Comparison analysis on vehicle operating cost (VOC) and passengers perception between transjakarta bus type of zhongtong LCK6180GC and scania K3201A (case study: transjakarta corridor 9)

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Abstract. The purpose of this research is to analyze comparison of vehicles operating costs (VOC) between the bus type of Zhongtong LCK6180GC and bus type Scania K3201A corridor 9, and also to know the level of satisfaction passengers using these two types of bus. The method used in this research including calculation of vehicles operating costs, Likert method, and distribution frequency. The results in summary is VOC of the type of Zhongtong LCK6180GC is smaller than Scania K3201A. Passengers’ satisfaction of Zhongtong LCK6180GC is lower then Scania K3201A but Zhongtong LCK6180GC gives more benefits for PT. Transportation Jakarta compare to Scania K3201A

Keyword: Vehicle Operating Cost (VOC), Passenger Perception, Tariff.

1. Introduction

According to Warpani public transport passenger is carried on a lease or pay for, and the purpose of convening public transport is to provide transport services are good and worth to society [1]. Along with the rapid growth of population is one of the things that cannot be separated from the social demand for public transport. Transjakarta is a BRT system that integrated between mode and operation to give good service and quality compare to other bus standard [2].

Transjakarta is a transport system Bus Rapid Transit (BRT) operating since 2004 and has a system with the world's longest passage (230,9km), and has 243 stations spread over 13 BRT corridors. However, in 2014 there were more than eight Transjakarta bus burned in every month. Early operation of Transjakarta bus is using branded buses from China such as Ankai, Yutong, and Zhongtong. These buses are often experienced problems in the engine, electricity, and others due to maintenance difficult for spare parts as well as the experience of human resources who have not mastered about Chinese bus.

With the extensive damage of Transjakarta buses imported from China and the need to increase the bus fleet, PT. Transjakarta brought the new types of buses namely Scania that imported from Sweden. These buses will provide comfort, security, and good quality to serve passenger.
This research will find out the comparison between Zhongtong LCK6180GC bus type (from China) and Scania K3201A bus type (from Sweden) including its Vehicle Operating Cost (VOC) and level of satisfaction of passengers using these two types of buses.

2. Methodology
The method used in comparative research vehicle operating costs and perception of passengers for bus types Zhongtong LCK6180GC and Scania K3201A can be seen in the flow of research that can be seen in the following figure.

![Flowchart of VOC Analysis](image_url)

**Figure 1.** Flowchart of VOC Analysis
2.1. Data Collection
Primary data obtained from respondents which is the bus passengers of Zhongtong LCK6180GC and Scania K3201A in the corridor 9. This survey collected the characteristic of passengers, passenger perception when use these two buses. Secondary data obtained from PT. Transportation Jakarta that collected the characteristics of Zhongtong and Scania, bus pricing, fuel usage, administrative and insurance costs, maintenance cost, etc.

2.2. Data Analysis
Likert method used to analyze passenger perception data and Directorate General of Land Transport Decree No: SK.687 / AJ.206 / DrJD / 2002 used to analyze the vehicle operating cost [3].

2.3. Processing and Analysis of Vehicle Operating Costs
Table 1 shows the general characteristics of Transjakarta bus Zhongtong LCK6180GC and Scania K3201A.

| Description Characteristics | Zhongtong LCK6180GC | Scania K3201A |
|-----------------------------|----------------------|--------------|
| Price Vehicle               | IDR 3,675,500,000    | IDR 4,542,000,000 |
| Vehicle Type                | Type 3B              | Type 3B      |
| Passenger capacity          | 111 passengers       | 111 passengers |
| Fuel                        | Gas                  | Gas          |
| Tank capacity (LSP)         | 1080                 | 1500         |

The operational characteristics of the Transjakarta bus corridor 9 such as:
• Round trips per day the bus in average is 5 for both buses.
• The length of corridor 9 is 28.8 kilometres (from Pinang Ranti to Pluit).
• The total travel length per year is round trip per day x length of corridor 9 x 350 days.
• The crew and labour cost consist of the salaries per year for vehicle crew costs (driver and doorman)
• The other costs collected such as such as vehicle registration fees, KIU-KP Cost (Business License and Route), KIR inspection fees, vehicle insurance costs, PKB (Motor Vehicle Tax) and spare parts.

