CSID Journal of Infrastructure Development

Volume 6 | Issue 2 Article 6

12-31-2023

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Recommended Citation
Alvinsyah, A., Hadian, E., & Syahputra, W. A. (2023). A Study on The Preferred Teleworking Policy by The Private Sector and Its Implication to The Demand on Transport Infrastructure (Case Study: Greater Jakarta Area). *CSID Journal of Infrastructure Development, 6*(2). https://doi.org/10.7454/jid.v6.i2.1120

CSID Journal of Infrastructure Development (6) 2: 211-222
ISSN 2407-4438

A STUDY ON THE PREFERRED TELEWORKING POLICY BY THE PRIVATE SECTOR AND ITS IMPLICATION TO THE DEMAND ON TRANSPORT INFRASTRUCTURE (CASE STUDY: GREATER JAKARTA AREA)

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(Received: August 2023 / Revised: October 2023 / Accepted: December 2023)

ABSTRACT

This study examines the implementation of a teleworking policy with a work-from-home (WFH) scheme from a private company perspective and its implications on the Greater Jakarta's proposed urban rail network's carrying capacity. Using descriptive and inferential statistical analyses, a representative percentage of employees capable of working from home was determined. This figure, found to be sixty percent, was then employed in a macro transport model simulation to assess its impact on urban rail network demand. The results of the statistical analysis indicate that sixty percent of the company's workforce can still permitted to work remotely. The model simulation conducted indicates that with this the sixty percent reduction in working trips utilizing transit, the proposed urban rail network plan experiences insignificant alterations in the required carrying capacity. This finding highlights the resilience of the current urban rail network plans against substantial shifts in working patterns and provides insights for future urban transport planning in the context of evolving work modalities.

Keywords: Demand; Preference; Teleworking; Urban rail; Work from home

1. INTRODUCTION

Teleworking, a key Transportation Demand Management (TDM) strategy, has been effectively implemented for over forty years (Suzuki Goshima et al., 2023). Among various TDM policies, teleworking stands out for its lower user costs and rapid implementation time (Choo et al., 2005; Kim, 2017; Zhu & Mason, 2014). It substantially benefits employers and employees, including enhanced morale, increased productivity, and significant long-term cost savings for organizations (Bernardino, 2017). Studies have also noted that telecommuters often dedicate more time to work activities and demonstrate higher productivity than in traditional office settings (Grawitch & Barber, 2010; Kirk & Belovics, 2006).

Jakarta as a metropolitan city struggles with severe congestion challenges, as it was ranked 12th by Traffic Index in 2023 and 46th by TomTom (2022) in global congestion ratings. In light of this issue, TDM strategies, including teleworking, is crucial way to address it. Such strategies offer an alternative to conventional approaches focusing primarily on highway infrastructure expansion and traffic management schemes.

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DOI: 10.7454/jid.v6.i2.1120

The COVID-19 pandemic has significantly altered lifestyles and work habits globally, driving teleworking, particularly Work from Home (WFH) policy, to the forefront of operational adaptations by employers and employees. Despite initial mobility pattern shifts, returning to pre-pandemic norms is expected as pandemic-related restrictions ease (Eisenmann et al., 2021; Molloy et al., 2021; Nilles et al., 1976). However, the continuation of WFH post-pandemic has garnered interest in various European studies (Reiffer et al., 2023).

From a policy-making perspective, teleworking offers multifaceted advantages, particularly in addressing traffic congestion, energy savings, and air quality improvement. It mitigates public costs associated with productivity losses, travel delays, and congestion during peak commuting hours. Thus, policymakers view teleworking as an instrumental tool in urban transport management.

