

## Study of Operational and Maintenance Costs for Public Bus Transport

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### ABSTRACT

*Public transportation is a means of transportation for travelling and carrying out daily activities, and it has become one of the community's transportation needs. This research also aims to determine vehicle operational costs and maintenance costs incurred. This research was conducted on the PT Sriwijaya Pratama Express economy bus. The data obtained from this research are the results of interviews with the bus and interviews with the company. The data obtained includes vehicle depreciation, vehicle interest capital, engine oil prices, fuel prices, tyre usage, maintenance wages and bus crew wages. Based on this data, fixed costs, variable costs and overhead costs can be obtained. For fixed costs, the result is IDR 515.64 per km. Non-fixed costs are IDR 4,867.57 per km and overhead costs are IDR 1,076.64 per km. Details such as minor servicing carried out every 10,000 km and major servicing carried out every 20,000 km are also routinely carried out by PT. Sriwijaya Pratama Express.*

**Keywords:** *Public transportation, BOK, Maintenance.*

### Introduction

Bandar Lampung is a city in Indonesia and the capital and largest city in Lampung Province. Bandar Lampung is also the third largest and most populous city on the island of Sumatra after Medan and Palembang. It is one of the largest cities in Indonesia and the most populous city outside the island of Java. The development of big cities will also increase activity for people in the city so that road mobility will be very high. Along with increasing development in all fields, especially in the economic sector, transportation facilities, as one of the economic chains, are also experiencing rapid progress. Transportation services are a form of service the community needs from the general public, government and industrial companies[1]–[5].

Transportation activities cover a broad field, where transportation grows and develops in line with the level of life[6]. It can be seen that development in Indonesia today in all development sectors will not be separated from transportation services. Transportation is moving goods and services with the help of humans or machines. As part of the transportation system anywhere, public transportation is one of the basic human needs, so it must be managed and organised well [7]. The transportation in question is like public transportation. There are also many types of public transportation, including land, sea and air. Examples of land public transportation include buses, angkot (city transportation), taxis, pedicabs, and trains.

The main function of public transportation is as a means of transportation for people to travel and carry out daily activities [8]. It is hoped to provide safe, fast, cheap, comfortable and efficient services. Determining the amount of transportation tariffs requires wise policies and the right approach because determining the amount of this tariff will certainly bridge the interests of passengers as consumers and entrepreneurs/public transportation operators. Weak passenger purchasing power is the main cause of flight delays or cancellation of existing fare adjustments [9]–[14].

PT. Sriwijaya Pratama Express is a private company that operates in the transportation services field, especially land transportation. Like every company, whether engaged in producing goods or services, it always wants its production activities to run well. It hopes that the facilities used will always be in good condition. However, sometimes maintenance doesn't get enough attention. This is because companies cannot feel the benefits of maintenance directly when carrying out maintenance, so they ignore maintenance. The consequence for the company is that serious damage cannot be avoided, accompanied by high vehicle repair costs, especially now that the price of spare parts has experienced a relatively high increase. Therefore, maintenance has a very important and determining role in the activities of equipment used in the field, which concerns smoothness or congestion, delays in completing work and efficiency in the operation of the equipment.

Basically, the government determines tariffs to ensure the sustainability of urban public transportation as well as service quality and safety standards on the one hand, as well as taking into account users' purchasing

capacity and willingness [15]. Many variables influence tariff determination, such as the community's economic status, maintenance/spare parts costs, fuel prices, facilities and infrastructure, etc. There is a tendency for the increasing travel demand, which increases travel volume, to increase travel rates. Transportation is said to reach perfect conditions if transportation costs/tariffs are not affected by passengers or transportation facilities providers. In this case, the offer (supply) is deemed sufficient if demand is met without influencing travel rates from transportation providers and freight passengers. The prices involved include terminal costs and movement costs [16]–[21].

There are many public transportation routes in Lampung province. One of the routes being developed is public transportation using buses, one of which is Lampung – Bengkulu. People's interests in travelling between Lampung and Bengkulu vary, ranging from education to sightseeing to entertainment and other activities. Public transport bus. Sriwijaya Pratama Express is one of the providers of public transportation services on the Lampung – Bengkulu route. That's the reason PT buses. Sriwijaya Pratama Express, as the study material, is one of the official land transportation service providers that provides tickets to passengers and seeks information on fares for public transportation passengers. Like every company, whether engaged in producing goods or services, it always wants its production activities to run well. It hopes that the facilities used will always be in good condition. Based on direct interviews conducted by the author and making detailed observations of the costs incurred when carrying out fleet operational activities. Therefore, it is necessary to study the operational costs of public bus transportation.

