2006, a catastrophic disaster occurred in Sidorajo City, 35 Kilometres southern part of Surabaya City, the second largest city in Indonesia. The Surabaya City is the next largest city after Jakarta in Indonesia and the capital of East Java Province with a population over 3 million. A hot mud has been gushing forming the ground. Infrastructure has been damaged extensively, including national arterial roads, electric power transmission systems, and toll road. The highway from Surabaya to Gempol was blocked, while the main road along Porong is occasionally flooded by the mud. This condition affects traffic from Pasuruan to Surabaya and back. Therefore, the central government decided to build new arterial road in order reduce traffic congestion from Pasuruan to Surabaya. Pasuruan city is located in south east of Surabaya, the place where industrial complex is located and the city is playing roles important in economic activities. There are many industrial complexes (Argo industry, chemical factory, small and medium industry). High traffic occurred due to the need for mobility of cargos and passenger especially company worker.

FIGURE 1 *Map of Mudflow Area and Surrounding Region*

Figure 3.2 Map of mudflow in Sidoarjo

3.3 Data Collection

3.3.1 Traffic Data

Traffic demand in main road from Pasuruan to Surabaya rapidly increased over the last decade, this problem causing level of significant economic loss due to traffic congestion, traffic accident, noise and air pollution. To calculate CBA, there is several variables such as traffic volume and traffic accident are needed. The traffic volume data was collected at the two-point location. Data on speed and travel time of vehicles are essential for design and operation of streets. There three classifications of vehicles: car, mini bus and truck. Public transport ridership and motorcycle is classified as Low Vehicle. Moreover, traffic accidents were collected from local government and local police department.

3.3.2. Travel demand forecasting

In our study, travel demand forecasting plays a crucial role in the preparation of the economic analysis, since the result feed directly into calculation such as cost, benefit, and environmental assessment. The accuracy of travel demand forecasting has been studied by many researchers. In this section, the process to calculate travel demand is obtained by using primary and secondary data from the report of the ministry of transportation. We calculated traffic volume and average speed. The summary table travel demand forecasting is displayed in appendix B.

3.3.3. Cost

The cost or investment such as operational cost and vehicle maintenance costs were collected for local transport administration and national statistic agencies. We use data from Ministry Public Work and Housing to calculate specification, bill of material and quantity for construction cost, land acquisition.

Figure 3.2. Lapindo Mudflow and existing road

Table 3.1 Show the project summary, comparison existing road without project and alternative road with project, this [projects] situation with and without project using time horizon in our scenario 33 years of project period including a construction period of 2 years.

3.3.4. Benefit

The purpose of the project was, as explained before, increasing demand for efficiency in mobility of goods and people has been increase traffic volume, which might not be enough to be accommodated to the current road capacity. A new road will relieve the pressure on traffic, travel time will reduce, and in terms of travel the new road will apply new safety technology, which it means will saver more lives and will make the area around the road more environmentally friendly. Four types of benefit were taken into account: saving in travel time, saving in accident cost, and saving vehicle operation cost and saving from recurrent cost.

Table 3.1 Summary research project

	Existing Road (Without Project)	**Alternative Road (With Project)**
Project description	Total Length: 10 Km, width:12 m, Two- way each 2- Lane	Total Length: 7,5 km width: 12 m, Two- way each 2- Lane
Traffic Demand Forecasting	Normal traffic	No generated traffic
		Some Diverted traffic
Costs	Maintenance costs Vehicle operating costs Traveling time cost Accident cost	Construction Costs Maintenance costs Vehicle operating costs Traveling Time cost Accident costs
Benefits		Savings in Traveling Time Savings in Vehicle operating cost Savings in Accidents
time horizon	Construction: 0 years Operation: 31 years Total 33 years (from year 2015 to 2047)	Construction: 2 years Operation: 31 years Total: 33 years (from year 2015 to 2047)