While initial teleworking research primarily focused on its potential to reduce travel and address mobility issues, contemporary studies have expanded to examine its impact on congestion, pollution, and overall mobility sustainability (Lier et al., 2014). Although much of the existing research focuses on telecommuters' behavior and related factors (Drucker & Khattak, 2000; Mokhtarian & Salomon, 1997; Singh et al., 2013), there is a noticeable gap in studies from employers' perspectives. Furthermore, research on teleworking's effect on transportation modes and network congestion is extensive (Choo et al., 2005; Helminen & Ristimäki, 2007; Lachapelle et al., 2017; Zhu & Mason, 2014), yet relatively few studies have investigated its implications on public transport demand in the aftermath of the pandemic (Tsavdari et al., 2022).

The enforced WFH policy during the pandemic has significantly impacted public transport by reducing overall commuting trips. On the supply side, social distancing measures have also affected the effective capacity of public transport vehicles, imposing additional costs on operators striving to maintain safe transport services. In many countries, since the total number of transport trips has decreased, the public transport market share has significantly declined (De Borger & Proost, 2022).

This study explores the potential post-pandemic implementation of teleworking policies and their impact on the demand of transport infrastructure plan. By integrating employer preferences on teleworking policy with the impact analysis of this policy to urban rail-based network plan carrying capacity demands, this research offers insights into the future of urban mobility in the context of evolving work patterns. Subsequent sections of this paper will cover the literature study, research methodology, employer-preferred teleworking scheme analysis, and its influence on Jakarta's urban rail network carrying capacity. The concluding section will summarize the findings of this research.

2. LITERATURE STUDY

2.1. Teleworking

Teleworking, introduced in the 1970s, refers to working remotely from an office headquarters location (HQ), often with flexible timing. In the USA, this practice is commonly known as telecommuting (Lin et al., 2006). Despite its four-decade history, teleworking lacks a universal definition, leading to ambiguity in its understanding and application (Suzuki Goshima et al., 2023). Over the years, the definition of teleworking has evolved alongside technological advancements. Initially, teleworking was described as using telecommunications technology from home or a nearby location during regular working hours as an alternative to commuting to a conventional workplace (Mokhtarian et al., 2004).

More recently, the Eurofound and the International Labor Office (2017) have broadened this definition to encompass work outside the employer's premises, facilitated by Information and

Communication Technologies (ICTs) such as computers, tablets, and cell phones. This modern interpretation of teleworking encompasses a variety of work arrangements that differ in duration, location, and frequency. Regarding duration, teleworking can be executed full-time, part-time, or intermittently as needed. The most common location for teleworking is the worker's home, although it can be practiced from various other locations.

Teleworking significantly influences the demand for passenger transport, particularly commuting. It impacts the volume of commuting trips and their average distances, especially when teleworking occurs from locations other than the worker's home. This shift in work dynamics, driven by technological advancements and changing organizational cultures, presents new challenges and opportunities for urban planning and transport management.

2.2. Admiralty Method

The macro (4-step) transportation model, pivotal for this study on the Greater Jakarta Area, incorporates four integral components: a Trip Generation model, a Trip Distribution model, a Mode Split model, and a Trip Assignment model. The fundamental concepts of this 4-step modeling approach are extensively documented in transportation planning literature, such as Ortuzar & Willumsen (2011) and Papacostas & Prevendeuros (2001). The choice of this model for the Greater Jakarta Area was driven by the availability and comprehensiveness of its origin-destination (O-D) database, as well as the four models mentioned above. This model, initially developed from various previous studies (Alvinsyah & Hadian, 2018), has undergone numerous updates, calibrations, and validations over time (Hadian & Alvinsyah, 2017; JakPro, 2019; Yooshin, 2022). The structure of the Admiralty model is discussed below.

2.2.1. Zoning System

The zoning system adopted for this study is based on the smallest administrative boundaries of *kelurahan* and *kecamatan*, with the Jakarta area further defined based on the block plan in each *kelurahan* as delineated in the Jakarta's Detail Land Us Plan. The model covers 1,443 zones, with 1,250 within DKI Jakarta province.

