Analysis on Logistic Company Action toward the Access Restriction Policy on Freight Vehicle

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\textbf{Abstract.} The high volume of freight vehicles that enters, leaves or passes through the urban areas, especially Jakarta, has caused traffic congestion. Local authority plans to perform the access restriction on freight vehicles on the Jakarta Outer Ring Road (JORR) to reduce the congestion on that toll road. The study aims to analyze the alternative solutions of the logistics companies to overcome the impact of such policy. The data collection is done by interviewing 102 truck drivers and 7 staffs of logistic companies that use JORR. The results show that the most preferred action is shifting the operating time. Based on the open test, access restriction policy on JORR may cause a significant impact on the operational costs of delivery. Shifting the operating cost by 1.71\%, while turning the route will increase the operating costs by 4.35\%. Moreover, changing the mode will reduce the operating expenses by 50\%, and the combination action of shifting the route and the time will increase the operating costs by 5.39\%.

\textbf{INTRODUCTION}

Transportation is a very vital for society because every people needs to transport to support their daily activity. In the city, transportation has a significant role in promoting public social-economics activity. A city can be characterized as a point of consumption, a connector between central of production and the end point of marketing products. The economics growth of the city depends on the efficiency of freight distribution that plays a significant role in the competitiveness of urban areas both in terms of generated income and employment.

As a capital city and the central of national economics, Jakarta city is facing numerous logistic transportation problems. The intensive goods movement has increased the traffic burden of the city. Afterward, the emergence of congestion may affect the operational cost of logistic activities. This could have an adverse impact on the economics of the city.

Freight vehicle tends to have a bigger size and requires more space to move rather than the other vehicles, so it can be the source of traffic congestion. Restricting large trucks in cities has been one of the most popular measures in developing countries due to road capacity limitations. The vehicle restriction policy in Metro Manila is one of the cases of large truck restrictions currently in effect. This system has been applied since 1978 as a measure to alleviate the worsening conditions of road traffic congestion. The ban applied to trucks with gross weights of more than 4.5 tons and prohibits vehicle movements along eleven specific routes, mostly primary arterial roads. The disadvantage of a road restriction is that it needs the enforcement, and it may impose the extra cost of delivery.

Some policies have been established by the government to reduce the congestion in the Jakarta. The Minister of Transportation of the Republic of Indonesia released the Regulation of the Minister of Transportation No. 62 in 2011 regarding the operating time restriction of freight vehicles at Jakarta Intra Urban Toll road (JIUT). Truck restriction is applied to delivery vehicles with axis configuration 1.2 or more on some segments of JIUT during 05.00 am – 10.00 pm with an exception for goods vehicles that carry petrol and gas (Figure 1).
Jakarta Outer Ring Road (JORR) is the other toll road of Jakarta, and it surrounds Jakarta. Due to the severe congestion occurred in such toll road dominated by truck trips, the government and PT. Jasa Marga as the toll operator planned to implement vehicle restriction policy to reduce the traffic congestion.

FIGURE 1 Jakarta Toll Road Network (Source: Department of Transportation DKI Jakarta)

Prior to the implementation of the policy, it is required to assess the impact of the truck restriction on the logistics company, particularly on their operating cost. Regarding the constraint, the logistics companies may have different solutions to overcome the consequences. They may choose to shift their operational time to the time at which the toll road is accessible for them. They may also want to change their routes to other ones, and it may cause the additional cost. Though the policy is aimed to reduce the congestion on JORR, it is important to see that it may cause a burden to the other parts of the road network of Jakarta or to the other time windows.

Based on this rationale, it is necessary to study the strategies that would be taken by logistic actors if hypothetically the truck restriction in JORR is applied, and also to investigate the impact of the policy on their operating cost. The objective of this research is to analyze the actions of the logistic actors and its implications due to the truck access restriction on JORR that is planned to be applied to this toll road.