## Research Methods

All cost data is collected from field research activities and library research. The cost components used include general financing (including vehicle price and vehicle depreciation value) and bus operation and maintenance financing (fuel costs, vehicle crew costs, terminal costs, and human resource costs other than crew). Based on the identified cost components, the amount of vehicle operational costs that must be borne by the operator per kilometre can be determined. This research was conducted at the company PT. Sriwijaya Pratama Express whose address is Jl. Scout No.11, Rajabasa District, Bandar Lampung City, Lampung Province. This research was conducted to determine the operational costs of PT bus vehicles. Sriwijaya Pratama Express route Lampung – Bengkulu.



Figure 1. Lampung – Bengkulu route (Google Maps)

### Data collection

Data collection is an activity that searches for data in the field that will be used to answer research problems. The primary and secondary data used in this research are primary and secondary data.

#### 1. Primary Data

According to [22]–[26], primary data is data that is directly obtained from a source and given to data collectors or researchers. According to Sugiyono, there is also an opinion that the primary data source is interviews with research subjects either through observation or direct observation. Primary data required includes bus interviews and company interviews. An example of a list of vehicle operational cost data includes:

- a. Vehicle Depreciation
- b. Vehicle Interest Capital
- c. Price of Engine Oil
- d. Fuel Prices
- e. Use of Tires
- f. Maintenance Wages
- g. Bus Crew Wages

## 2. Secondary Data

Secondary data according to [27] secondary data is a data source that does not directly provide data to data collectors, for example through other people or through documents. Secondary data sources are complementary data sources that function to complete the data required by primary data. The data required includes company and bus vehicle data on this Lampung – Bengkulu route.

### BOK (Vehicle Operating Costs)

Cost is a determining factor in determining tariffs and means of transportation so that operations can reach an effective and efficient level [28]. If viewed from transportation business activities, the costs incurred in producing sales transportation services to service users can be divided into three parts, namely:

- 1) Which is issued to company managers.
- 2) Those issued for vehicle operation
- 3) Disbursement due to fees, contributions, donations and expenses related to business owners, vehicles and operations.

### Basic Cost Components

Cost is a determining factor in determining tariffs and equipment in transportation in order to calculate cost groups based on the relationship between services produced, including:

A. Direct Costs: Costs that are directly related to the service products produced. It is a calculation of Depreciation on productive public transportation vehicles, which can be calculated using the straight-line method. For new vehicles, the price of the vehicle is assessed based on the price of the new vehicle, including BBN and transportation costs, while for old vehicles, the price of the vehicle is assessed based on the acquisition price such as:

B. Indirect Costs: Costs that are not directly related to the service products produced. Indirect costs are grouped into 3 parts: fixed, variable, and overhead.

## Results and Discussion

Based on the results of a survey conducted on the Sriwijaya Pratama Express bus general force for the Lampung - Bengkulu route, which is part of the land transportation route on the island of Sumatra which is  $\pm$  565 km. There is also data obtained from interviews with drivers and company officials.

### BOK Analysis (Vehicle Operating Costs)

Analysing vehicle operating costs based on non-fixed direct costs (variable costs) vary greatly depending on the travel time and number of passengers carried [29]. Several factors are parameters for component costs: vehicle characteristics, production per bus, and vehicle operational cost components.

Table 1. BOK Analysis

Vehicle Characteristics	
Vehicle Type	Mitsubishi SH PS 120
Vehicle Capacity	28 person
Transportation type	Passenger transportation

Source: Interview Results

### Components of Vehicle Operational Costs

#### A. Fixed Cost

Fixed costs are costs that do not change even if the volume of service production changes by a certain level

Table 2. Fixed Costs

No	Goods/Component	Cost incurred
1	Initial Costs	
	a) Cost of Depreciation	
	• Vehicle Price (HK)	Rp 225.000.00
	• Loss Period (MS)	5 Years
	b) Capital Interest Costs	