2.2.2. Transport Network Model

The transport network model utilizes highway network data, including geometric data, links, and node capacity, as well as public transport data that include the number of lines, line capacity, headway, and mode type. The Greater Jakarta (*Jabodetabek*) transportation network model comprises both road and public transport networks. Detailed illustrations and descriptions of these network models are available in JakPro (2019).

2.2.3. Trip Generation Model

The trip generation model, adopted from previous studies and utilizing the trip rate approach from the Japan International Cooperation Agency (JICA) study (2014), correlates socio-economic conditions, land use, and vehicular flow in and out of each zone. The model is a function of population parameters and Gross Regional Domestic Product (GRDP), as demonstrated in Alvinsyah & Hadian (2018) and Hadian & Alvinsyah (2017).

2.2.4. Trip Distribution Model

The O-D matrices, categorized by mode, purpose, and income level, are derived from primary survey results in previous studies (Alvinsyah & Hadian, 2018; Hadian & Alvinsyah, 2017). The Furness or double-constrained method estimates trip patterns, with matrices prepared for the target year based on socio-economic indicators and population data (Ortuzar & Willumsen, 2011).

2.2.5. Transit Assignment Model

In contrast to the allocation of private car assignments, transit assignment model comprises a multitude of components, including connections and segments that connect stations or stops. The ability of individual units and their corresponding frequencies are intrinsically tied to the notion of link capacity within this framework. The transit assignment computation of travel time encompasses various components, such as the duration of time spent in the vehicle, wait periods at stops, and access and egress times.

Additionally, the fare variable is a crucial component of this computation. In contrast to private car networks that establish monetary costs in relation to fuel consumption, travel distance, or time, the public assignment model places significant importance on the monetary cost, which is represented by the fare applied to each line service, within the larger context of generalized costs. The applied transit tariffs, which are expressed in units of 'time', come together with the total travel time to form the all-encompassing notion of "generalized costs." Further elucidation on the notion of "generalized cost" can be obtained through an examination of previous investigations conducted by Hadian & Alvinsyah (2017) and Alvinsyah & Hadian (2018).

EMME software is utilized to facilitate the assignment process, with the transit assignment mechanism detailed in Alvinsyah & Hadian (2018) and the mathematical formulation explained in Spiess and Florian (1989).

3. METHODS

3.1. Analysis of the Preferred Teleworking Scheme

Building on the worker-centric focus of previous teleworking studies, as discussed in the Introduction section, this research aims to analyze teleworking schemes from companies' perspective. Understanding the company's stance on teleworking is crucial, given that their acceptance significantly determines the feasibility of implementation. Previous research indicates a potential misalignment between worker preferences for teleworking and the preferences of their employers.

Given the lack of a standard definition of teleworking, for survey clarity, this study defines it as 'working from home'. This definition encompasses various teleworking arrangements without limiting them to specific locations, provided they maintain productivity. The methodology for analyzing employer preferences for teleworking schemes is divided into four main steps:

a) Step 1

The first step is to design a questionnaire adopting a preference survey approach (Ortuzar & Willumsen, 2011). The questionnaire consists of two sections: the company data and the preferences for the teleworking schemes offered. Information on the company, among other things, is the type or category of its business, the number of workers, and the work method after the pandemic (e.g., WFO, hybrid, or WFH). Meanwhile, preferences for teleworking schemes consist of two parts: the hypothetical conditions and the choice of the offered schemes. The hypothetical condition is required for respondents to select the teleworking schemes with the following details:

- Based on transportation conditions during the pandemic, the government plans to implement the same policy (e.g., teleworking/WFH) to reduce congestion and air pollution levels.
- The teleworking scheme consists of several options for reducing the number of employees working in offices. The company's decision on the option is considered not to harm the

company's business and refers to the WFH's experience during the pandemic in 2020.
- The questionnaire must be filled out by either the company owners, directors, or the officials whose positions have the authority to decide on work schemes for their employees.
- The choice of the offered teleworking scheme is the reduction percentage of workers per working day, namely 100%, 90%, 75%, 50%, 25%, 10% and 0%. Since this study adapts the concept of preference survey method, the magnitude of these percentages is determined arbitrarily and not based on any specific rule. This percentage value is to ease the respondent's understanding to decide their choice.

