How did the COVID-19 Pandemic Impact Passenger Choice toward Public Transport? The Case of Jakarta, Indonesia

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Abstract

The development of public transport in Jakarta, Indonesia, in the last two decades is quite significant. However, the Corona Virus Disease (COVID-19) pandemic has changed people's travel habits. People have concerns about the spread of the virus on public transport. In order to become the primary choice to return to the New Normal, it is necessary to adjust the conditions of public transport. This paper aims to determine the considerations of passengers in determining the choice of using public transport. The research method used is qualitative by collecting data using a questionnaire and analysis using stated preference. The analysis shows that the passenger restriction and tariff discount significantly affect the probability of using public transport in the new-normal era with an R2 of 0.934. The sensitivity test shows that the stricter the passenger restriction and the discount rate, the higher the probability of using public transport.

Keywords

Pandemic impact, Passenger restriction,Public transport,Tariff

1. Introduction

The Corona Virus Disease (COVID-19) pandemic has occurred for almost two years, impacting all sectors. Transportation is one sector that has a considerable influence. This condition can be seen from the decrease in the number of public transport passengers.(Wielechowski, Czech, & Grzęda, 2020).The impact is getting higher in line with government policies in the form of travel restrictions on a micro-scale (Isradi& Abdika, 2021). The limitations and reluctance of humans to carry out mobility cause various modes of public transport to lose their passengers. Many public transport companies have to stop their business due to a lack of income (Isa, Nusa, Ishak, & Fam 2021). If these conditions continue, there is a possibility that the services of various modes of transportation will stop and cause the global transportation system to paralyze.

The economic and social impact of the COVID-19 outbreak on public transport extends beyond service performance. Health risks to financial viability, social equity, and sustainable mobility are the risks that are expected in the post-pandemic(Tirachini, 2020). The effects of the COVID-19 pandemic will last for a long time. However, it is necessary to control it so that public transportation can gradually operate again soon (Dong, Ma, Jia, Tian, 2021).Getting to a normal situation, of course, takes a long process. However, as an initial stage, adjustments can be made to conditions in the new-normal era. COVID-19 is assumed to be around public transport, so a protocol must be prepared that ensures the safety and health of passengers. In addition, passengers must also be encouraged to have a sense of comfort and satisfaction with the public transport conditions that will be chosen.

Public transport is a limited space conducive to the transmission of infectious diseases from human to human. As a result, several countries have reported large clusters of cases on public transport with infections caused by respiratory viruses, Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) (Shen et al., 2020). For common influenza, several studies report that the likelihood of spreading influenza increases sixfold for people traveling by public transport within five days of the onset of symptoms. This condition makes people have excessive worries when they have to use public transport. Of course, this condition must be addressed wisely by stakeholders so that public services are still served, and the transportation business is maintained.

To convince the public to continue to use public transport safely, of course, is not easy. It takes some research that can find out the desires and needs of the public transport users. Through these various studies, it is hoped that public transport operators can prepare various facilities and protocols for the convenience of passengers. Regulators, operators, and other stakeholders need to work together to serve passengers again optimally immediately. If this condition is left unchecked, it is feared that public transport users will decline, and private vehicle users will increase again and increase congestion levels (Tan & Ma, 2021).

As a country with a large population, Indonesia is undoubtedly quite at risk for the spread of COVID-19. Several times experienced COVID-19 emergencies, which caused restrictions and temporary suspension of public transport services(Olivia, Gibson, & Nasrudin, 2020).As a result, some public transport services in Jakarta experienced a decrease in passengers, resulting in a decrease in service frequency. The government, as the regulator, has to restore the public transport service immediately. Meanwhile, health and the pandemic must remain strictly controlled. Addressing these problems, of course, requires a measurable step so that public transport can continue to operate by modifying services that are safe for health during the pandemic. This paper aims to examine the public's desire to return to using public transport.

2. Literature Review

Public transport as part of the urban transportation system is one of the basic needs of the urban community and is an inseparable part of the city's needs in general. This public transport has a vital role in serving urban transportation and provides convenience for the community to carry out their activities in different locations and spread across urban areas. Therefore, public transportation is needed, especially for people who do not have personal means of transportation. Given its essential role, city life will become a problem (Kakar & Prasad, 2020).