The additional variables that are considered are summarized in following table

- Shadow Exchange Rate Factor (SERF) = Shadow ER/Official ER =0.5595
- Conversion Factor = 1/ SERF (use two digits below decimal point with rounded off) = 1.79
- Official ER per $= Rp10,390
- PPP(GDP) conversion factor per $ = Rp5,814 (a proxy for Shadow ER)
- Internal transport & handling: 10% of Border Price equivalents
- Calculate all costs and benefits at the project site based on border prices in constant 2014 prices

- All data come from World Bank’s Development Indicators (for Indonesia)

Figure 3.3. Yellow dashed line new arterial road

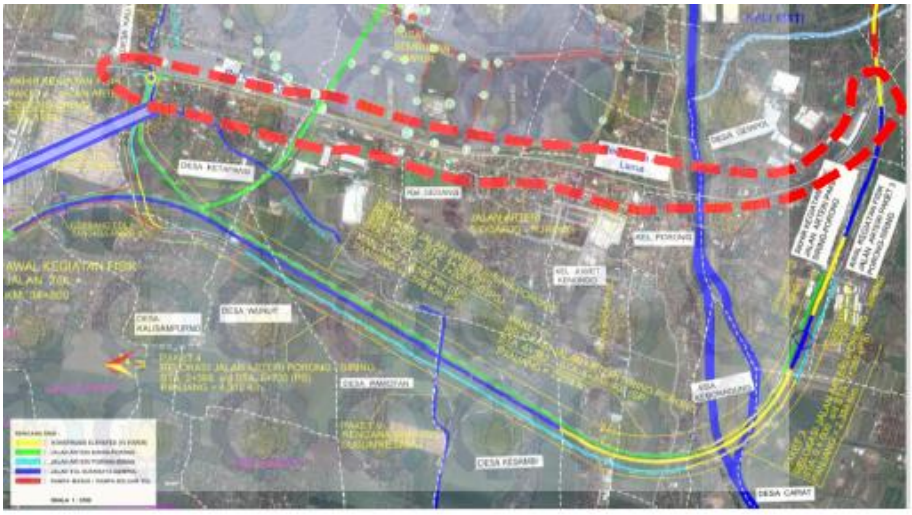


Figure 3.4. Red dashed line existing road

Chapter four

Result and Discussion

4.1 Cost and Benefit Summary

In this section, we present the result of economic analysis for the project. There are three steps to conducted economic analysis of road project, firstly we estimate the cost, which is consisting capital and recurrent cost, Financial cost were converted into economic cost and adjusted to the local market basis, which was again converted into the border price equivalent, using conversion factor of 1.79. Secondly, we estimate the benefit, four types of benefit are computed in this analysis which are travel time saving, vehicle operational cost saving, saving accident cost and saving in recurrent cost. Lastly, compare the cost and benefits of two project.

The capital cost consists of civil work and labour which contain 100% local component, for equipment we assume for foreign procurement component around 60%, moreover for material are estimated 20% foreign component, since majority fine aggregate, cement and sand is supplied by local companies. fuel usage is estimated 30 % foreign components. The annual maintenance for the road is estimated 97 million rupiah/km, increasing 5% per annum in real term. Major repairs are assumed every 7 years at five times the cost of regular (annual maintenance).

The benefit of road project component are expressed in 1 January 2015 prices and comprise vehicle operation cost (VOC), travel time saving and road safety benefit. The VOC with and without are computing for each vehicle type using average speed and volume

capacity from travel demand forecasting model. The saving in accident cost are based on the accident rate than obtained from Police department during period 2010-2013.

Table 4.1. Comparison the economic viability of the road project

(Unit: Rupiah billion in January 1, 2015 prices)

