Abstract

Based on the results of the analysis, it is known that the problem at the Bakauheni Ferry Port is a decrease in productivity, especially passenger productivity due to the Covid-19 pandemic that entered Indonesia in March 2020. The limitation on the number of passengers from the total load capacity has caused the services provided so far to have to undergo many adjustments in meeting the adaptation of new habits to prevent the spread of Covid-19. In the context of optimizing crossing services on the Merak – Bakauheni crossing during the Covid-19 pandemic, it is necessary to make efforts, including evaluating the schedule for fleet needs and the frequency of departures on the route.

So that the implementation of the planned schedule can be carried out properly and there is a balance between the facilities that serve and the service users during the Covid-19 pandemic, it is necessary to reduce the number of ships operating according to current conditions so that they can achieve the ideal ship frequency according to the ship’s load capacity.

Based on this analysis, it can be concluded that the loading capacity of passengers and vehicles has decreased which affects the frequency of ships and the ideal number of ships to operate. The ideal number of ships is 22 ships/day at the regular dock and 5 ships/day at the executive dock with a ship frequency of 174 trips/day at the regular dock and 45 trips/day at the executive dock.

Keywords: Loading capacity, frequency, schedule, ship, track.

1. Introduction

Bakauheni Ferry Port is a ferry port located in Lampung Province and is under the supervision of Land Transportation Management Center Region VI Bengkulu and Lampung Provinces. The trajectory is the Merak – Bakauheni crossing which is separated by the Sunda Strait and has a distance of about 15 miles. Bakauheni Ferry Port has 7 (seven) Moveable Bridge piers consisting of 6 (six) regular piers and 1 (one) executive pier. The specified travel time for the Merak – Bakauheni route is 108 minutes for regular ships and 75 minutes for executive ships with a service time of 60 minutes at both piers. Bakauheni Ferry Port has 73 (seventy three) ferry boats, including 8 (eight) PT. ASDP Indonesia Ferry (Persero) and 65 (sixty five) private vessels.
The Covid-19 pandemic has hit all countries in the world, including Indonesia, which was confirmed to have entered in March 2020 to date and has had a significant impact on the sectors driving the economy, one of which is the transportation sector. One of the impacts is a decrease in the movement of transportation modes. This is because the government made a decision with the existence of a new social system, namely social distancing and physical distancing, and was followed up with the Large-Scale Social Restriction Policy (PSBB). The government applies regulations on transportation services in the form of limiting the number of passengers from the total load capacity. The application of this rule causes passenger productivity to decrease and the services that have been provided so far have had to undergo many adjustments in order to meet the adaptation of new habits to prevent the spread of Covid-19. Bakauheni Ferry Port experienced a decline in productivity between the period before the Covid-19 pandemic (March 2019 - February 2020) and the period during the Covid-19 pandemic (March 2020 - February 2021). This is because in the period before the Covid-19 pandemic, ships could transport passengers and vehicles with a carrying capacity of 100% without social distancing. Meanwhile, during the Covid-19 pandemic, the number of passengers and vehicles experienced a decline in social distancing restrictions because ships could only carry 50% of passengers. Therefore, in the context of optimizing crossing services on the Merak - Bakauheni crossing during the Covid-19 pandemic, it is necessary to make efforts including evaluation of fleet needs and the frequency of departures on the route. The purpose of this study was to (1) determine the load factor of ships operating on the Merak - Bakauheni crossing during the Covid-19 pandemic. (2) Knowing the schedule for the Merak - Bakauheni crossing in 2021 can be optimal to meet transportation needs during the Covid-19 pandemic.

2. Research Method
The writing in this study uses a quantitative approach by analyzing the number of ships and the frequency of ships that are suitable for the Merak - Bakauheni crossing during the Covid-19 pandemic. Collecting data using the method of observation, and literature. Data collection is intended to obtain relevant, accurate and real data material. Where 1) Observation is an observation process using our five senses. 2) The library method is one of the first steps in the data collection method. This method is also a collection method directed at searching for data and information through documents, both written documents, photographs, pictures, and electronic documents that can support the research process.

