

## Analysis of Operational Performance and Price of Penataran Train on Surabaya City – Blitar Route

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### ABSTRACT

The Penataran Train is the train that has the highest passenger volume among the Local Economy Trains in East Java Province. The Penataran train is very much needed by people, but if the operational and management is not handled properly, it may affect on the effectiveness and efficiency of the transportation system as a whole. Operational performance assessment is needed to improve the services to users of the Penataran Train in the future. Operational performance was assessed on several aspects, including load factor, travel time, frequency, headway, and ticket prices. The purpose of this study was to analyze the operational performance and prices of the Penataran Train on Surabaya City – Blitar route. The results showed that the average load factor was 61% and met the standard of SE No. 24 of 2020. The average rate of the train arrival time of 99% was in accordance with the SIPOKA standard. In contrast, the average rate of departure time of 83% was not in accordance with the SIPOKA standard. The frequency of 8 trips per day with a headway of 198.75-202.25 minutes was not meet the standards in KM No. 22 of 2003. The point of intersection between the respondents' ATP and WTP was at a price following the ticket price stipulated in PM No. 21 of 2020, which was Rp10,001–Rp15,000.

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## 1. INTRODUCTION

The Penataran Train is an alternative solution for public transportation for residents in East Java in supporting activities of mobility from one city to another. The Penataran Train is one of the trains that has the highest passenger volume among local economy trains in East Java province. In 2020, data issued by PT KAI Daop 8 in 2021 showed that 1,323,367 passengers using the Penataran Train. The Penataran Train's daily operational schedule is four trips from Surabaya City and four trips. Information issued by PT KAI in 2021, the Penataran Train series consists of a single locomotive, six economy class passenger trains (K3), and one generator dining train (KMP3). The carrying capacity is 636 passengers and travel times ranging from 5-6 hours [1]. The price for one trip for the Penataran train is between Rp. 10,000 – Rp. 15,000.00.

The operation of railway facilities must meet the operating standards of railway facilities that form the railway service network [2]. To maintain the services of the Penataran Train, it needs to maintain the operational performance of the train to always be optimal [3]. The bad condition of the public transportation system could reduce the effectiveness and efficiency of the transportation system as a whole. The existence of the Penataran Train is very much needed by the community. But, when the performance is not handled properly, it may cause problems. For example, the travel time does not in accordance with the schedule and ticket prices are higher than people's purchasing power which results in decreased passenger occupancy. Data released by the Master Standard for Control of Railway Operations (SIPOKA) Daop 8, the delay of the Penataran train is generally caused by road obstacles due to natural factors, such as floods and landslides, crossing transfers, and overtaking between trains.

Evaluation of the operational performance of public transportation may be reviewed based on several aspects. Aspects of operational performance set by the World Bank include load factor, frequency, headway, and travel time [4]. Load factor is the ratio between sold of load capacity and availability of load capacity for one trip, expressed in percent (%) [5], [6]. The load factor greatly affects the comfort of passengers in using public transportation. The Standard load factor set by SE No. 24 of 2020 is 70%. Travel time is the time needed for a vehicle or transportation in a certain route, including the stopping time for getting on and off passengers and the time of delays [7]. Based on the minimum service standards of railways transportation, regulated by Minister of Transportation No. 63 of 2019 (PM 63 of 2019) on the Minimum Service Standards for the Mass Transportation by Train, the tolerance for delays on intercity trains is 10% of the total travel time according to the schedule. Frequency is the number of vehicles operating per unit time, expressed in units of vehicles per hour or per day. Headway is the distance or time interval between one vehicle and another successive vehicle when passing the same point [8]. The frequency value affects the headway. The more the number of vehicles operating in a certain period of time, the smaller the headway [9].

Operational performance assessment is also carried out by comparing current ticket prices with the willingness and passengers' ability to pay so that ticket prices could be appropriate to passengers or counting the subsidies issued by the state. Ability To Pay (ATP) is a person's ability to pay for services based on ideal income [10], [11]. Factors affected to ATP include income, transportation needs, total transportation costs, travel intensity, total expenditure per month, type of activity, and percentage of income for transportation needs. Willingness To Pay (WTP) is the willingness of users to pay for the services they receive [12]–[15]. Factors that affected the WTP include the production of transportation services by entrepreneurs, the quality and quantity of services provided by entrepreneurs, user benefits for transportation, and user income. The value of ATP and WTP is used to determine the relationship between ATP and WTP. ATP is a function of the ability to pay, so the value of the applicable price should not exceed the ATP value of a group of people. WTP is a function of the level of public transportation services so that when the WTP value is lower than the ATP value, it is still possible to increase the value of transportation price by following the increasing services on public transportation. The focus of this research was the analysis of the operational performance and price of the Penataran Train as a public transportation mode on Surabaya City - Blitar.