In parallel with the design process, prospective respondents of companies engaged in industry and services in Jakarta were listed through the IDN Financial websites.

b) Step 2

A pilot survey, both offline and online, was conducted among the listed companies, leading to questionnaire and method refinements. The primary survey followed, with a minimum sample size of 30 companies per category, to ensure feasibility for descriptive statistical analysis, considering the challenges in obtaining respondents.

c) Step 3

The survey data was processed to construct the distribution of the maximum teleworking scheme selected by respondents for each business category. A Shapiro-Wilk normality test determined the need for parametric or non-parametric inferential statistical tests. Comparative analysis, using the Mann-Whitney test, assessed differences across categories. If insignificant, data from different categories were combined for further analysis.

d) Step 4

After identifying a representative business category group, central values were calculated, with one value selected through a significance test to represent company teleworking scheme preferences. This selected value was a correction factor for trip generation in subsequent analyses.

3.2. Analysis of the Impact of the Teleworking Scheme on the Carrying Capacity of the Jakarta Rail Network Plan

The Jakarta Metropolitan Macro Transport Model is employed to assess the influence of the teleworking scheme on the Jakarta Rail Network Plan's demand. The model's modal split component is derived from mode share compositions in previous studies, such as abodetabek Urban Transportation Policy Integration Project Phase 1 (JUTPI-1) in 2012; Japan International Cooperation Agency-Creative Technology Solution (JICA-CTS) in 2016, and JUTPI Phase 2 in 2020. The analytical process is divided into four steps:

a) Building a basic scenario (without a teleworking scheme)

First, trip generation for each zone in Greater Jakarta is predicted using the base year model and annual trip growth rates (Yoshiin, 2022). The synthesized origin-destination (OD) matrix is then re-balanced using the double constraint method (Ortuzar & Willumsen, 2011). Concurrently, the Jakarta rail network plan scenario, based on the Jakarta Transportation Master Plan 2039 and adapted for 2030, is defined. Several planned rail corridors are integrated into the existing network (detailed in Appendix Table A-1). The planning year's OD matrix is divided into three mode-based matrices: cars, motorcycles, and transit, using previous studies' mode shares. The transit OD matrix is the basic scenario for transit assignment analysis.

b) Building scenarios with teleworking schemes

For scenarios incorporating teleworking, the proportion of work trips to total trips is first calculated, referencing prior studies (Hadian & Alvinsyah, 2017; Alvinsyah & Hadian, 2018). Then, the number of work trips in each destination zone is adjusted using the teleworking factor value determined from the preferred teleworking policy analysis. The correction for government institution employees uses the same teleworking factor due to the relative ease of implementing teleworking policies in the public sector compared to private companies. The model-based person trip matrix is re-balanced, reflecting the teleworking policy's impact, with the updated transit matrix forming the 'with teleworking scheme' scenario.

c) Model Simulation and Carrying Capacity Estimation

Transit assignment simulations for both the basic and teleworking scheme scenarios estimate the required carrying capacity for Jakarta's rail transport network. Operational characteristics of public transport (headway, mode capacity, average commercial speed), tariff structures, and amounts are based on assumptions from previous studies (Jakpro, 2019; Yooshin, 2022). These simulations provide estimates of potential demand for each rail corridor under both scenarios, determining the necessary capacity for each corridor in the network plan.

d) Comparison Analysis on Carrying Capacity

Differences in estimated demand between the two scenarios are analyzed to determine their impact on the planned rail infrastructure requirements.

Figure 1 outlines the research method framework adopted in this study, illustrating the sequential approach from scenario development to capacity analysis.