3. Results and Discussion
The analysis used in this study is as follows:

a. Analysis Load Factor
Analysis of the load factor of the ferry crossing Merak - Bakauheni there are several things that need to be considered, namely, the number of passengers and vehicles and the capacity of the ferry that carries passengers and vehicles. The number of passengers and vehicles transported affects the load factor of the Merak - Bakauheni crossing in Lampung Province. From the calculation, the average total load factor can be calculated during the Covid-19 pandemic at the regular and executive docks of the Bakauheni Ferry Port, as follows:
Based on the calculations above, it was found that the average load factor during the Covid-19 pandemic at the regular dock for passengers was 2.5% and for vehicles was 137.52% while the average load factor during the Covid-19 pandemic at the executive dock was for passengers is 2.42% and for vehicles is 148.87%. A comparison of the load factor was obtained between before the Covid-19 pandemic (March 2019 - February 2020) and during the Covid-19 pandemic (March 2020 - February 2021) which is shown in the following graph:
Evaluation Of Implementation (Driaskoro Budi, et. al)

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Figure 3 Comparison of Executive Jetty Passenger Load Factor

Executive Vehicle Load Factor Comparison

Figure 4 Comparison of Executive Jetty Vehicle Load Factor

Based on the graph, the load factor during the Covid-19 pandemic decreased on average compared to the load factor before the Covid-19 pandemic. The average ship load factor of Merak - Bakauheni at the regular dock during the Covid-19 pandemic decreased, for passengers to 2.5% and vehicles to 137.52%, while at the executive dock there was an increase for passengers to 2.42% and vehicles to 148.87%.

b. Forecasting passenger and vehicle productivity

In this calculation, it is predicted that the growth or demand for passenger and vehicle transportation is based on the realization of productivity during the Covid-19 pandemic, namely productivity from January 2021 - June 2021 to find out the growth of passengers and vehicles in July 2021 - December 2021. Prediction of the number of passengers and vehicles can be calculated using the Microsoft Excel program by using the following formula:

\[ Y = a + bX \]

Information:
- \( Y \): Predicted variable
- \( X \): time variable
- \( a \) and \( b \): Parameters and regression coefficients

The results of the prediction of passenger and vehicle growth are obtained as follows:

1) Passenger Prediction Calculation

Calculation of passenger predictions in July 2021 – December 2021 using Microsoft Excel linear regression calculations as follows:

Table 2 Passenger Productivity Predictions

<table>
<thead>
<tr>
<th>Year</th>
<th>Passenger (Person)</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 2021</td>
<td>30,555</td>
</tr>
<tr>
<td>August 2021</td>
<td>28,060</td>
</tr>
<tr>
<td>September 2021</td>
<td>25,564</td>
</tr>
<tr>
<td>October 2021</td>
<td>23,069</td>
</tr>
<tr>
<td>November 2021</td>
<td>20,574</td>
</tr>
<tr>
<td>December 2021</td>
<td>18,078</td>
</tr>
</tbody>
</table>
Based on the table above, it can be seen that there was a decrease in passenger productivity in July 2021 - December 2021.

2) Vehicle Prediction Calculation

Calculation of vehicle predictions in July 2021 – December 2021 using Microsoft Excel linear regression calculations as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Vehicle (Unit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 2021</td>
<td>184.190</td>
</tr>
<tr>
<td>August 2021</td>
<td>184.627</td>
</tr>
<tr>
<td>September 2021</td>
<td>185,065</td>
</tr>
<tr>
<td>October 2021</td>
<td>185.502</td>
</tr>
<tr>
<td>November 2021</td>
<td>185,940</td>
</tr>
<tr>
<td>December 2021</td>
<td>186,377</td>
</tr>
</tbody>
</table>

Based on the table above, it can be seen that there is an increase in vehicle productivity in July 2021 - December 2021.

c. Analysis of Ship Operation Schedule in Setting Ship Departure Schedule

1) Ship Frequency

Determining the frequency is determined from the number of transportation requests, namely the number of requests for passenger and vehicle transportation at the Bakauheni Ferry Port.

The number of ship frequencies needed for regular docks, namely:

\[
FK = \frac{N}{365 \times K \times O \times M}
\]

\[
FK = \frac{94,673.215,83}{365 \times 0.9 \times 0.7 \times 2364.174}
\]

\[
FK = 94,673.215,83
\]

\[
FK = 543.641,8113
\]

\[
FK = 174,15 \text{ Trip/day}
\]

\[
FK = 174 \text{ Trip/day}
\]

The number of ship frequencies needed for the executive dock, namely:

\[
FK = \frac{N}{365 \times K \times O \times M}
\]

\[
FK = \frac{29,665.233,31}{365 \times 0.9 \times 0.7 \times 2858.849}
\]

\[
FK = \frac{29,665.233,31}{29,665.233,31}
\]

\[
FK = 657.392,328
\]

\[
FK = 45,13 \text{ Trip/day}
\]

\[
FK = 45 \text{ Trip/day}
\]
Based on the above calculation, it was found that the number of appropriate ship frequencies at the regular dock is 174 trips/day while the appropriate ship frequency at the executive dock is 45 trips/day.