In the basic theory of transport system planning, it is stated that the quality and quantity of services are a significant part of the development of public transport. Some things that become the reference for service level are schedule, Tariff, service time, security, and convenience. COVID-19 has added to the quality of public transport services, namely anticipating the risk of being exposed to the virus while traveling. When all of these are met, reliable services can be realized. Of course, the needs and expectations of public transport users will continue to develop following technological advances and current conditions (Cooke & Behrens, 2017).

2.1 Public Transport

The development of public transport has developed since hundreds of years ago (Fowler, 2019).User demand grows along with the development of technology. The power of public transport starting with human-powered transportation, animal-powered, steam-powered, fuel-oil-powered, electricity, until now battery technology. Of course, the development of these technologies must be addressed wisely and adapted to users' needs in general. The development of public transport in various countries shows the orientation of user services (Zhang, 2018).

The primary purpose of public transport is to provide excellent and decent transportation services for the community. The size of a good service is a service that is safe, fast, cheap, and convenient (Rifai& Arifin, 2020). In addition, the existence of public transport also creates job opportunities (Boisjoly, Moreno-Monroy, & El-Geneidy, 2017). Therefore, users of vehicles require an adequate level of service. One of the indicators to assess the ability of transportation to provide security and comfort to passengers is to measure the suitability between the transport capacity and the number of passengers transported (Drabicki, Kucharski, & Szarata, 2017). Transport capacity is defined as the capacity of passengers on each public transport vehicle, both sitting and standing.

Users of public transport want an adequate level of service. Some ordinary things are travel time, waiting time, and guaranteed safety and comfort during the trip (Bouscasse & de Lapparent, 2019). If public transport cannot meet these needs, then there is a possibility that passengers will not use this mode. This condition increases the level of private vehicle ownership, leading to many problems in the past. In the end, congestion and air pollution will become homework for the government (Nogueira, 2019).

Public transport performance can be measured by the suitability of the level of service the regulator has set (Rifai, & Fajriliani, 2020). This level measures the quality and quantity provided by public transport. (Winter, Cats, Correia, & van Arem, 2018). Characteristics that can be quantified are security, travel time, frequency, cost of travel, number of transfers. At the same time, the characteristics that cannot be quantified are convenience, availability, convenience, and image mode. The better the level of service of a public transport service, the passengers will be more interested in using it.

2.2 New Normal

Since the COVID-19 pandemic hit the world in early 2020, the transportation sector has been most affected. To address this, the government has provided incentives and subsidies for this sector. Meanwhile, the government also issued regulations for controlling transportation and implementing health protocols in transportation (Muley, Ghanim, Mohammad, Kharbeche, 2021).The control issued can also reduce the number of passengers who can use public transport. Of course, these various conditions must be addressed so that all sectors involved can run well.

One of the transportation policies that local governments are trying to implement related to COVID-19 is restricting public transportation services in big cities like Jakarta. These conditions caused criticism because they resulted in the accumulation of passengers at several bus stops. The number of passengers who accumulate and gather in one place can increase the risk of transmission. Transportation sector policies during a pandemic must aim to find a point of balance (Sabat, 2020). On the one hand, transportation facilities and infrastructure are not a vector of COVID-19 transmission. On the other hand, this sector can ensure that the supply of necessities remains safe.

The basic principle to slow the pace of the COVID-19 pandemic is social distancing or social restrictions. This principle can be interpreted as actions to reduce contact between humans to stop or reduce the rate of transmission of disease through primary activities such as work, school, recreation, and socializing. Therefore, the policy for public transport operations in the new-normal era should adjust other policies in controlling COVID-19 (De Vos, 2020).

During the COVID-19 pandemic, transportation policies must adhere to the effectiveness of social restrictions and certainty of transportation continuity. In the end, transportation policies are only part of the national strategy in dealing with the COVID-19 pandemic and must synergize with other sectors. The passenger transportation policy will not succeed without limiting activities with mass concentration, such as in schools and offices, that can increase mass mobility. In addition, the government must also ensure that the products and essential commodities for the community can be fulfilled.

