Revenue components of road construction operations based on economic feasibility analysis

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Abstract. Regional development is closely related to the provision of infrastructure, namely the road network with the hope of creating a positive impact. Roads as a means of connecting, open access, play a role in the smooth movement of people and goods and have the potential to increase economic activity. The purpose of this study is to analyze the economic feasibility of road construction. The method used refers to Pd.T-15-2005-B. Components analyzed the economic feasibility aspects of road construction are based on differences in vehicle operating costs and time values arising from differences in transportation costs on the new road and existing road. The results of the study took the form of specific recommendations and were a solution to the need for work to be carried out by examining the extent to which the level of feasibility, especially from the economic and financial aspects. The economic indicators used are Net Present Value, Internal Rate of Return, and Benefit-Cost Ratio. The indicator provides a scale that compares the benefits and costs of each alternative proposed, specifically each indicator has different characteristics. In general, all of these indicators need to be examined to more clearly describe economic events during the planning period.

1. Introduction
Development feasibility analysis is carried out to find out how much profit is obtained if the work begins to be built in terms of benefits to the community or better known as economic analysis (Economic Feasibility) [1,2]. Development feasibility studies that greatly require an analysis of economic or financial feasibility including, in particular, the construction of roads, bridges, and other infrastructure [3-5]. The basic principles of economic feasibility analysis and analysis are financially reviewed through viewpoints, objectives, criteria, applications, benefit components, and cost components [6,7].

The development of the provision of road networks aims to create a positive impact. Roads are a means of connecting to smoothness and potentially increasing economic activity [8]. The thing that is the basis in determining the economic feasibility of development and operation of transportation or road facilities is a comparison of costs with benefit/revenue which is a comparison of costs and benefits/revenue.

Economic feasibility analysis in this study to find out how much benefits or benefits obtained if in a road network towards development. This is reviewed based on the value of investment or development funds that are examined in terms of the number of resources that must be spent by the government including construction costs, land use, and other costs [9]. Based on the existing problems, the purpose of this study is to analyze the economic feasibility of road construction referring to the difference in the value of vehicle operating costs (BOK), time value and the amount of profit from vehicle operating costs (BKBOK) [10].
2. Methods
The research method conducted an economic feasibility analysis referring to Pd.T-15-2005-B concerning Vehicle Operating Cost Calculations developed by the Ministry of Public Works in Indonesia [11]. This model provides BOK formulas which are slightly different between BOK on new roads and BOK on existing roads. BOK is the sum of running costs and standing costs, with the silent costs of vehicles being costs that must be spent but not affected by the operation of the vehicle or not operating (vehicle tax, vehicle test fees, and vehicle and passenger insurance). Travel costs are costs incurred due to vehicle operations (fuel consumption, lubricating oil consumption, and tire consumption) [12]. The research flow charts can be seen in the figure 1.

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**Figure 1.** Flow chart.

Components which are analyzed in terms of economic feasibility of road construction due to differences in BOK values and time values due to differences in transportation costs on new roads and existing roads [13,14]. The value of travel time will be calculated based on the value of time per vehicle per hour for each group (Rp. /Hour/vehicle) [15].

Fixed costs are calculated by summing the costs of fuel consumption, oil consumption costs, spare parts consumption costs, maintenance costs, and tire consumption costs:

\[ BTT = BiBBMj + BOi + BPi + BUi + BBi \]

with,

- BTT is a non-fixed amount, in IDR /km
- BiBBMj is the cost of consuming fuel oil, in IDR / km
- BOi is the cost of oil consumption, in IDR / km
- BPi is the cost of consuming spare parts, in IDR / km
- BUi is maintenance costs, in IDR / km
- BBi is a tire consumption fee, in IDR / km

3. Result
In evaluating the projects to be worked on, a project feasibility analysis is made. Therefore, it is known how much the benefits or benefits that are obtained due to the construction of road networks, including routine maintenance, periodic maintenance, widening of sections and improvement of roads.