METHODS

This research is initialized by defining the alternative actions that may be chosen by the logistics company if the local authority performs the truck access restriction on JORR. It is described as route shifting, time shifting, mode shifting, and their combination, i.e. route and time shifting, route and mode shifting, and time and mode shifting. The impact of choosing the action toward the logistic actors is represented by the operating cost.

Data collection is initialized by interviewing 7 staffs of logistic companies to identify their opinions concerning the truck access restriction in JORR. It is found that all the companies give the authority to decide the best action to the truck drivers as they know more about the operational aspects of the delivery process. It is confirmed on the interview of 102 truck drivers that use JORR. The questionnaires are a combination of closed questions and open-ended questions. Besides the alternative action that will be chosen by the drivers, the drivers are asked about the actual operational cost to travel from the origin to the destination as well as the possible value as the consequence of their choice. The operating cost covered all the expenses spent during the most frequent trip was taken from the origin to destination, including loading/unloading cost, fuel cost, road retribution, meal, and driver fee.

The drivers were interviewed at three rest areas, i.e. Jakarta-Cikampek toll road rest area, Jakarta-Tangerang toll road rest area and Jakarta-Bogor toll road rest area. Those locations were chosen based on the flow patterns of freight transport of Jakarta city. Jakarta is adjacent to Cikampek on the east side, to Tangerang on the west side, and to Bogor on the southern shore. Most of the trucks that use JORR is originated or destined to the toll roads located at those municipals (Fig. 1).
The adequacy of the data is tested with the number of disability or with the Bernoulli equation method. The minimum number of the sample which can be obtained from Bernoulli equation as follows:

$$N \leq \frac{(z_{a/2})^2 pq}{e^2}$$

where:
N = minimum number of sample
Z = value of normal distribution
p = proportion of questionnaires that are considered correct
q = proportion of questionnaires that are considered incorrect

In addition to the statistical description, normality test is done to check the distribution of the data. The result of normality test is used to determine the inferential analysis that will be performed later. If the normality test indicates that all variables are normally distributed, then the data is treated by parametric test and the statistic inductive calculation will use the parametric method. Vice versa, if the data is not normally distributed the inference test must use the non-parametric method. Normality test is done by applying the Normal Kolmogorov-Smirnov test of SPSS. If the significance level of the output of normality test is greater than 0.05, then the data is categorized as a normal distribution. Vice versa, if it is smaller than 0.05, then it is not normally distributed.

Furthermore, reliability test is carried out to measure the stability and consistency of respondents in answering the questions. Reliability is tested based on the following criteria:

<table>
<thead>
<tr>
<th>Range of $\alpha$</th>
<th>Interpretation of The Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.80 – 1.00</td>
<td>Very High</td>
</tr>
<tr>
<td>0.60 – 0.80</td>
<td>High</td>
</tr>
<tr>
<td>0.40 – 0.60</td>
<td>Medium</td>
</tr>
<tr>
<td>0.20 – 0.40</td>
<td>Low</td>
</tr>
</tbody>
</table>

The correlation test between variables is done to verify the relationship between two variables or more. The level of significance that is used to describe the correlation is based on the following rule:
- If Sig > 0.05 then $H_0$ is accepted. It means that there is no relationship between two variables;
- If Sig < 0.05 then $H_0$ is rejected. It means that there is a relationship between two variables.

In order to describe the object of observation through the sample data of population, the data is processed through the descriptive statistics, and the hypothesis test is done to analyze the impact of the actions chosen by logistic actors.

RESULT AND ANALYSIS

Based on adequacy data analysis, the minimum number of sample is 73, and then all of the data can be proceeded to statistic process. According to the normality test (Kolmogorov-Smirnov test), the significance of all variables is zero (sig < 0.05), then it can be concluded that the data should be processed with non-parametric statistic method. Furthermore, the reliability test finds that Cronbach’s Alpha is 0.53 (0.4-0.60). It implies that the data is reliable.