2.3 Passenger Choice

Mode selection can be defined as dividing trips made by travelers into available modes with various influencing factors. This mode selection stage is a stage of the transportation planning process that determines the trip assignment. Therefore, knowing the number of people and goods that will use or choose various transportation modes serves a particular point of origin-destination. When connected with the COVID-19 pandemic, the choice of transportation mode will closely correlate with passenger policies and beliefs about health protocols. (Falchetta & Noussan, 2020) .

The modal selection has two modes of transportation, namely between public and private transport. Realistic mode selection models are disaggregate, behavioral, and probabilistic (Habib, 2019). The disaggregate model is individual travel behavior. Some factors influence a person in choosing a mode of transportation. In each case, there is always a factor that has more influence on the choice of mode. In several studies, there have not been many choices of transportation modes by including the attributes of the COVID-19 protocol.

The mode choice approach can be analyzed with the behavior and expectations of current consumers who are traumatized by COVID-19 (Trucco, Maggia, & Petrenj, 2020). The behavioral model is the consumer's economic behavior and psychological behavior in determining the decision-making used. Both models are made based on hypotheses related to identifying variables that determine the decision to choose. It is called a probabilistic model because it shows a probability of the outcome of potential passenger decision-making. This probability can be used as a primary material to formulate policies to implement the optimal public transport provision.

2.4 Stated Preference

The process of determining travel behavior is complex. Socio-economic conditions and activity patterns of travelers are the main factors that influence these travelers. Therefore, in predicting transportation demand, it is necessary to be based on the decision factors of travelers, in this case, the behavior of consumers who use these transportation services. The decisions made by travel agents greatly determine the quantity, mode distribution, time, and route of the means of transportation. One of the methods to obtain data on traveler's decisions is the stated preference technique (Ho, Mulley, & Hensher, 2020).

The stated preference technique is based on the classical economic concept, namely the utility of using a product. Utility represents satisfaction with one's profit when it costs to obtain a product. The utility also implies a value of total satisfaction with using the product for the product purchased. Service users are assumed to choose services that provide

maximum utility for themselves. The utility measured by the stated preference technique is described as an indirect utility(Mulley et al., 2018). The utility value by measuring the attributes of a product that is predicted to provide a satisfaction value.

A key element in the success of a stated preference survey is the degree of response realization achieved. Therefore, stated preferences usually emphasize specific things. Questions are posed to respondents who are directed to respond to an alternative to a given event. The interview form should be attempted to avoid abstract questions that cause low response reliability. Furthermore, it must clarify the boundaries between choices so that the context made is realistic. In addition, a realistic context is needed for respondents who already have personal experience. Choices of public transport in the new-normal era must be simplified according to user understanding.

3. Research Method

The research method used is descriptive-analytical, which describes an event and then analyzes the problems. This study begins by collecting literature and secondary data related to the research conducted and then determining the survey technique. In this study, the event to be observed is the possibility of selecting public transportation modes in the new-normal era. The variables to be studied are the internal attributes of public transport services that are adjusted to the health protocol and refer to the factors of mode selection.

The data collection technique is by distributing digital questionnaires to travelers using the Stated Preference technique. The question form of the planned survey form includes two things. First, the question is focused on knowing the existing condition of the characteristics of current public transport users. In this case, we want to know the socio-economic conditions of the users and information on trips made using public transport. Second, the question is directed to determine the respondent's preferences if several hypothetical conditions are offered during the new-normal era. These preferences are tariff changes and the implementation of the COVID-19 protocol. Therefore, using the respondent's perception data, an analysis was then carried out to determine the trend of using public transport during the new-normal era in Jakarta.

With stated preference techniques, hypothesis analysis can be carried out to determine the magnitude of changes in travel situations in the new-normal era. In the research conducted, passengers provide perceptions of various alternative changes. Elements of community behavior may be influenced by external factors such as service attributes, alternatives, situational constraints, and internal factors such as perceptions and preferences of travelers. External factors encourage and limit market behavior, while internal factors reflect the level of consumer understanding of their choices and actions. The number of public transport users in the new-normal era will be obtained from this stated preference data analysis.