## 2. RESEARCH METHOD

### 2.1. Method of Data Collection

The types of data in the particular research were primary and secondary data [16]. Primary data was obtained through observations and questionnaire surveys [17]. Observations were used to obtain primary data on the travel time of the Penataran train. Observations were carried out 3 times for each of the Penataran train trips which were carried out every weekday on 26 April 2021 – 4 May 2021 and 24 – 29 May 2021. Questionnaires in a Google Form were used to obtain primary data, such as work, the number of trips, income,

the cost for transportation, and ticket prices by the passenger. Slovin formula in equation (1) was used in sample determination and obtained 97 respondents. The equation of the Slovin formula was as follows [18]:

$$n = \frac{N}{1+Ne^2} \quad (1)$$

Where n is the sample size. N is the population size. And e is the critical value (limit of accuracy).

Secondary data was obtained by borrowing data from PT. KAI Daop 8, such as GAPEKA, SIPOKA, Penataran train passenger volume per month, load capacity of Penataran train, and ticket prices.

$$n = N / (1 + Ne^2) \quad (1)$$

## 2.2. Data Analysis

### 2.2.1. Data Analysis Method of Load Factor

The data of load factor on the Penataran train obtained from equation (2) [19].

$$\text{load factor} = \frac{\text{total of passengers}}{\text{Capacity}} \times 100\% \quad (2)$$

### 2.2.2. Data Analysis Method of Time Travel

The ontime of the trip on the Penataran train was obtained through the formula for the percentage the time arrivals and departures. The formula for ontime is obtained from equation (3).

$$\% \text{ Ontime} = \frac{\text{Number of Station Ontime}}{\text{Total of stations}} \times 100\% \quad (3)$$

### 2.2.3. Data Analysis Method of Frequency

Data on the trip's frequency of the Panataran train obtained from the number of vehicles per time using equation (4). Headway data on the Penataran train calculated using equation (5).

$$\text{Frequency} = \frac{\text{Number of vehicle}}{\text{Time}} \quad (4)$$

$$\text{Headway} = \frac{\text{Time Different between vehicle}}{\text{Frequency}} \quad (5)$$

### 2.2.4. Data Analysis Method of Ability to Pay and Willingness to Pay

The questionnaire obtained Primary data of respondents' characteristics, including name, age, gender, and occupation, and the data were analyzed using a pie chart. Also, it obtained primary data such as occupation, number of trips, income, and realistic cost according to the passengers of Penataran train. Then, the primary data was analyzed using ATP and WTP methods. The ATP value was calculated using equation (6), while the WTP value was calculated using equation (7) [20], [21].

$$\text{ATP individual} = \frac{Ic \times \%TC}{D} \quad (6)$$

Where Ic is income per month. %TC is % of travel expenses of income per month. And D is the frequency of the trips. The WTP value calculated using the following formula:

$$\text{WTP} = \frac{\sum \text{WTP}}{N} \quad (7)$$

Where  $\sum \text{WTP}$  is the number of WTP for all occupations and N is the total respondents for each type of occupation.

## 3. RESULTS AND DISCUSSION

### 3.1. Load Factor

The data used in calculating the load factor was the passenger volume data of the Penataran train in the period December 2020 – February 2021 on weekdays. It aimed to determine the load factor of the Penataran train on normal conditions. In December 2020, there are 31 days with 22 working days and 9 holidays. In January 2021, there are 31 days with 20 working days and 11 holidays. And, in February 2021, there are 28 days with 19 working days and 9 holidays. The occupancy of all the Penataran train trips in the period December 2020–March 2021 was presented in Table 1. Based on Table 1, the average load factor of the

Penataran Train was 61%. Mean, the load factor of the Penataran Train has met the standards of SE No. 14 of 2020, which determined the maximum of 70%.