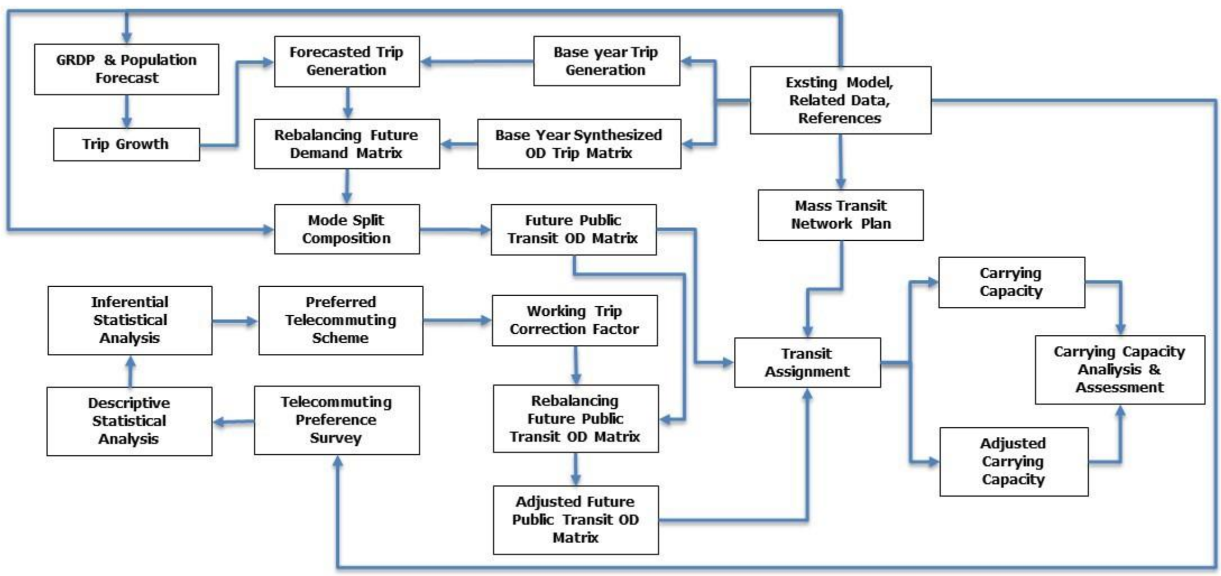

Figure 1 Research Method Framework

4. RESULTS AND DISCUSSION

The preference survey conducted for this study yielded 290 valid samples, comprising 173 from the services sector, 105 from the industry sector, and 12 from the agricultural sector. Due to the agricultural sector samples were less than 30, so they were excluded from further analysis. Of the remaining sectors, only 94 service sector and 59 industrial sector samples—those implementing full-time office work—were considered for this study. The comparative analysis revealed that companies with a hybrid work scheme preferred WFH more than those predominantly working in the office. Furthermore, a sample adequacy test, comparing the maximum percentage of teleworking scheme choices from a minimum sample of 30 to larger multiples of 10, indicated no significant differences within each group, deeming the sample size sufficient for this study.

After the distribution of the service and industrial sector sample groups was attained, a comparative test was performed on the two distributions to obtain the value of the teleworking scheme that can represent the distribution of respondents' answers. However, before doing so, a distribution normality test was performed to determine the appropriate test instrument (e.g., parametric or non-parametric statistical test).