	• Loan Period	4 Years
2	Terminal Levy Fee	Rp 10.000
3	STNK fees	Rp 600.000
4	KIR fees/bus	Rp 90.800

Source: Interview Results

1. Fixed Costs

- Cost of depreciation :

$$\text{Cost of depreciation/km} = \frac{HK - NR}{PST \cdot MS} = \frac{Rp\ 225.000.000 - Rp\ 45.000.000}{108.480\ km \times 5} = Rp\ 331,86$$

- Capital Interest Costs :

$$\text{Value of capital interest costs/km} = \frac{\frac{n+1}{2} \cdot \text{capital} \cdot \text{Annual Interest Rate}}{\text{Depreciation Period}} = \frac{\frac{4+1}{2} \times 75\% \cdot 225.000.000 \cdot 12\%}{108.480\ km \cdot 4} = Rp\ 116,67$$

- STNK fees :

$$\text{STNK fees / km} = \frac{(0,5\ HK)}{PST} = \frac{Rp\ 600.000}{108.480\ km} = Rp\ 5,53$$

- KIR fees

$$\text{KIR fees/km} = \frac{(\text{KIR fees/bus})}{PST} = \frac{181.600}{108.480\ km} = Rp\ 1,67$$

As for fixed costs such as administration/licensing, they are as follows :

**Table 3.** Fixed cost

No	Goods/Components	Costs incurred/Amount
1	Administration/Licensing	
	a) Business License Fee	Rp 500.000
	b) Route Permit Fee	Rp 5.000.000
	c) Corporate Tax	Rp 1.000.000

Source: Interview Results

- Company Licensing Fees

a) Business License Fee = Rp 500.000

b) Route Permit Fee = Rp 5.000.000

c) Corporate Tax = Rp 1.000.000

amount = Rp 6.500.000

$$\text{Company Licensing Fees/km} = \frac{\text{Number of administrations}}{1\ year\ gap} = \frac{Rp\ 6.500.000}{108.480\ km} = Rp\ 59,91$$

So the costs are fixed costs:

$$\text{Fixed Costs} = \text{Depreciation Costs} + \text{Capital Interest} + \text{STNK Fees} + \text{KIR Fees} + \text{Company Licensing Fees}$$

$$= Rp\ 331,86 + Rp\ 116,67 + Rp\ 5,53 + Rp\ 1,67 + Rp\ 59,91$$

$$= Rp\ 515,64$$

2. Variable Costs

Variable costs are costs that change when the volume of service production changes. Examples of non-fixed costs include costs for bus crew, costs for fuel, maintenance costs (tyres, engine overhaul, body overhaul, replacement of bus parts, body maintenance, bus washing costs, minor servicing and major servicing) and terminal levy fees.

**Table 4.** Variable Costs

No	Goods/Components	Costs incurred/Amount
1	Costs for Bus Crew	
	a) Vehicle Crew Composition	
	• Driver	1 person

<ul style="list-style-type: none"> <li>• Conductor</li> </ul>	1 person
b) Salaries and allowances	
<ul style="list-style-type: none"> <li>• Salary/wages per month</li> <li>• Social Benefits</li> </ul>	10% of ticket revenue excluding deposits of IDR 250,000/day
<ol style="list-style-type: none"> <li>1. Production service</li> <li>2. Treatment</li> <li>3. Service Clothes</li> </ol>	

• Costs for bus crew

The salary of the bus crew is obtained from 20% of the profits from deposits every day, and they are required to pay a deposit of IDR 700,000 every day. Driver fees are obtained in the following ways:

- 1) Ticket price = Rp 150.000
- 2) Payload Power = 28 Passenger
- 3) Load Factor = 70% x load power = 20 Passenger
- 4) Ticket revenue/day = 2(150.000 x 20) = Rp 5.400.000 (10% for commission)
- 5) Deposit = Rp 700.000
- 6) Driver Income = Rp 20% x Rp 4.700.000 = Rp 3.760.000
- 7) Bus crew charges/km = Driver income x distance 1 rit  
= Rp 3.760.000 / 1.130 km = Rp 3.327,43

**Table 5.** Bus Crew Fees

No	Goods/Components	Costs incurred/Amount
1	Fuel Costs	
	Fuel costs/day	Rp 1.200.000,-
	Price/Liter	Rp 6.800,-