**Table 1 - Load Factor of Penataran Train**

Train Number	Load Factor			Average Load Factor Per Month	Average Load Factor
	December 2020	January 2020	February 2020		
367	69%	63%	68%	67%	61%
369	70%	66%	70%	69%	
370	61%	68%	70%	66%	
371	70%	66%	70%	69%	
372	63%	46%	59%	56%	
373	68%	45%	59%	57%	
374	69%	42%	53%	55%	
376	66%	36%	44%	49%	

### 3.2. Ontime of Penataran Train

Ontime analysis of the Penataran Train was carried out by comparing the train schedule based on GAPEKA with observations data of 3 times of travel time. The tolerance for delays in train departures and arrivals was stipulated in SIPOKA for the Penataran Train which is categorized as a train for economy class. The delay tolerance was set at 0.5 and 7 minutes for the economy class with a percentage of departure accuracy of 98.70% and a percentage of arrival accuracy by 67%. The level of on time arrival for all Penataran Train trip was presented in Table 2.

**Table 2 - The level of ontime arrival for the Penataran Train**

Train Number	Punctuality			Average Punctuality	Total Average
	Survey 1	Survey 2	Survey 3		
367	100%	100%	100%	100%	99%
369	100%	100%	100%	100%	
370	100%	100%	100%	100%	
371	100%	100%	100%	100%	
372	82%	100%	100%	94%	
373	100%	100%	100%	100%	
374	100%	100%	100%	100%	
376	100%	100%	100%	100%	

Based on Table 2, the average ontime arrival of the Penataran Train was 99%, which was in accordance with the SIPOKA standards by 67%. The level of ontime departure for the all Penataran Train trip was presented in Table 3.

**Table 3 - Level of ontime Departure of Penataran Train**

Train Number	Punctuality			Average Punctuality	Total Average
	Survey 1	Survey 2	Survey 3		
367	68%	82%	91%	80%	83%
369	86%	95%	100%	94%	
370	81%	95%	100%	92%	
371	82%	100%	100%	94%	
372	50%	91%	91%	77%	
373	76%	90%	90%	86%	
374	75%	80%	95%	83%	
376	48%	52%	81%	60%	

Based on Table 3, the average on time departure of the Penataran train was 83%, which was not in accordance with the SIPOKA standards by 98.7%.

### 3.3. Analysis of Frequency and Headway of Penataran Train

The calculation of the frequency and headway of the Penataran train referred to data released by GAPEKA. The Penataran Train has a frequency of 8 trips per day with 4 trips from the Station of Surabaya City and 4 trips from Blitar Station. The factor that affected the frequency of trips was the condition of the infrastructure, such as the number of lanes and the type of signaling. The condition of the infrastructure on the Surabaya – Blitar route was mostly single track with a mechanical signaling type, so it used a low frequency. Penataran Train serves intercity travel. The standard of travel frequency on low-frequency intercity trains was a maximum of 2 trips per hour (KM 22 of 2003). Based on the calculation results, the frequency of travel for the Penataran Train did not meet the standards in KM 22 of 2003, which was a maximum of 2 trips per hour for low frequencies.

Headway adalah interval waktu antara satu Kereta Api Penataran dan Kereta Api Penataran lain yang berurutan saat melewati satu titik yang sama. Rata-rata headway Kereta Api Penataran relasi Surabaya Kota–Blitar diperoleh sebesar 198,75 menit atau 3 jam 19 menit. Rata-rata headway Kereta Api Penataran relasi Blitar–Surabaya Kota diperoleh sebesar 201,25 menit atau 3 jam 22 menit. Berdasarkan hasil perhitungan, frekuensi dan headway Kereta Api Penataran belum memenuhi standar yang ditetapkan dalam KM 22 Tahun 2003 Tentang Pengoperasian Kereta Api yaitu headway 30–60 menit.