Item		Financial Analysis			Economic Analysis		Present Value (with project)
		Without Project	With project	Local Component (%)	Existing Road (Without Project)	New arterial road (With Project)	
A. Civil Works							
	Labour		7.124.	100		12.752	6.742
	Equipment		10.686.	40		14.063	10.113
	Material		14.248.	80		23.253	13.484
	Fuel		3.562.	30		4.406	3.371
	Land Acquisition		81.225	100		0	0
Total Civil Works						54.473	33.711
B. Recurrent cost	Routine Maintenance	7.425.	5.382	80	12.117	8.784	625
	Reseal	17.900.	14.320.	80	29.212	23.370	504
Total Recurrent		25.335	19.702			32.154	1.130
Total Cost (A+B)		25.325	100.927		41.330	86.628	34.841
Benefit	Saving Time	0	39.347	100	0	70.432	6.239
	Saving VOC	7.728	495.727	100	0	887.352	79.002
	Saving Accident	33.370	14.924	100	0	26.714	2.383
	Saving in Recurrent Cost				0	6.610	3.692
Total Benefit					0	991.108	89.072
Net Benefit					-41.330	904.480	54.230
NPV					-4.067	70.337	4.643
EIRR (%)					-8,12	26,79	13,49
Benefit Cost Ratio						11,44	2,56
Discount rate	12%						
CF	1.79						

The main finding about economic analysis, the net present value from existing road is estimated with total -4.067 Billion Rupiah, however for the alternative or proposed projectt the NPV value is higher 70.337 Billion Rupiah. It means that investment for proposed project is more economically viable. The second the internal rate of return also computed, the result show that the IRR for alternative project is 13,49 %, which is higher than existing road. This value can be explained as an indication that society would obtain 13,49 Rupiah for each 100 Rupiah invested in the project for over period of 33 years. In short, the IRR for alternative project is higher than discounted rate of 12 %, it means the project is economically viable. Moreover, the net present value after discounted for 33 years is obtained 4.643 with IRR 13.49%

Finally, the benefit cost ratio for proposed project is greater than 0. Therefore, the alternative project is preferable. Further, according to the Asian Development Bank use discounted rate between 10-12%, it means that alternative project is acceptable based on the benefit and cost ratio criterion.

4.2. Sensitivity and Risk Analysis

The sensitivity analysis conducted in this study is based on comparison between existing project and the alternative. The table 4.2 shows the varying specific test benefit and cost factor. The result the sensitivity analysis with different combination variable by modifying between +/- 10 %. The sensitivity test result indicate that the project is highly like economically viable even the substantial cost overruns or benefit shortfall. Overall Since the lowest IRR is above the 12% acceptable rate of return, this gives some confidence that the project is robust to the demand risk identified. This means that the project is a bit sensitive to the changes in the savings of vehicle operating cost, and during the project implementation

stage, the project entity should pay more attention to the savings in time travel. this project reflects that in the long term new arterial road would properly to user, since can saving more and less spending in vehicle operational cost.

Table 4.2 Sensitivity and Risk Analysis Result

(Unit: Rupiah billion)

Item	**Change (%)**	**NPV (Rp billion)**	**IRR (%)**	**Sensitivity Indicator**	**Switching Value (%)**
Base Case		4.788	13,49		
Cost					
Routine maintenance	+10	4,758	13,48	8,553	11,69
Benefit					
Saving in Travel Time	-10	4.528	13,36	5,642	17,72
Savings in Vehicle Operational Cost	-10	1.478	11,79	0,697	143,41
Savings in Accident Cost	-10	4,688	13,44	5,646	17,71
Savings in Recurrent cost	-10	4.562	13,37	5,311	18,83

From the table above shows that when costs increase 10% , the IRR and NVP declines, but in no case the IRR is below 12%, the discount rate, except for the savings in vehicle operating cost, which has to be monitored continuously during project implementation.

Likewise, when the benefits decrease 10%, in no case the IRR is below 12%, the opportunity cost of capital. Therefore, the proposed project is economically viable with little risk.

Chapter five

Conclusion

To sum up, in road project evaluation with principles cost benefit analysis, the new arterial road or alternative project is to be considered as positive scenarios (see sensitivity analysis). There benefits related to vehicle operational cost, time travel saving usually constitute a large share of the total benefits in such projects, and, the accident cost saving also considerable on this project. The people or user will get benefit from these time savings. However, some of input value is not proper for decision making due to robustness of input data. This is particularly relevant for the cost calculations, but, also for the assumptions regarding traffic, number of vehicle. The observation traffic analysis is very important.