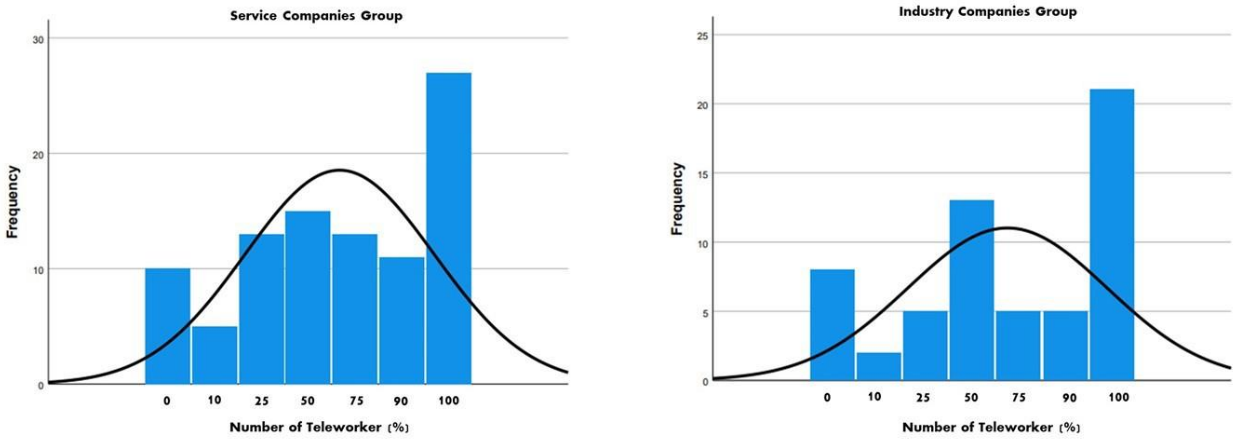

Figure 2 The Preferred Teleworking Scheme for Service and Industrial Companies

The normality test on the distributions of preferred teleworking schemes, as shown in Figure 2, exhibited a right-skewed distribution with a skew value greater than 2, as confirmed by mean values where the mode exceeded the median and the median exceeded the average (see Table 1).

Table 1 Preferred Teleworking Scheme

MeanValue	Sectors	
	Industries	**Services**
Average	61.60%	63,05%
Median	75.00%	75.00%
Mode	100.00%	100.00%

The Mann-Whitney test showed in Table 2 indicates that there is no significant difference between the two distributions, allowing their combination into one group for further analysis (see Figure 3).

Table 2 Homogeneity Test Result

Test Method	Test Value
Mann-Whitney U	.000
Asymp. Sig. (2-tailed)	.601

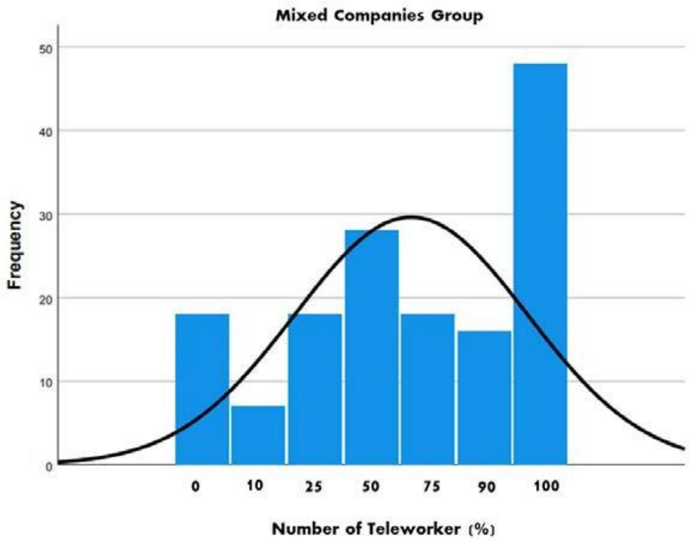

Figure 3 The combined preferred teleworking scheme

After calculating the mean, median, and mode values as has been summarized in Table 3, a Mann-Whitney significance test was performed. The average value (mean) emerged as the most significant, representing a 62.16% reduction in workforce numbers due to teleworking (see Table 4).

Table 3 Preferred Teleworking Scheme

MeanValue	Worker Reduction (%)
Average	62.16
Median	75.00
Mode	100.00

Table 4 Mann-Whitney Significance Test

Mean	Asymp. Sig. (2 – tailed)
Average	.929
Modus	.257
Median	.926

Using the base year model and annual trip growth rates, the 2030 daily person trips in Greater Jakarta are estimated at approximately 73,387,283. The distribution of these trips by mode, with and without teleworking, is calculated and shown in Table 5.