2.4. Fixed cost
To calculate fixed costs, components such as vehicle capital costs, depreciation costs, licensing and administrative costs, vehicle crew salary costs are needed [3]. The detail calculation of each component as follows:
  • Capital Costs Vehicles per year = New Price of Vehicle / Age Economical Vehicle
  • Capital Cost Vehicle per kilometers = Vehicles per year Capital Cost / Length of Corridor 9 per year
  • Residual Value Used Vehicles per year = Price x 20% New Vehicle
  • Cost Depreciation per year = (Price New Vehicles - Used Vehicle Residual Value per year) / Age Economical Vehicle
  • Cost Depreciation per kilometer = Cost Depreciation per year / Length of Corridor 9 per year.
  • Licensing and Administrative Costs per year = Vehicle Registration Fees + KIU-KP Fees + KIR Fees + PKB Fees
  • Licensing and Administrative Costs per kilometer = Total Licensing and Administrative costs per year / Length of Corridor 9 per year
  • Insurance Costs per kilometer = Insurance Costs per year / Length of Corridor 9 per year
  • Total Salary Vehicle Crew per month = (Driver Salary + Guard Door Bus Salary) x Value Ratio
  • Total Salary Vehicle Crew per year = (Total Salary Vehicle Crew per month x 12 months) + THR
  • Total Salary Vehicle Crew per kilometers = Total Salary Vehicle Crew per year / Length of Corridor 9 per year

2.5. Variable cost
To calculate variable costs, components such as fuel costs, tire usage costs, and vehicle maintenance and repair costs are needed [3]. The detail calculation of each component as follows
  • BBG Usage Fee per day = Use of CNG per day x Price of CNG per LSP
  • BBG Usage Fee per year = Usage of CNG per day x 350 days (assumed 350 days per year for ideal operations)
  • BBG Usage Fee per kilometer = Cost of CNG Consumption per year / Length of Corridor 9 per year
  • Total Tires Replacement per year = (Length of Corridor 9 per year / Durability Tire) x Total Tire Usage
  • Tires Usage Fees per year = Price x Amount of New Tires
  • Tires Usage kilometer = Cost per year / Total length of track per year
  • Small Service per year = Length of Corridor 9 per year / Distance per kilometer of Small Service
  • Small Service Maintenance Costs per year = Total Cost of Small Service x Small Service per year
  • Small Service Maintenance Costs per kilometer = Small Service Maintenance Costs per year / Length of Corridor 9 per year
- Large Service per year = Length of Corridor 9 per year / Distance per kilometer of Large Service
- Large Service Maintenance Costs per year = Total Cost of Large Service x Large Service per year
- Large Service Maintenance Costs per kilometer = Large Service Cost per year / Length of Corridor 9 per year
- Non-Scheduled Maintenance Service Fee per year = Total number of non-scheduled service items
- Non-Scheduled Service Maintenance Costs per kilometer = Non-Scheduled Service Maintenance Costs per year / Length of Corridor 9 per year
- Total Cost of Maintenance and Repair Vehicle per year = Small Service Maintenance Costs per year + Large Service Maintenance Costs per year + Non-Scheduled Maintenance Costs per year
- Total Cost of Maintenance and Repair Vehicle per kilometers = Total Vehicle Maintenance and Repair Costs per year / Length of Corridor 9 per year

3. Result and Discussion

3.1. General Characteristic of Passengers
- Number of Respondents by Rising and Falling Passenger
  Total number of respondents are 130.
- Number of Respondents by Gender
  The number of male and female respondents are 59 and 71 respectively.
- Number of Respondents by Age
  The number of respondents by age as follows 25-35 years (29%), 18-25 years (25%), 35-45 years (24%), 45-55 years (15%), 55-60 (5%) and less than 17 years (2%).
- Number of Respondents by Disability
  Only 1 passenger who had limitation (using walkers).

3.2. Passengers Perception

Table 2. Passenger Perception Questionnaire

| Question | Score 1 | Score 2 | Score 3 | Score 4 | Score 5 | Total Respondents | Total score |
|----------|---------|---------|---------|---------|---------|-------------------|-------------|
| 1        | Zhongtong LCK6180GC | 0 (0.0%) | 9 (6.9%) | 37 (28.5%) | 64 (49.2%) | 20 (15.4%) | (100.0%) | 485 |
|          | Scania K3201A | 0 (0.0%) | 3 (2.3%) | 16 (12.3%) | 76 (58.5%) | 35 (26.9%) | (100.0%) | 553 |
|          | Zhongtong LCK6180GC | 1 (0.8%) | 9 (6.9%) | 58 (44.6%) | 57 (43.8%) | 5 (3.8%) | (100.0%) | 446 |
|          | Scania K3201A | 0 (0.0%) | 1 (0.8%) | 25 (19.2%) | 72 (55.4%) | 32 (24.6%) | (100.0%) | 525 |
|          | Zhongtong LCK6180GC | 2 (1.5%) | 8 (6.2%) | 59 (45.4%) | 52 (40.0%) | 9 (6.9%) | (100.0%) | 448 |
|          | Scania K3201A | 0 (0.0%) | 1 (0.8%) | 14 (10.8%) | 73 (56.2%) | 42 (32.3%) | (100.0%) | 546 |
|          | Zhongtong LCK6180GC | 15 (11.5%) | 30 (23.1%) | 55 (42.3%) | 25 (19.2%) | 5 (3.8%) | (100.0%) | 365 |

What do you think about temperature inside the bus?
What is the noise level of the bus engine?
What is the sitting condition in the bus? (damaged, torn, thin foam)
How does the density of the bus?
Table 3. Comparison of The Score

| Number | Commentary | Zhongtong LCK6180GC | Scania K3201A | Comparison of Percentage |
|--------|------------|---------------------|---------------|-------------------------|
| 1      | Temperatures| 485                 | 553           | 13%                     |
| 2      | Machine Noise| 446                 | 525           | 16%                     |
| 3      | Seating Conditions| 448               | 546           | 18%                     |
| 4      | Passenger Density| 365               | 424           | 14%                     |
| 5      | Passenger Holder| 447               | 521           | 14%                     |

From table 3 shown the Scania type has dominant for good perception to all the question compare to Zhongtong. It can be assumed that the Scania type is newer and also still in good conditions compare to Zhongtong.