This research concentrated on identifying viability of road project, from the scenario the new arterial road is most promising, higher capacity to cover traffic flow. This method of cost benefit analysis has been successfully demonstrating new project road which playing a crucial role in improving social welfare in the region and enabling the city to achieve economic growth and development. Furthermore, this appraisal will help local and central government to estimate cost saving, and efficiency in another future similar project.

The Indonesian government should make it a standard practice that an economic analysis of infrastructure investment project or program be made when a new investment is proposed for allocation of budgetary resources.

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APPENDIX

A. Travel Demand Forecasting

Vehicle trip/year

Year	Without Project	With Project
2015	2.066.131	1.291.332
2016	2.121.484	1.359.962
2017	2.176.618	1.428.591
2018	2.233.207	1.497.220
2019	2.291.289	1.565.850
2020	2.350.904	1.634.479
2021	2.412.092	1.703.109
2022	2.474.897	1.771.738
2023	2.539.360	1.840.367
2024	2.605.527	1.908.997
2025	2.673.442	1.977.626
2026	2.743.154	2.046.255
2027	2.814.709	2.114.885
2028	2.888.157	2.183.514
2029	2.963.548	2.252.143
2030	3.040.935	2.310.773
2031	3.120.372	2.389.402
2032	3.201.912	2.458.031
2033	3.285.613	2.526.616
2034	3.371.532	2.595.290
2035	3.459.729	2.663.919
2036	3.550.264	2.733.834

2037	3.643.201	2.805.588
2038	3.738.604	2.879.230
2039	3.836.538	2.954.808
2040	3.937.073	3.032.374
2041	4.040.277	3.111.981
2042	4.146.223	3.193.681
2043	4.254.983	3.277.531
2044	4.366.634	3.363.587
2045	4.481.253	3.451.907

B. With project cash flow
January 1, 2015 (Unit: million Rp.)

Item		Financial Price With Project	Local Component (%)	Economic Price	Present Value	1	2
A.Civil Works							
	Labour	7.124.000.000	100	12.751.960.000	6.742.357.143	3.562.000.000	3.180.357.143
	Equipment	10.686.000.000	40	14.062.776.000	10.113.535.714	4.770.535.714	5.343.000.000
	Material	14.248.000.000	80	23.252.736.000	13.484.714.286	6.360.714.286	7.124.000.000
	Fuel	3.562.000.000	30	4.406.194.000	3.371.178.571	1.590.178.571	1.781.000.000
	Land Acquisition	8.122.500.000	0				
Total Civil Works				54.473.666.000	33.711.785.714	16.283.428.571	17.428.357.143
B.Recurrent Cost							
	Routine Maintenance	5.382.530.000	80	8.784.288.960	625.194.206		
	Reseal	14.320.000.000	80	23.370.240.000	504.977.281		
Total Operating Cost		19.702.530.000		32.154.528.960	1.130.171.487	0	0
Total Cost	A+B	19.702.530.000		86.628.194.960	34.841.957.201	16.283.428.571	17.428.357.143
C.Project Benefits							
	Saving Travel Time	6.239.531.025	100	70.432.116.728	6.239.531.025		
	Saving Vehicle Operatinal	78.351.195.681	100	887.352.108.442	78.351.195.681	124.361.381	111.036.948
	Saving Accident	1.461.532.422	100	26.714.029.292	789.235.197	355.175.893	317.121.333
	Saving Recurrent cost	3.692.816.655	100	6.610.141.812	3.692.816.655	446.428.571	398.596.939
Total Benefit				991.108.396.274	89.072.778.557	925.965.846	826.755.219
Net Benefits C-(A+B)				904.480.201.314	54.230.821.355	-15.357.462.726	-16.601.601.923
NPV				5.221.992.197	4.643.999.418		
EIRR (%)				26,79%	13,49%		
Benefit Cost				11,44	2,56		
Discount Rate	12%						
CF	1,79						