Description of the company characteristics is represented by its business sector, experience, commodity, fleet size, the number of drivers, and truck type. Business sector is categorized under 6 (six) groups, namely industry, trading, agriculture, mining, construction, and miscellaneous. Company experience is denoted by how long it is operated (in years). It is classified into 4 (four) groups, i.e. age < 10, 11 ≤ age ≤ 20, 21 ≤ age ≤ 30, and age > 30. In term of commodity handled, companies are categorized into 8 (eight) groups, i.e. food, waste, industrial product, agriculture, industrial equipment, construction equipment, delivery package, nine key food commodity, and chemical material. Fleet size is categorized into 6 (six) groups, namely fleet size < 20, 21 ≤ fleet size ≤ 40, 41 ≤ fleet size ≤ 60, 61 ≤ fleet size ≤ 80, 81 ≤ fleet size ≤ 100, and fleet size > 100. Regarding the number of drivers employed by the company, the company is grouped into 6 (six) classes, i.e. drivers < 20, 21 ≤ drivers ≤ 40, 41 ≤
drivers \leq 60, 61 \leq \text{drivers} \leq 80, 81 \leq \text{drivers} \leq 100, \text{drivers} > 100. Moreover, truck types are grouped into 5 (five) groups, i.e. one axle (1.1), two axles (1.2), three axles, four axles, five axles and more.

Regarding the operational characteristics of the company, some variables are identified, namely trip frequency, average speed, travel distance, delivery time and operating cost. Trip frequency denoted the number of trips taken per week by the driver. It is grouped into 5 groups, i.e. trips < 30, 30 \leq \text{trips} \leq 60, 61 \leq \text{trips} \leq 90, 91 \leq \text{trips} \leq 120, \text{trips} > 120. For the average speed (in km/hour), the trips categorized into 3 groups, i.e. speed < 30, 30 \leq \text{speed} \leq 60, \text{speed} > 60. Distance travelled (in km) by most of the trips is classified into 6 groups, i.e. distance < 100, 100 \leq \text{distance} \leq 300, 301 \leq \text{distance} \leq 500, 501 \leq \text{distance} \leq 700, 701 \leq \text{distance} \leq 100, \text{distance} > 100. The Central tendency of those variables is measured by its mode.

The alternative actions consist of 6 (six) categories namely shifting route, changing time, changing mode, moving route-time, shifting time mode, and shifting route-mode. Since no one chose the combination of route and mode shifting, as well as time and mode shifting, only 4 (four) alternative actions presented in Table 1. Table 1 indicates the statistics description of company characteristics. It can be seen that the features of the group of the six categories of actions are almost similar. It implies that the features of the company, as well as its operational characteristics do not affect the decision on the action that should be taken if the trucks are restricted in particular time window.

Figure 2 shows that 37.3% of respondents choose shifting route, 43.1% of shifting delivery time, 1% of changing the mode, and 18.6% of moving the road time. Table 2 shows the difference between the current operating cost and the possible operating cost as the truck restriction policy is applied. It is differentiated according to the type of action taken by the company. Table 2 and Figure 3 indicate the cost change (in %) as consequence of choosing the alternative work. The positive value means increasing the operating cost will choose the action, and vice versa for the negative value.