3.3. Questioner Validation

Table 4 shown the example of validation of Zhongtong Passengers with Pearson Correlation. It is shown that all the question value is higher than value of R Table. It means that this correlation is valid.

Table 4. Validation of Zhongtong Questioners

| Correlations | X1.1 X1.2 X1.3 X1.4 X1.5 X1.6 X1.7 Total_X1 R Table Valid |
|--------------|-----------|----------|----------|----------|-----------|----------|-----------|-----------|
| X1.1 Pearson Correlation | 1  .491  .260  .549  .319  .427  .098  .662  0.361  Yes |
| N | 30 30 30 30 30 30 30 30 |
| X1.2 Pearson Correlation | .491 1  .166  .264  .342  .449  .636  .728  0.361  Yes |
| N | 30 30 30 30 30 30 30 30 |
| X1.3 Pearson Correlation | .549  .264  .695  1  .399  .270  .335  .746  0.361  Yes |
| N | 30 30 30 30 30 30 30 30 |
| X1.4 Pearson Correlation | .319  .342  .207  .399  1  .087  .334  .660  0.361  Yes |
| N | 30 30 30 30 30 30 30 30 |
| X1.5 Pearson Correlation | .098  .636  .373  .335  .334  .135  1  .665  0.361  Yes |
| N | 30 30 30 30 30 30 30 30 |
| Total_X1 Pearson Correlation | .662  .728  .594  .746  .660  .476  .665  1  0.361  Yes |
| N | 30 30 30 30 30 30 30 30 |

3.4. Comparison of Vehicle Operating Costs (VOC)

Vehicle operating costs for Scania bus type K3201A is higher than Zhongtong LCK6180GC types with percentage of 54% vs 46%. In detail, some of the VOC component of Scania are higher
than Zhongtong. Scania need 24% more fuel compare to Zhongtong and maintenance cost of Scania is 18% higher than Zhongtong.

3.5. Comparison of Revenue Analysis
The revenue of both types of buses calculated with components such as passenger capacity, ticket prices, roundtrip.

- Company Revenue per day = Passenger Capacity x Roundtrip Ticket Prices
- Company Revenue per year = (Company revenue per day x 350) + PSO Local Government Fund
- Total Company Revenue per year = Company Revenue per year - Total Operational Vehicles per year
- Total Company Revenue per kilometer = Company Revenue per year / Length of Corridor 9 per year

The calculation shown that the revenue per km for Zhongtong is higher than Scania (51% vs 49%). This can be explained that VOC of Scania is higher than Zhongtong with the same number of passenger and same fare.

3.6. Farebox Recovery Ratio
The farebox recovery ratio is the ratio of fare revenue to total transport expenses for a given system. In the other word, the fraction of operating expenses which are met by the fares paid by passengers. Farebox Recovery Ratio = Company Revenue per year / Vehicle Operating Costs per year.

| Farebox Recovery Ratio |
|------------------------|
| Zhongtong LCK6180GC    | 3.95 |
| Scania Type K3201A     | 3.37 |

From the Table 5, it can be shown that Zhongtong has higher Farebox Recovery Ratio compared to Scania. This result can be explained because of the VOC per year of Scania is 15% higher than Zhongtong. It is also shown that the lower VOC value, the efficiency of the operation of bus is higher [4].

4. Conclusions
From the analysis of VOC, the VOC of Scania is 15% higher than Zhongtong which means that the Zhongtong may more efficient and economical than Scania. This result impacted to the farebox recovery rations of two buses. The fare is the same for both buses however the revenue from Zhongtong is higher than Scania since Zhongtong is more efficient than Scania. But the result is contrary from the passenger perspective, the level of satisfaction of Scania is 16% higher than Zhongtong.

References
[1] Warpani, S. 1990. Merencanakan Sistem Perangkutan. Bandung. Institut Teknologi Bandung.
[2] Institute for Transportation and Development Policy. 2009. Transjakarta: Guidelines for Minimum Service Standards. Jakarta.
[3] Decree of the Director General of Land No. SK.687 / AJ.206 / DrJD / 2002. Technical Guidelines for Implementation of Public Transport in Urban Areas for Fixed And Regular Route.
[4] Zulkifli Ramadan. 2014. Analysis Calculation and Comparison Vehicle Operating Costs (VOC) Bus Rapid Transit (BRT) Transmussi Type Mercedes Benz-OH-1521 And Hino RK8-235. Sriwijaya University. Palembang.