Data processing is taken after the respondent's data is collected is to group the data according to the question items in the questionnaire. Regression analysis can only be performed on quantitative data. Variables or qualitative data are converted into quantitative data. Coding is done after the variable measurement scale is determined. The variables of gender, education, occupation, vehicle ownership, and trip purpose were measured on a nominal scale. Variables of age, income and hours of travel were measured with an interval scale. Further data analysis was performed using the regression method. This analysis aligns with the theory that a suitable procedure applied in the stated preference form with the rating method for a data group is a regression model that applies multiple regression.

4. Result and Discussion

The survey was conducted during the regional restriction period in August 2021. Questionnaires were distributed digitally to respondents suspected of having the habit of traveling to and from Jakarta. Two hundred seventy-one a result, respondents returned questionnaires, but 200 could be processed. The data processing results were separated into two parts, namely personal attributes and perceptions of the use of public transport in the new-normal era. In this discussion, a statistical analysis of the probability of choosing public transport by travelers in Jakarta will be carried out after the end of the restriction period.

4.1 Personal Attributes

Respondents have different personal attributes, which will also have different behavior and psychology in choosing transportation during the new-normal era. Therefore, these differences will affect the perception of the use of public transport that regulators and operators must prepare. The survey results can be seen in table 1. As for the gender, among the 200 respondents, 101 are women, accounting for 50.50%. As for the age, since the survey was conducted on the digital platform, most of the network users and the primary labor force in the society are middle-aged. The age of the

respondents is concentrated at 21-60 years old, accounting for 78.00%. As the occupation, 75.5% of the respondents are employees of enterprises and institutions who must return to work during the COVID-19 pandemic. As for the personal monthly income, 56.00% of the respondents' monthly income is above 2 million IDR. At the same time, those without income are 31.5% of the age group under 20 years and the housewife group.

Table 1. Statistical characteristics of the sample

Variable	Category	Frequency	Relative Frequency
Gender	Male	99	49,50%
	Female	101	50,50%
Age	Under 20 years old	35	17,50%
	21 – 30 years old	39	19,50%
	31 – 40 years old	37	18,50%
	41 – 50 years old	52	26,00%
	51 – 60 years old	28	14,00%
	Above 60 years old	9	4,50%
Occupation	Government sector employees	23	11,50%
	Private sector employees	30	15,00%
	Entrepreneur	31	15,50%
	Student	67	33,50%
	Housewife	28	14,00%
	Homemaker/Unemployed	21	10,50%
Personal monthly income	without income	63	31,50%
	Under 1 Million IDR	11	5,50%
	1 – 2 Million IDR	14	7,00%
	2 – 3 Million IDR	34	17,00%
	3 – 4 Million IDR	20	10,00%
	4 – 5 Million IDR	17	8,50%
	Above 5 Million IDR	41	20,50%
Purpose of travel	Works	31	15,50%
	Scholl/University	67	33,50%
	Shopping	28	14,00%
	Recreation	26	13,00%
	Social Trip	24	12,00%
Ownership	Car	50	25,00%
	Motorcycle/Scooter	50	25,00%
	Two or more car ownership	45	22,50%
	No car ownership in the family	55	27,50%

4.2 The Utility Function

After getting the data through a digital survey, the utility function analysis will then be carried out. The analysis was compiled to determine the utility function that describes the respondents' willingness to use public transport in the new-

normal era. The public transport offered is given several scenarios as the respondent's choice. Some of the questions asked to respondents can be seen in table 2.

Table 2. Scenario

No	Question (scenario)		Answer	Remark
	Passenger restriction	Tariff		
1.	No	Normal	Yes	Stop
			No	Next question
2.	No	Discount	Yes	Stop
			No	Next question
3.	Yes	Normal	Yes	Stop
			No	Next question
4.	Yes	Discount	Yes	Stop
			No	

Based on the respondent's data for each alternative scenario, the probability value of the 'Yes' answer is calculated for the total sample who answered 'yes'. Furthermore, the probability value will be used as the dependent variable (Y). After getting the probability of the answer 'yes', the utility results are used to form a utility function using the linear regression method. The utility function formed is in the form of the following equation 1.