2) Number of ships

Based on the survey, it is known that the lay over time for the regular jetty is 69 minutes while the executive dock is 68 minutes. After knowing the Sailing Time (ST) and Lay Over Time (LOT), you can determine the RTT (Round Trip Time) as shown in the following table:

<table>
<thead>
<tr>
<th>Sailing Time</th>
<th>Lay Over Time</th>
<th>RTT = 2 x (ST+LOT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>108 minutes</td>
<td>69 Minutes</td>
<td>354 Minutes</td>
</tr>
<tr>
<td>75 minutes</td>
<td>68 Minutes</td>
<td>286 Minutes</td>
</tr>
</tbody>
</table>

Based on the calculation, it is known that the RTT (Round Trip Time) for regular ships is 354 minutes while the RTT (Round Trip Time) for executive ships is 286 minutes. After obtaining the RTT (Round Trip Time), the Trip Capability (KT) of the ship can be determined using the formula:

\[
KT = \frac{\text{Ship operating time in port}}{\text{RTT}}
\]

a) Regular Pier Plan Ship Trip Capability

\[
KT = \frac{1440 \text{ menit}}{354 \text{ menit}}
\]

\[
KT = 4,06 \text{ RTT/Kapal} = 8 \text{ Boat Trips/day}
\]

b) Executive Pier Plan Boat Trip Capability

\[
KT = \frac{1440 \text{ menit}}{286 \text{ menit}}
\]

\[
KT = 5,03 \text{ RTT/Kapal} = 10 \text{ boat trips/day}
\]

c) Number of Vessels Required Regular Pier

\[
\text{Jumlah kapal} = \frac{\text{Number of frequencies needed}}{\text{Trip ability}}
\]

\[
\text{Jumlah kapal} = \frac{174}{8}
\]

Number of ships = 21.75 ships

Number of ships = 22 ships
d) Number of Vessels Required Executive Pier

\[
\text{Jumlah kapal} = \frac{\text{Number of frequencies needed}}{\text{Trip ability}}
\]

Jumlah kapal = \frac{45}{10}
Number of ships = 4.5 ships
Number of ships = 5 ships

Based on calculations that have been made with RTT for 354 minutes for regular docks, the frequency of ships is 174 trips per day with the ability to trip 8 times per ship. While the calculation is carried out with RTT for 286 minutes for the executive pier, the frequency of ships is 45 trips per day with the ability to trip 10 times per ship. For the required number of 22 ships at the regular dock and 5 ships at the executive dock.

3) Headway

Before setting the ship’s departure and arrival schedule, the Headway must first be determined using the formula:

\[
\text{Headways} = \frac{\text{Ship operating time in port}}{f}
\]

a) Headway regular pier

\[
\text{Headway} = \frac{\text{Ship operating time in port}}{f} = \frac{1440 \text{ minutes}}{174} = 8.27 \text{ minutes} = 8 \text{ minutes}
\]

b) Headway executive dock

\[
\text{Headway} = \frac{\text{Ship operating time in port}}{f} = \frac{1440 \text{ minutes}}{45} = 32 \text{ minutes}
\]

Based on the results of the above calculation, it is found that the regular ship's headway is 8 minutes while the executive ship's headway is 32 minutes. The results of the calculation of the schedule analysis can be seen as follows:

- Lay over time regular pier = 69 minutes
- Lay over time executive dock = 68 minutes
- Headway regular pier = 8 minutes
- Headway executive dock = 32 minutes
- Port operation time = 1440 minutes
- Regular jetty travel time = 108 minutes
- Executive pier travel time = 75 minutes
Based on the results of the analysis, a schedule can be made by compiling a departure and arrival schedule on the Merak - Bakauheni route. The following is the planned schedule at Bakauheni Ferry Port:

### Table 5 Planned Ship Departure Schedule (Regular)

<table>
<thead>
<tr>
<th>No</th>
<th>Dock</th>
<th>Ship name</th>
<th>Trips / Departures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Trip 1</td>
</tr>
<tr>
<td>1</td>
<td>MB I</td>
<td>Ship A</td>
<td>08.00</td>
</tr>
<tr>
<td>2</td>
<td>MB II</td>
<td>Ship B</td>
<td>08.08</td>
</tr>
<tr>
<td>3</td>
<td>MB III</td>
<td>Ship C</td>
<td>08.16</td>
</tr>
<tr>
<td>4</td>
<td>MB IV</td>
<td>Ship D</td>
<td>08.24</td>
</tr>
<tr>
<td>5</td>
<td>MB V</td>
<td>Ship E</td>
<td>08.32</td>
</tr>
<tr>
<td>6</td>
<td>MB VI</td>
<td>Ship F</td>
<td>08.40</td>
</tr>
<tr>
<td>7</td>
<td>MB I</td>
<td>Ship G</td>
<td>08.48</td>
</tr>
<tr>
<td>8</td>
<td>MB II</td>
<td>Ship H</td>
<td>08.56</td>
</tr>
<tr>
<td>9</td>
<td>MB III</td>
<td>Ship I</td>
<td>09.04</td>
</tr>
<tr>
<td>10</td>
<td>MB IV</td>
<td>Ship J</td>
<td>09.12</td>
</tr>
<tr>
<td>11</td>
<td>MB V</td>
<td>Ship K</td>
<td>09.20</td>
</tr>
<tr>
<td>12</td>
<td>MB VI</td>
<td>Ship L</td>
<td>09.28</td>
</tr>
<tr>
<td>13</td>
<td>MB I</td>
<td>Ship M</td>
<td>09.36</td>
</tr>
<tr>
<td>14</td>
<td>MB II</td>
<td>Ship N</td>
<td>09.44</td>
</tr>
<tr>
<td>15</td>
<td>MB III</td>
<td>Ship O</td>
<td>09.52</td>
</tr>
<tr>
<td>16</td>
<td>MB IV</td>
<td>Ship P</td>
<td>10.00</td>
</tr>
<tr>
<td>17</td>
<td>MB V</td>
<td>Ship Q</td>
<td>10.08</td>
</tr>
<tr>
<td>18</td>
<td>MB VI</td>
<td>Ship R</td>
<td>10.16</td>
</tr>
<tr>
<td>19</td>
<td>MB I</td>
<td>Ship S</td>
<td>10.24</td>
</tr>
<tr>
<td>20</td>
<td>MB II</td>
<td>Ship T</td>
<td>10.32</td>
</tr>
<tr>
<td>22</td>
<td>MB IV</td>
<td>Ship V</td>
<td>10.48</td>
</tr>
</tbody>
</table>

### Table 6 Planned Ship Departure Schedule (Executive)

<table>
<thead>
<tr>
<th>No</th>
<th>Dock</th>
<th>Ship name</th>
<th>Trips / Departures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Trip 1</td>
</tr>
<tr>
<td>1</td>
<td>MB VII</td>
<td>Ship AA</td>
<td>08.00</td>
</tr>
<tr>
<td>2</td>
<td>MB VII</td>
<td>Ship AB</td>
<td>08.32</td>
</tr>
<tr>
<td>3</td>
<td>MB VII</td>
<td>Ship AC</td>
<td>09.04</td>
</tr>
<tr>
<td>4</td>
<td>MB VII</td>
<td>Ship AD</td>
<td>09.36</td>
</tr>
<tr>
<td>5</td>
<td>MB VII</td>
<td>Ship AE</td>
<td>10.08</td>
</tr>
</tbody>
</table>
The planned schedule has been adjusted to the number of ships and the appropriate frequency of ships so that the implementation of the schedule can be more optimal.

4. Closing
   a. Conclusion
      1) **Load factor** ships operating on the Merak - Bakauheni crossing during the Covid-19 pandemic experienced a decrease compared to the ship load factor before the Covid-19 pandemic.
      2) The schedule for the Merak - Bakauheni ferry crossing can be optimal to meet transportation needs during the Covid-19 pandemic, which is planned based on predictions of passenger and vehicle growth as well as calculations on the number of ships and the frequency of planned ship departures. In addition, it is necessary to have a Count Down Timer equipped with a siren at the dock so that the planned schedule can be implemented optimally.

   b. Suggestion
      1) Improving services to service users, by reviewing the ship loading factor in order to achieve a balance between the need for ferry transportation and the transportation provided and more efficient crossing activities.
      2) It is advisable to reduce the number of ships operating in accordance with current conditions so that they can achieve the ideal frequency of ship departures in accordance with the loading factor and balanced against the needs of service users during the Covid-19 pandemic.

5. References
   1) Law of the Republic of Indonesia Number 17 of 2008 concerning Cruise
   2) Government Regulation Number 20 of 2010 concerning Water transportation
   3) Regulation of the Minister of Transportation Number 104 of 2017 concerning Operation of Crossing Transportation,
   5) Regulation of the Director General of Land Transportation Number: SK.2681/AP.005/DRJD/2006 concerning the Operation of Ferry Ports