In conducting an economic feasibility analysis there are several basic principles that distinguish it from financial analysis, the different economic and financial components can be seen in Table 1.
Table 1. Differences in economic and financial approaches.

| Component          | Economic Analysis                  | Financial analysis               |
|--------------------|------------------------------------|----------------------------------|
| Viewpoint          | Public                             | Private                          |
| Purpose            | Economic efficiency                | Returns and investment returns   |
| (reduction in transportation costs) |                      |                                  |
| Criteria           | NPV, BCR, EIRR                     | Pay Bac Period, IRR               |
| Application        | Projects for the community carried out by the government | Private projects are profit oriented |
| Benefits           | Benefit from BKBOK                 | Revenue from profit income        |
| Cost               | Construction, operation and maintenance costs | Construction, operation and maintenance costs |

The components to be analyzed in terms of economic feasibility of development are reviewed based on the difference in BOK (Vehicle Operational Cost) and NK (Time Savings). The components of the cost of building a road feasibility study work considered in the feasibility analysis are:

- The cost of land acquisition (IDR 16,907,000,000)
- Design and supervision costs (4.5% of total construction costs)
- Construction cost (Rp. 848,529,253,521)
- Operation and maintenance costs, namely:
  - Annual maintenance costs are 2,197,100,303.48
  - 3-year maintenance costs are 3,295,650,455.22
  - The 5-year maintenance cost is 5,492,750,758,704
- Value Added Tax of 10%
- Overhead is estimated at 1% of the total project cost
- Contingency costs 10% of construction costs

The value of the time of passenger car and bus vehicles is calculated based on the total value of the time of the vehicle. The assumptions used are:

- Minimum work wage of Rp. 3,204,551, - per month
- Disposable Income, which is assumed to be 80% of per capita income
- Monthly work hours, in this case, assumed to be 160 hours/month
- The value of business trips is taken one third of non-business trips

Table 2. Vehicle operating costs / existing road BOK.

| Moda Transportation | Non-Fixed BOK Component (Rp. / Km) | Non-fixed BOK (Rp. / Km) |
|---------------------|-----------------------------------|--------------------------|
|                     | Fuel oil  | Oil   | Parts | Salary | Tire |                             |                          |
| Passenger car       | 501.4     | 91    | 142.9 | 8.2    | 20.8 | 764.4                        |                           |
| Utilities           | 622.9     | 91    | 178.6 | 8.2    | 44.2 | 944.9                        |                           |
| The Bus < 8 ton     | 892.1     | 156   | 193.2 | 26     | 38.5 | 1305.7                       |                           |
| The Bus> 8 ton      | 1101.9    | 312   | 275.9 | 20.4   | 298.6| 2008.9                       |                           |
| Truck< 8 ton        | 1558.3    | 156   | 30.2  | 12.2   | 220.4| 1977.1                       |                           |
| Truck> 8 ton        | 2665.4    | 312   | 64.4  | 11.8   | 291.2| 3344.8                       |                           |
| Tandem Truck        | 2675.3    | 624   | 29.5  | 8.8    | 475.9| 3813.5                       |                           |

BKBOK is derived from savings in transportation costs, namely the amount of time savings and BOK savings. BKBOK obtained in the planned new road construction in the first year Rp. 40,047,650,488,-.

The benefits of new roads for road users are analyzed by comparing construction costs, operational and maintenance costs with BKBOK throughout the service life. In calculating the economic feasibility of analysis, a calculation scheme is carried out throughout the service life of 20 years assuming that road
access will continue to be maintained during the planned life so that road conditions are always in a steady state.

The economic analysis parameters in assessing the benefits of the projects built include the Net Present Value (NPV), Benefit Cost Ratio (BCR) and the Economic Internal rate of Return (EIRR). Projects are said to be economically feasible if NPV > 0, BCR > 1 and the IRR value must be greater than the interest rate currently used. If NPV < 0, BCR < 1 and lower IRR value, it can be said that the project is not feasible, so the implementation costs will be more profitable if invested in activities or elsewhere.