3	4	5	6	7	8	9	10
69.042.684	61.645.254	55.040.405	49.143.219	43.877.874	39.176.673	34.979.172	31.231.404
						288.488.020	
69.042.684	61.645.254	55.040.405	49.143.219	43.877.874	39.176.673	323.467.192	31.231.404
69.042.684	61.645.254	55.040.405	49.143.219	43.877.874	39.176.673	323.467.192	31.231.404
484.228.492	457.054.038	430.143.792	403.753.234	378.080.035	353.273.211	329.442.022	306.662.003
6.097.118.109	5.748.490.691	5.404.574.681	5.068.364.632	4.742.158.909	4.427.670.202	4.126.135.181	3.838.385.802
94.381.349	82.084.617	71.315.775	62.054.088	54.088.307	47.236.401	41.341.042	36.266.951
286.847.440	256.113.786	228.673.023	204.172.342	634.645.949	162.764.941	-143.162.180	129.755.214
6.962.575.390	6.543.743.132	6.134.707.272	5.738.344.297	5.808.973.200	4.990.944.755	4.353.756.065	4.311.069.971
6.893.532.706	6.482.097.878	6.079.666.867	5.689.201.078	5.765.095.326	4.951.768.082	4.030.288.872	4.279.838.567

11	12	13	14	15	16	17	18
27.885.182	24.897.484	22.229.896	19.848.122	17.721.537	15.822.801	14.127.501	12.613.840
					130.497.329		
27.885.182	24.897.484	22.229.896	19.848.122	17.721.537	146.320.131	14.127.501	12.613.840
27.885.182	24.897.484	22.229.896	19.848.122	17.721.537	146.320.131	14.127.501	12.613.840
284.981.556	264.426.630	245.004.800	226.709.282	209.521.723	193.414.641	178.353.853	163.971.955
3.564.930.657	3.306.010.864	3.061.649.111	2.831.698.935	2.615.877.971	2.413.797.023	2.224.989.923	2.044.256.379
31.897.411	28.131.995	24.884.499	22.080.692	19.656.851	17.558.413	15.738.491	14.423.987
115.852.870	103.440.062	92.357.199	287.081.597	73.626.593	-64.759.300	58.694.669	52.405.955
3.997.662.494	3.702.009.551	3.423.895.608	3.367.570.506	2.918.683.139	2.560.010.777	2.477.776.936	2.275.058.276
3.969.777.312	3.677.112.067	3.401.665.712	3.347.722.384	2.900.961.601	2.413.690.647	2.463.649.435	2.262.444.436

19	20	21	22	23	24	25	26	27
11.262.357	10.055.676	8.978.282	8.016.324	7.157.432	6.390.564	5.705.861	5.094.519	4.548.677
				59.030.365				
11.262.357	10.055.676	8.978.282	8.016.324	66.187.796	6.390.564	5.705.861	5.094.519	4.548.677
11.262.357	10.055.676	8.978.282	8.016.324	66.187.796	6.390.564	5.705.861	5.094.519	4.548.677
151.210.385	139.039.521	127.739.838	117.267.255	107.571.557	98.609.395	90.393.966	82.863.046	75.959.598
1.885.059.364	1.734.328.009	1.592.860.571	1.461.824.656	1.340.570.535	1.229.331.525	1.127.324.305	1.033.782.711	948.004.155
12.779.430	11.576.588	10.524.131	9.598.091	8.782.715	8.044.141	7.367.996	6.748.974	6.182.225
46.791.031	41.777.706	129.861.135	33.304.932	-29.293.818	26.550.488	23.705.793	21.165.886	18.898.113
2.095.840.210	1.926.721.824	1.860.985.675	1.621.994.933	1.427.630.989	1.362.535.549	1.248.792.059	1.144.560.617	1.049.044.090
2.084.577.853	1.916.666.148	1.852.007.393	1.613.978.609	1.361.443.193	1.356.144.985	1.243.086.198	1.139.466.099	1.044.495.413