$$Z_i = U_i = a + b_1 x_1 + b_2 x_2 \qquad (1)$$

where
$Z_i = U_i$-utility function
x_1- passenger restriction
x_2- tariff discount

The results of the recapitulation of the digital questionnaire and the summary of calculations can be seen in table 3. The data is formed into a utility function for public transport users in the new-normal. Based on the table, the probability of selecting a future passenger public transport scenario is shown in the value $\hat{P}_{(i)}$. To get the utility function value, you can follow the following equation 2.

$$Z_i = \ln\left[\frac{\hat{P}_i}{1-\hat{P}_i}\right] \qquad (2)$$

where
$\hat{P}_i$-probability

Table 3. The utility analysis

Scenario		1	2	3	4
Answer	Yes	21	44	59	71
	No	179	135	76	5
Total	Yes	195			
$\overline{P(i)}$		0,1077	0,2256	0,3026	0,3641
$1 - \overline{P(i)}$		0,8923	0,7744	0,6974	0,6359
$\ln\dfrac{\overline{P(i)}}{1-\overline{P(i)}}$		-2,1145	-1,2331	-0,8351	-0,5576
X_1	Capacity (%)	100	100	70	70
X_2	Tariff (%)	100	75	100	75

Based on the calculation of the utility value for each alternative, a utility function is then compiled. The utility function shows the passenger's willingness to use public transport during the new-normal. This function can be seen in the following equation 3.

$$Y = 3{,}6125 - 0{,}0326x_i - 0{,}0232x_2 \qquad (3)$$

When viewed from the calculation results obtained, it can be learned that the attributes used have a significant influence in determining the opportunities for using public transport during new-normal. The level of correlation in the equation is very high with an R^2 is 0.9340. Based on the analysis results, the implementation of passenger restrictions and tariff reductions significantly affects the pattern of using public transportation modes. From this equation, most respondents are willing to use public transport in the new-normal era with the scenario offered.

4.2 The Probability Analysis

A policy requires decision-making based on several alternative scenarios. Making decisions must be accompanied by clear goals to be achieved. In achieving the desired goal, several actions must be chosen as an action decision. Finally, each of the several alternative actions needs to be measured the benefits or costs that result. Of course, in decision-making, there is uncertainty regarding the results achieved, where there is a risk that will always be possible. Therefore, in making a decision, probability analysis is needed.Based on the analysis method about the utility function described, probability analysis will then be carried out. The utility model that has been formed can be developed into a probability model. The probability compiled is the possibility of respondents using public transport in the new-normal era. Determination of this probability is done using the variables used in the utility function using the logit model. The equation chosen to determine the probability is as follows.

$$P_{(i)} = \frac{1}{1+e^{-Z_i}} \qquad (4)$$

where

$P_{(i)}$ for probability passenger chooses public transport during new-normal.

Therefore, simulation calculations are carried out using some of the above equations to obtain various utility values. Based on the utility value, the probability value is then calculated. The utility sensitivity and probability can be seen in figure 1. The utility value will correspond to the scenario. If the probability value is getting smaller, the negative value in the utility value will be higher. This condition shows that travelers are increasingly less likely to choose public transport during the new-normal.
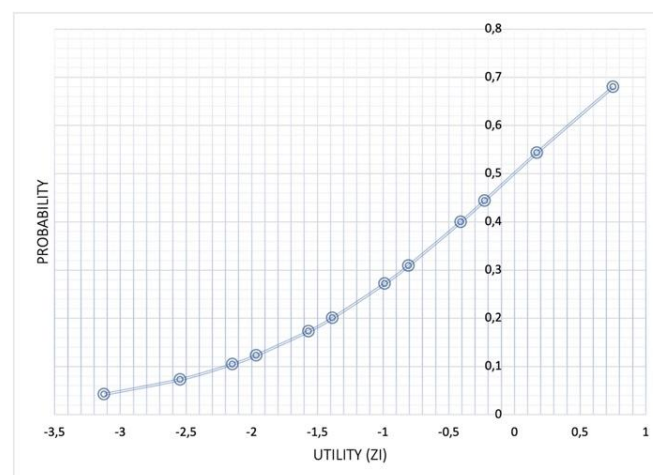

Figure 1. Probability graph

As the primary regulator in the state transportation system, the government has the highest interest in controlling public transport. Therefore, this COVID-19 pandemic must be addressed quickly and appropriately. Various momentums must be utilized to carry out campaigns to increase awareness of the use of urban mass public transportation and non-motorized transportation (NMT). However, do not forget that it is necessary to socialize the enforcement of strict health protocols. These efforts are needed to maintain public confidence in using mass public transportation during this SarsCov-2 virus pandemic if they are forced to leave the house or have daily mobility.