• Costs for fuel

$$\text{Fuel/day} = \frac{\text{fuel costs per bus/day}}{PST} = \frac{\text{Rp } 1.200.000}{1130 \text{ km}} = \text{Rp } 1.061,94$$

**Table 6.** Fuel Costs

No	Goods/Components	Costs incurred/Amount
1	Tire Costs	
	Tire/piece cost	Rp 1.200.000,-
	Use of tyres/buses	6 pcs
	Tire durability	50.000 km

• Costs for tires

The total cost of tyres = cost of tyres per piece x number of tyres per bus  
= Rp 1.200.000 x 6  
= Rp 7.200.000

$$\text{Biaya Ban per km} = \frac{(\text{tire/bus costs})}{\text{Distance}} = \frac{\text{Rp } 7.200.000}{50.000 \text{ km}} = \text{Rp } 144$$

**Table 7.** Distance

No	Goods/Components	Costs incurred/Amount
1	Engine Overhaul	
	• Done Every	250.000 km
	• Overhaul Fee (5% Chassis price)	Rp 6.750.000,-
2	Overhaul Body	
	• Done Every	250.000 km
	• Overhaul costs (18% of body price)	Rp 16.200.000,-
3	Adding Engine Oil	
	• Adding Engine Oil	1 Liter
	• Oil price per litre	Rp 36.000,-

4	Bus Washing Fees	Rp 100.000,-
5	SC Replacement (2% Chassis price)	Rp 2.700.000,-
6	Body Maintenance (1% Body Price)	Rp 900.000,-
7	Service/mentorship fees	
	a) Small Services	
	• Minor services are carried out every day	10.000 km
	• Engine Oil Costs (price per litre)	10 Liter Rp 36.000,-
	• Axle Oil Costs (price per litre)	4 Liter Rp 46.250,-
	• Transmission Oil Costs (price per litre)	4,5 Liter Rp 40.000,-
	• Fat Fee (price per kg)	1,5 kg Rp 70.000,-
	• Low service wages	Rp 100.000,-
	b) Great Service	
	• Great service is done every time	20.000 km
	• Engine Oil Costs ( price per litre)	10 Liter Rp 36.000,-
	• Axle Oil Costs (price per litre)	4 Liter Rp 46.250,-
	• Transmission Oil Costs (price per litre)	4,5 Liter Rp 40.000,-
	• Fat Fee (price per kg)	1,5 kg Rp 70.000,-
	• Brake Fluid Cost (price per litre)	1 Liter Rp 50.000,-
	• Oil Filter Cost (price per pcs)	3 Pcs Rp 50.000,-
	• Air Filter Cost (price per pcs)	1 Pcs Rp 75.000,-
	• Great Service Work Wages	Rp 150.000,-

Source: Interview Results

- Maintenance costs

- 1) Engine overhaul

Engine overhaul is carried out every 250.000 km

$$\begin{aligned} \text{a) Chasis} &= 60\% \times \text{vehicle price} &&= 60\% \times \text{Rp } 225.000 \\ &&&= \text{Rp } 135.000.000 \end{aligned}$$

$$\begin{aligned} \text{b) Engine overhaul costs} &= 5\% \times \text{chassis} \\ &= 5\% \times \text{Rp } 135.000.000 = \text{Rp } 6.750.000 \end{aligned}$$

$$\begin{aligned} \text{c) Costs per km} &= \text{Rp } 6.750.000 / 250.000 \text{ km} \\ &= \text{Rp } 27 \end{aligned}$$

- 2) Overhaul body

Overhaul body is carried out every 250.000 km

$$\begin{aligned} \text{a) Body Costs} &= 40\% \times \text{Vehicle Price} = 40\% \times \text{Rp } 225.000.000 \\ &= \text{Rp } 90.000.000 \end{aligned}$$

$$\begin{aligned} \text{b) Overhaul body costs} &= 18\% \times \text{Karseri Price} \\ &= 18\% \times \text{Rp } 90.000.000 = \text{Rp } 16.200.000 \end{aligned}$$

$$\begin{aligned} \text{c) Costs per km} &= \frac{\text{Body overhaul costs}}{\text{distance}} \\ &= \frac{\text{Rp } 16.200.000}{250.000 \text{ km}} = \text{Rp } 64,8 \end{aligned}$$