28	29	30	31	32	33
4.061.319	3.626.178	3.237.659	2.890.767	2.581.042	2.304.501
		26.961.567			
4.061.319	3.626.178	30.199.226	2.890.767	2.581.042	2.304.501
4.061.319	3.626.178	30.199.226	2.890.767	2.581.042	2.304.501
69.631.335	63.830.331	58.512.651	53.638.022	49.169.529	45.073.329
869.344.351	797.212.480	731.066.751	670.410.337	614.787.644	563.780.888
9.471.809	8.677.756	7.950.500	7.284.403	6.674.303	4.431.264
21.060.242	15.065.460	-13.510.264	12.010.092	12.319.817	9.574.372
969.507.737	884.786.026	784.019.638	743.342.855	682.951.293	622.859.853
965.446.418	881.159.849	753.820.412	740.452.088	680.370.251	620.555.352

C. Without project cash flow
January 1, 2015 (Unit: billion Rp)

Item		Financial Price With Project	Local Component (%)	Economic Price	Present Value	1
A.Civil Works						
	Labour					
	Equipment					
	Material					
	Fuel					
	Land Acquisition					
Total Civil Works						
B.Recurrent Cost						
	Routine Maintenance	7.425.000.000	80	12.117.600.000	2.987.301.294	446.428.571
	Reseal	17.900.000.000	80	29.212.800.000	2.921.280.000	
Total recurrent Cost		25.325.000.000		41.330.400.000	5.908.581.294	446.428.571
Total Cost	A+B	25.325.000.000		41.330.400.000	5.908.581.294	446.428.571
C.Project Benefits						
	Saving Travel Time	0	0	0	0	
	Saving Vehicle operation cost	0	0	0	0	0
	Saving Accident Cost	0	0	0	0	0
	Saving recurrent cost	0	0	0	0	0
Total Benefit				0	0	0
Net Benefits C-(A+B)				-41.330.400.000	-5.908.581.294	-446.428.571
NPV				-4.067.676.054	-2.219.573.615	
EIRR (%)				-8.12%	-2,57%	
Benefit Cost					0,00	

Discount Rate	12%
CF	1,79

2	3	4	5	6	7	8	9
398.596.939	355.890.124	317.759.039	283.713.428	253.315.561	226.174.608	201.941.614	180.305.012
					452.349.215		
398.596.939	355.890.124	317.759.039	283.713.428	253.315.561	678.523.823	201.941.614	180.305.012
398.596.939	355.890.124	317.759.039	283.713.428	253.315.561	678.523.823	201.941.614	180.305.012
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
-398.596.939	-355.890.124	-317.759.039	-283.713.428	-253.315.561	-678.523.823	-201.941.614	-180.305.012

10	11	12	13	14	15	16	17	18
160.986.618	143.738.052	128.337.546	114.587.095	102.309.906	91.348.131	81.560.831	72.822.170	65.019.795
				204.619.813				
160.986.618	143.738.052	128.337.546	114.587.095	306.929.719	91.348.131	81.560.831	72.822.170	65.019.795
160.986.618	143.738.052	128.337.546	114.587.095	306.929.719	91.348.131	81.560.831	72.822.170	65.019.795
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
-160.986.618	-143.738.052	-128.337.546	-114.587.095	-306.929.719	-91.348.131	-81.560.831	-72.822.170	-65.019.795

19	20	21	22	23	24	25	26
58.053.388	51.833.383	46.279.806	41.321.255	36.893.978	32.941.052	29.411.653	26.260.405
		92.559.612					
58.053.388	51.833.383	138.839.418	41.321.255	36.893.978	32.941.052	29.411.653	26.260.405
58.053.388	51.833.383	138.839.418	41.321.255	36.893.978	32.941.052	29.411.653	26.260.405
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
-58.053.388	-51.833.383	-138.839.418	-41.321.255	-36.893.978	-32.941.052	-29.411.653	-26.260.405

27	28	29	30	31	32	33
23.446.790	20.934.634	18.691.637	16.688.962	14.900.859	13.304.338	11.878.873
	4.186.927					
23.446.790	25.121.561	18.691.637	16.688.962	14.900.859	13.304.338	11.878.873
23.446.790	25.121.561	18.691.637	16.688.962	14.900.859	13.304.338	11.878.873
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
-23.446.790	-25.121.561	-18.691.637	-16.688.962	-14.900.859	-13.304.338	-11.878.873