**TABLE 2.** Statistic Description of the Data

<table>
<thead>
<tr>
<th>Alternative action</th>
<th>Business Sector</th>
<th>Experience (years)</th>
<th>Commodity</th>
<th>Fleet size</th>
<th>Number of Drivers</th>
<th>Truck Type</th>
<th>Trip Frequency (trips/week)</th>
<th>Average Speed (km/hr)</th>
<th>Travel Distance (km)</th>
<th>Current Operating Cost (Rp.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route Shifting</td>
<td>Mean/Mode</td>
<td>miscella neous</td>
<td>&lt; 10 years</td>
<td>Industrial product</td>
<td>&lt; 20 &lt; 20</td>
<td>2 axles</td>
<td>&lt; 30 &lt;30 &lt;30 &lt;300</td>
<td>3,417,236</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>38</td>
<td>38</td>
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<td>38</td>
<td>38</td>
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<td>38</td>
</tr>
<tr>
<td>Time Shifting</td>
<td>Mean/Mode</td>
<td>miscella neous</td>
<td>&lt; 10 years</td>
<td>Industrial product</td>
<td>&lt; 20 &lt; 20</td>
<td>2 axles</td>
<td>&lt; 30 30-60 100-300</td>
<td>3,155,568</td>
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<tr>
<td>N</td>
<td>44</td>
<td>44</td>
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<td>44</td>
<td>44</td>
<td>44</td>
<td>44</td>
<td>44</td>
</tr>
<tr>
<td>Mode Shifting</td>
<td>Mean/Mode</td>
<td>miscella neous</td>
<td>&lt; 10 years</td>
<td>Industrial equipment</td>
<td>&lt; 20 &lt; 20</td>
<td>1 axle</td>
<td>61-90 30-60 100-300</td>
<td>1,500,000</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>1</td>
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</tr>
<tr>
<td>Route &amp; Time Shifting</td>
<td>Mean/Mode</td>
<td>miscella neous</td>
<td>&lt; 10 years</td>
<td>Industrial product</td>
<td>&lt; 20 &lt; 20</td>
<td>2 axles</td>
<td>&lt; 30 30-60 100-300</td>
<td>2,290,263</td>
<td></td>
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<tr>
<td>N</td>
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<td>19</td>
<td>19</td>
<td>19</td>
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<td>19</td>
</tr>
<tr>
<td>All sample</td>
<td>Mean/Mode</td>
<td>miscella neous</td>
<td>&lt; 10 years</td>
<td>Industrial product</td>
<td>&lt; 20 &lt; 20</td>
<td>2 axles</td>
<td>&lt; 30 30-60 100-300</td>
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Table 2 and Figure 3 indicate that all the alternative actions affect the operating cost of the logistics company. For the businesses that choose to shift the route the operational cost is increased by 1.71%. For them who decide to change the time, the operational cost is increased by 4.35%. Changing way and time increase the operating cost as 5.39%, and changing the mode decrease 50% of the operating cost.

Furthermore, a hypothesis test is conducted to test if truck restriction policy in JORR gives a significant impact on the operating cost of the company. The result of hypothesis test shows that the policy is having a significant impact on the increase of the operating cost. Shifting the time gives more consequence on the operational cost compared to the route shifting as it increases the working time of the drivers. In term of mode shifting, though the operational cost seems to be decreased, it is realized that the change of mode may lead to the consequence of the cost of investment.

Based on Figure 3, it can be seen that even though the truck access restriction policy might be expected to smooth the traffic in JORR, it might have the negative impact on the logistics actors. All the possible actions that they may choose except the shifting mode will increase their operational cost. It can be understood that trucks have
been troubled the other road users due to their size and their limitation in the movement. However, in term of the equity, vehicles are deemed to have the same right of using the road space. Hence, this policy is supposed to be complemented by the advisory system to keep the traffic remains smooth while the operational cost of logistics could be maintained. One of the advisory systems among others is by setting up viable alternative truck routes and proper truck rest area.

CONCLUSION

The analysis shows that time shifting is the most chosen action by the logistics actor to face the vehicle restriction policy that may be applied on JORR. The hypothesis test also shows that the vehicle restriction policy at JORR will affect the operating cost of Logistics Company. All alternatives of action, i.e. route shifting, time shifting, and the combination of route and time shifting may increase the operating cost ranged from 1.71% to 5.35%, whereas changing the mode will decrease the operational cost by 50%. In order to take into account the equity among all road users, this policy is supposed to be complemented by the advisory system to keep the traffic remains smooth while the operational cost of logistics could be maintained.

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