During the COVID-19 pandemic, regulators are expected to issue a series of policies to limit capacity and enforce strict health protocols for all types of mass public transport. This policy can help stakeholders carry out campaigns to increase public understanding and awareness about the great benefits of mass public transportation. The implementation of coordination must continue to be carried out to ensure that public transportation is safe, secure, comfortable, healthy, and environmentally friendly and enforce strict health protocols according to the provisions that have been set.

The use of mass public transportation has excellent positive benefits for the public interest in general and personally. The use of mass public transportation is closely related to public health and environmental health problems that must be the concern of all parties. The purpose of using public transport is to establish sustainable transportation, including its impact on health and the environment. The use of public transport during the new standard can encourage people to be physically active and leave motorized vehicles. Physical activity (walking or cycling) will nourish the body so that we avoid non-infectious diseases, which currently in Indonesia, the number of sufferers continues to grow due to the lack of movement of people.

5. Conclusion

The conclusion obtained from this research is that there is an equation about the possibility of people returning to use public transport to carry out activities in the new-normal era. The most influential variable is the Health protocol in the form of passenger restrictions and tariff reductions. The resulting equation has an R^2 of 0.934 and has a very high correlation. Furthermore, the sensitivity test shows that the stricter the passenger restriction, the higher the probability of using public transport. This probability is presumably due to concerns about the spread of the virus. Likewise, a reduction in tariffs can increase the probability of using public transport, which is related to current economic conditions.

Reference

1. Boisjoly, G., Moreno-Monroy, A. I., & El-Geneidy, A. (2017). Informality and accessibility to jobs by public transit: Evidence from the São Paulo Metropolitan Region. Journal of Transport Geography, 64, 89-96.

2. Bouscasse, H., & de Lapparent, M. (2019). Perceived comfort and values of travel time savings in the Rhône-Alpes Region. Transportation research part A: policy and practice, 124, 370-387.

3. Cooke, S., & Behrens, R. (2017). Correlation or cause? The limitations of population density as an indicator for public transport viability in the context of a rapidly growing developing city. Transportation research procedia, 25, 3003-3016.

4. De Vos, J. (2020). The effect of COVID-19 and subsequent social distancing on travel behavior. Transportation Research Interdisciplinary Perspectives, 5, 100121.

5. Dong, H., Ma, S., Jia, N., & Tian, J. (2021). Understanding public transport satisfaction in post COVID-19 pandemic. Transport Policy, 101, 81-88.

6. Drabicki, A., Kucharski, R., & Szarata, A. (2017). Modelling the public transport capacity constraints' impact on passenger path choices in transit assignment models. Archives of Transport, 43.

7. Falchetta, G., & Noussan, M. (2020, December). The Impact of COVID-19 on transport demand, modal choices, and sectoral energy consumption in Europe. In IAEE Energy Forum, Special(No. 2020).

8. Fowler, J. (2019). The Historical Development of London Transport. In London Transport: A Hybrid in History 1905–1948. Emerald Publishing Limited.

9. Habib, K. N. (2019). Mode choice modelling for available rides: An investigation of the competition of Uber with other modes by using an integrated non-compensatory choice model with probabilistic choice set formation. Transportation Research Part A: Policy and Practice, 129, 205-216.

10. Ho, C. Q., Mulley, C., & Hensher, D. A. (2020). Public preferences for mobility as a service: Insights from stated preference surveys. Transportation Research Part A: Policy and Practice, 131, 70-90.