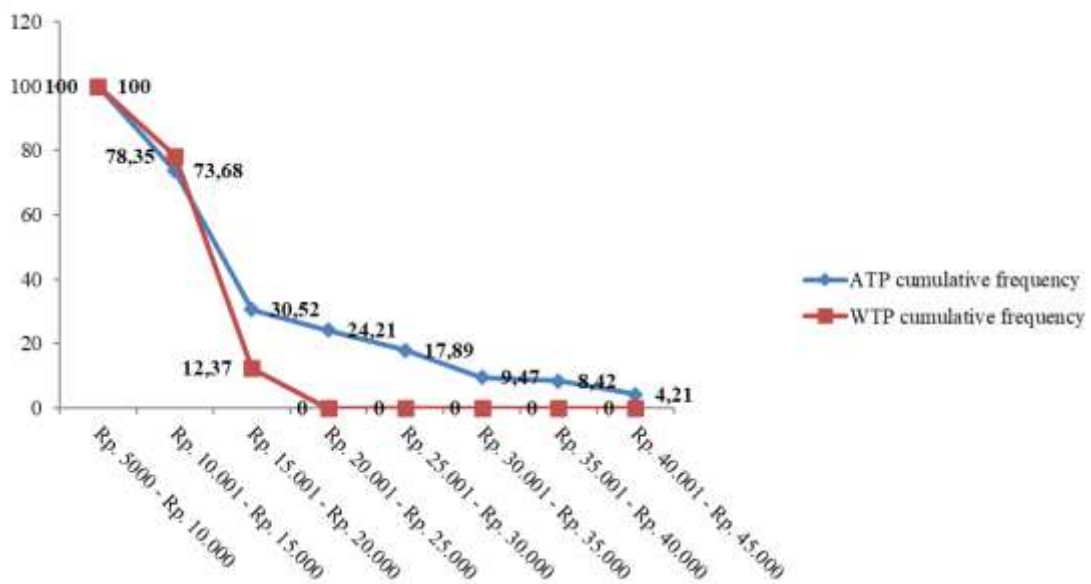
Headway is the time interval between one Penataran Train and another as it passes through the same point. The average headway of the Penataran Train for the Surabaya City – Blitar was 198.75 minutes or 3 hours 19 minutes. The average headway of the Penataran Train for the Blitar – Surabaya City was 201.25 minutes or 3 hours 22 minutes. Based on the calculation results, the frequency and headway of the Penataran Train have not met the standards in KM 22 of 2003 on Railway Operations, that the headway was 30-60 minutes.

### 3.4. ATP WTP Analysis of Penataran Train Passengers

In the ATP analysis of Penataran Train passengers, the value of ATP was influenced by the respondents' income, expenditure for transportation, expenditure for transportation using the Penataran Train, and the frequency of the respondents' trips in one month. The questionnaire showed the average respondents' income per month was Rp. 3,489,691. 30% of respondents have the highest income lower than Rp. 1,500,000. And, 23% of respondents have an average income of Rp. 3,500,000 - Rp. 4,500,000 per month.

The value of ATP highly depends on the respondent's ability to pay which is influenced by income, expenditure on transportation, and frequency of using transportation. The largest ATP value of the respondents was in the range of Rp. 10,001 – Rp 15,000 with 42% respondents. The ATP values were in the range of Rp. 5,000 – Rp. 10,000 with 26% of respondents. Based on the ATP value, it drew scenarios for the price of the Penataran train. First, if the price for the Penataran Train was set at Rp. 10,001–Rp. 15,000, then 74% of respondents have the ability to pay. Second, if the train price was set at Rp. 15,001–Rp. 20,000, then 32% of respondents have the ability to pay. And, if the train price was set at Rp. 20,001–Rp. 25,000, then 24% of respondents have the ability to pay.

In the analysis of WTP toward passengers of the Penataran Train, the value of WTP is influenced by the passengers' willingness to pay. The payment depends on the services and facilities obtained during the trip so that it obtained the price of the ticket train according to the respondent. The value of WTP depends on the willingness to pay of the respondents which are influenced by the service and facilities they received. The highest WTP value given by respondents was in the range of Rp. 10,001–Rp 15,000, which rated by 66% respondents. Then, 22% of respondents rated in the range of Rp. 5,000 – Rp. 10,000. In sum, If the ticket price was set at Rp. 10,000 – Rp. 15,000, the respondent's willingness to pay was 78%. And, if the ticket price was set at Rp. 15,001 – Rp. 20,000, the respondent's willingness to pay was 12%.



**Figure 1.** The relationship between ATP and WTP

Figure 1 showed the comparison between the ability to pay and the willingness to pay rated by respondents. Based on figure 1 concluded that the intersection point between the respondent's ATP and WTP was at a price of Rp. 10,001 – Rp. 15,000. This means the ability of passengers to pay and the willingness to pay was at Rp. 10,001 – Rp. 15,000. And the price was in accordance with the ticket price stipulated in PM No. 21 of 2020, which was IDR 10,000 – IDR 15,000.

#### 4. CONCLUSION

Analysis of the operational performance of the Penataran Train on aspects, such as load factor, travel time, frequency, headway, and ticket prices have met the standards. The average load factor was 61% and meets the standard SE No. 24 of 2020. The average rate of on time arrival was 99% and meet the SIPOKA standard. But the average rate of the departure time was 83% and was not in accordance with the SIPOKA standard. The frequency of 8 trips per day with a headway of 198.75 - 202.25 minutes was not meet the standards in KM No. 22 of 2003. The point of intersection between the respondents' ATP and WTP was at a price in accordance with the ticket price stipulated in PM No. 21 of 2020, which was Rp10,001–Rp15,000.

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