- 3) Adding Engine Oil

Add 1 litre of engine oil every 2 days

$$\begin{aligned} \text{Engine oil surcharge per km} &= \text{Price of oil/distance} \\ &= \text{Rp } 30.000/1130 \text{ km} \end{aligned}$$

$$= \text{Rp } 26,55$$

- 4) Bus washing costs = Bus washing costs / 1 rit  
 $= \frac{\text{Rp } 100.000}{1130 \text{ km}} = \text{Rp } 88,49$
- 5) SC Replacement (2% Chassis price) = Cost per km =  $\frac{\text{Rp } 2.700.000}{108.480 \text{ km}} = \text{Rp } 24,9$
- 6) Body Maintenance (1% of Body Price) = Cost per km =  $\frac{\text{Rp } 900.000}{108.480 \text{ km}} = \text{Rp } 8,29$
- 7) Small service/small maintenance  
 This small service is carried out every 10,000 km of travel. This minor service includes:
- a) Machine oil = Rp 36.000 x 10 liter  
 = Rp 360.000
  - b) Gardan Oil = Rp 46.250 x 4 liter  
 = Rp 185.000
  - c) Transmission Oil = Rp 40.000 x 4,5 liter  
 = Rp 180.000
  - d) Fat fee = Rp 70.000 x 1,5 kg  
 = Rp 105.000
  - e) Wages = Rp 100.000
- Small Service Fee Amount = Rp 930.000  
 Small service charge per km = Rp 930.000 / 10.000 km  
 = Rp 9,3

- 8) Big service/big maintenance  
 This major service is carried out every 20,000 km of travel. These major services include:
- a) Machine oil = Rp 36.000 x 10 liter  
 = Rp 360.000
  - b) Gardan Oil = Rp 46.250 x 4 liter  
 = Rp 185.000
  - c) Transmission Oil = Rp 40.000 x 4,5 liter  
 = Rp 180.000
  - d) Fat fee = Rp 70.000 x 1,5 kg  
 = Rp 105.000
  - e) Brake fluid = Rp 50.000 x 1 liter  
 = Rp 50.000
  - f) Oil filter = Rp 50.000 x 3 pcs  
 = Rp 150.000
  - g) Air Filter = Rp 75.000 x 1 pcs  
 = Rp 75.000
  - h) Wages = Rp 150.000
- Large Service Charge Amount = Rp 1.255.000  
 The amount of service charges is large per km = Rp 1.255.00 / 20.000 km  
 = Rp 62,75

- Terminal levy fees  
 Terminal levy fee per km = Rp 25.000 / 1130 km  
 = Rp 22,12

So the costs for variable costs (per km):

$$\begin{aligned} & \text{Fees for bus crew} + \text{Fees for fuel} + \text{Fees for tyres} + \text{Maintenance fees} + \text{Terminal levy fees} \\ & = \text{Rp } 3.327,43 + \text{Rp } 1.061,94 + \text{Rp } 144 + \text{Rp } 312,08 + \text{Rp } 22,12 \\ & = \text{Rp } 4.867,57 \end{aligned}$$

#### 4. Overhead Costs

Calculating overhead costs is done in the first way, namely 20-25% of fixed costs and variable costs so that:

$$\begin{aligned} \text{Overhead Costs} & = (\text{Fixed Costs} + \text{Variable Costs}) \times 20 \% \\ & = (\text{Rp } 515,64 + \text{Rp } 4.867,57) \times 20 \% \\ & = \text{Rp } 1.076, 64 \end{aligned}$$

## Conclusion

Based on the study of the results and discussion above carried out in this research, it can be concluded that the fixed costs incurred by each operational vehicle are IDR 515.64 per KM, the variable costs incurred by each operational vehicle are IDR 4,867.57 per KM, and overhead costs spent on each operational vehicle is IDR 1,076.64 per KM. Based on the detailed table from the Results and Discussion above which includes BOK and treatments carried out by PT. Sriwijaya Pratama Express is quite good. Details such as minor servicing carried out every 10,000 km and major servicing carried out every 20,000 km are also routinely carried out by PT. Sriwijaya Pratama Express. With this, a good maintenance system will benefit transport operators/entrepreneurs because even though the vehicle has reached the end of its economic life, it can still be operated for several more years, providing profits for the company. And suggestions for future researchers to research using other methods such as PCI and research with different departments or routes.

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