11. Isa, C. M. M., Nusa, F. N. M., Ishak, S. Z., & Fam, S. F. (2021, June). Impacts of COVID-19 Pandemic on the Road and Transport Sectors using Relative Importance Index. In 2021 IEEE International Conference on Automatic Control & Intelligent Systems (I2CACIS) (pp. 305-310). IEEE.

12. Isradi, M., & Abdika, M. A. (2021). Analysis of the Performance of Koasi K01A Public Transport During the Implementation of the PSBB. IJTI International Journal of Transportation and Infrastructure eISSN 2597-4769 pISSN 2597-4734, 4(2), 105-117.

13. Kakar, K. A., & Prasad, C. S. R. K. (2020). Impact of urban sprawl on travel demand for public transport, private transport and walking. Transportation research procedia, 48, 1881-1892.

14. Muley, D., Ghanim, M. S., Mohammad, A., & Kharbeche, M. (2021). Quantifying the impact of COVID–19 preventive measures on traffic in the State of Qatar. Transport Policy, 103, 45-59.

15. Mulley, C., Ho, C., Ho, L., Hensher, D., & Rose, J. (2018). Will bus travellers walk further for a more frequent service? An international study using a stated preference approach. Transport policy, 69, 88-97.

16. Nogueira, T., Dominutti, P. A., Vieira-Filho, M., Fornaro, A., & Andrade, M. D. F. (2019). Evaluating atmospheric pollutants from urban buses under real-world conditions: implications of the main public transport mode in São Paulo, Brazil. Atmosphere, 10(3), 108.

17. Olivia, S., Gibson, J., & Nasrudin, R. A. (2020). Indonesia in the Time of Covid-19. Bulletin of Indonesian Economic Studies, 56(2), 143-174.

18. Rifai, A. I., & Arifin, F. (2020, March). Analysis of The Level of Passenger Satisfaction With Services And Transport Facilities-Based Integration in Jakarta. In Journal of World Conference (JWC) (Vol. 2, No. 2, pp. 66-73).

19. Rifai, A. I., & Fajriliani, Y. I. (2020, March). Analysis of Passenger Satisfaction Level of Service And Facilities of Electric Rail Train (KRL) Commuter Line Route Bekasi-Manggarai. In Journal of World Conference (JWC) (Vol. 2, No. 2, pp. 126-135).

20. Sabat, I., Neuman-Böhme, S., Varghese, N. E., Barros, P. P., Brouwer, W., van Exel, J., & Stargardt, T. (2020). United but divided: Policy responses and people's perceptions in the EU during the COVID-19 outbreak. Health Policy, 124(9), 909-918.

21. Shen, J., Duan, H., Zhang, B., Wang, J., Ji, J. S., Wang, J., & Shi, X. (2020). Prevention and control of COVID-19 in public transportation: Experience from China. Environmental pollution, 115291.

22. Tan, L., & Ma, C. (2021). Choice behavior of commuters' rail transit mode during the COVID-19 pandemic based on logistic model. Journal of Traffic and Transportation Engineering (English Edition), 8(2), 186-195.

23. Tirachini, A. &. (2020). COVID-19 and public transportation: Current assessment, prospects, and research needs. Journal of Public Transportation, 22(1).

24. Trucco, P., Maggia, P., & Petrenj, B. (2020). Adapting public transport to covid-19 contingencies: Evaluating unlock policies in the metropolitan area of Milan through dmci simulation. In 30th European Safety and Reliability Conference, ESREL 2020 and 15th Probabilistic Safety Assessment and Management Conference, PSAM15 2020 (pp. 317-324).

25. Wielechowski, M., Czech, K., & Grzęda, Ł. (2020). Decline in Mobility: Public Transport in Poland in the time of the COVID-19 pandemic. Economies, 8(4), 78.

26. Winter, K., Cats, O., Correia, G., & van Arem, B. (2018). Performance analysis and fleet requirements of automated demand-responsive transport systems as an urban public transport service. International journal of transportation science and technology, 7(2), 151-167.

27. Zhang, H., Song, X., Xia, T., Yuan, M., Fan, Z., Shibasaki, R., & Liang, Y. (2018). Battery electric vehicles in Japan: Human mobile behavior-based adoption potential analysis and policy target response. Applied Energy, 220, 527-535.