The parameter of the discount rate of 13.00% is used to determine the conversion value of the costs and benefits that will be incurred in the future to the present (2017-2040). The results of the cost analysis for 20 years of service life can be seen in Table 3.

| Year | BOK (Rp. Thousand) | BKBOK (Rp. Thousand) | Time value savings (Rp. Thousand) | Cost (Rp. Thousand) |
|------|---------------------|-----------------------|-----------------------------------|---------------------|
| 2017 | 96,914,156          | 40,047,650            | 82,605,503                        | 1,081,602,213       |
| 2018 | 109,840,082         | 45,746,066            | 93,623,012                        | 2,197,100           |
| 2019 | 122,766,007         | 51,423,948            | 104,640,521                       | 2,197,100           |
| 2020 | 135,691,933         | 57,122,364            | 115,658,030                       | 3,295,650           |
| 2021 | 145,565,063         | 60,924,881            | 124,735,466                       | 5,492,750           |
| 2022 | 155,438,193         | 64,727,398            | 132,488,901                       | 3,295,650           |
| 2023 | 165,299,208         | 68,542,029            | 140,894,011                       | 5,492,750           |
| 2024 | 175,172,338         | 72,344,546            | 149,309,447                       | 3,295,650           |
| 2025 | 185,045,467         | 76,147,063            | 157,724,883                       | 5,492,750           |
| 2026 | 194,918,593         | 79,944,665            | 168,979,883                       | 3,295,650           |
| 2027 | 204,791,719         | 83,754,381            | 180,224,557                       | 5,492,750           |
| 2028 | 214,664,841         | 87,551,982            | 191,479,557                       | 3,295,650           |
| 2029 | 224,538,963         | 91,361,698            | 202,724,231                       | 5,492,750           |
| 2030 | 234,413,084         | 95,159,300            | 213,979,231                       | 3,295,650           |
| 2031 | 244,287,201         | 102,894,134           | 225,443,111                       | 5,492,750           |
| 2032 | 254,161,322         | 110,616,854           | 226,917,318                       | 5,492,750           |
| 2033 | 263,935,443         | 118,351,688           | 233,381,198                       | 3,295,650           |
| 2034 | 273,809,570         | 126,074,408           | 239,855,405                       | 3,295,650           |
| 2035 | 283,683,696         | 133,809,242           | 246,319,285                       | 5,492,750           |
| 2036 | 293,557,822         | 140,567,155           | 254,765,698                       | 3,295,650           |
| 2037 | 303,431,948         | 147,325,068           | 263,321,111                       | 5,492,750           |
| 2038 | 313,306,074         | 154,082,980           | 271,658,524                       | 3,295,650           |
| 2039 | 323,180,198         | 161,840,893           | 280,104,936                       | 5,492,750           |
| 2040 | 332,254,323         | 169,598,805           | 288,551,349                       | 3,295,650           |

Based on the feasibility analysis of the investment with an assessment of the Net Present Value (NPV) of Rp.579,805,656,532. The project Benefit and Cost ratio (BCR) is 1.59 that the benefits obtained exceed the costs incurred. The EIRR value is 13.7% higher than the discount rate. Judging from the results of the NPV calculation, the feasible project is continued because the comparison of initial investment and cash flow is more than zero, based on the results of the ratio of cost and benefit shows a value greater than 1, the project is predicted to be profitable, and from the EIRR value age plan.

4. Conclusion

Components measured in economic feasibility in terms of the aspects of economic analysis criteria include NPV, BCR, and EIRR. Based on the economic feasibility analysis the road construction is determined to be feasible, with NPV, BCR and EIRR values exceeding the project eligibility requirements to be accepted.

With regard to the feasibility of development, it is recommended that a review of a decision (investment decision) be made to find out how much inaccuracy in using an assumption that can be
tolerated without causing the decision not to take effect. Tests use sensitivity analysis regarding sensitivity to decisions based on the assumption that all decisions are based on various assumptions so that what can happen with the results of the project analysis can be predicted if there are errors or changes in the calculation of costs or benefits.

The test needs to be done because the analysis of the project is based on projections that contain a lot of uncertainty about what will happen in the future, in between there is an increase in construction costs or cost overrun, a change in the price comparison to the general price level due to a price decline production results, delay in implementation schedule.

The result of sensitivity analysis testing is a step to formulate a number of preventive actions or efforts to be taken in improving the way the project is being implemented, improving the design of the project to increase NPV, and reducing the risk of loss.

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