Table 5 Total Estimated Trips in Jakarta in 2030 (Person-Trips/Day)

Trip Mode	Without Teleworking Scheme	Mode Share
Car	19,047,014	25.95%
Motorcycle	44,377,831	60.47%
Transit	9,962,437	13.58%

Referring to Yooshiin (2022), the composition of work trips is 33.9% of the total trips in the Greater Jakarta Area. By implementing the teleworking policy where the number of teleworkers is 62.16% of the working trip destined in Jakarta city, the composition of work trips is reduced to 20.05% as shown in Table 6.

Table 6 Corrected Total Working Trip in Jakarta (by Destination)

Working Trip	Teleworking Correction Factor	Corrected Working Trip
33.9%	62.16%	21.05%

Furthermore, by carrying out the same correction process, the reduction of the working trips by cars, motorcycles and transit to the Jakarta area is shown in Table 7.

Table 7 Corrected Working Trip by Mode in Jakarta

Mode	Person-Trips by Mode	Teleworking Composition
Car	25.95%	5.46%
Motorcycle	60.47%	12.73%
Transit	13.58%	2.86%

Based on the percentage reduction in the number of working trips for car, motorcycles and transit as shown in Table 7, the estimated number of trips due to the implementation of the teleworking policy in the Greater Jakarta area in 2030 is shown in Table 8.

Table 8 Total Estimated Trips in Jakarta in 2030 (Person-Trips/Day)

Trip Mode	Without Teleworking Scheme	Teleworking	With Teleworking Scheme
Car	19,047,014	1,040,438	18,006,576
Motorcycle	44,377,831	5,648,825	38,729,006
Transit	9,962,437	284,785	9,677,652
Total	73,387,283	6,974,049	66,413,234

Referring to Table 7, the number of trips using transit destinated in the Jakarta Area due to the teleworking policy decreases by 2.86%. This reduction is not considered significant. On the other hand, the person trip reduction using motorcycles is relatively high at 12.73%. The analysis shows that the teleworking policy has a relatively small impact to the transit carrying capacity requirement. Furthermore, to obeserve whether the Jakarta planned urban rail infrastuctures need to be revised, a simulation with transit assignment is conducted to the teleworking scenario in Table 8. The results of the simulation are shown in Table 9.

Table 9 Total estimated maximum passenger flow in 2030 (Passenger/Peak-hour)

Jakarta Rail Corridor	Without Teleworking Scheme	With Teleworking Scheme	Reduced Passenger Flow	Different (%)
Bogor Railway Line	40,899	38,940	1,959	4.79
Serpong Railway Line	13,632	13,118	514	3.77
Tangerang Railway Line	13,779	13,298	481	3.49
Bekasi Railway Line	27,127	26,380	747	2.75
LRT Gading - Manggarai	1,417	1,389	28	1.98
MRT East-West Line	6,609	6,505	104	1.57
LRT Pulo Gadung - Joglo Line	5,855	5,739	116	1.98
MRT Lebak Bulus – Kota Line	5,287	5,248	39	0.74
LRT Cibubur – Dukuh Atas Line	6,759	6,503	256	3.79
LRT Bekasi - Dukuh Atas Line	7,329	7,280	49	0.67

The results of the transit assignment are consistent with the estimated trip due to the teleworking scheme shown in Table 8, where the reduction is relatively small. Since the peak hour demand is used for determining the carrying capacity, the operational design process, the proper type and technology of the mode, the values in Table 3.9 are in the peak hour. Referring to Table 9, the reduction rate of the potential demand is less than 5%, where the smallest reduction rate occurs on the Bekasi - Dukuh Atas LRT line and the largest on the Bogor - Jakarta Kota commuter line. Table 9 also shows that a relatively large reduction rate occurs on the "existing" commuter rail lines that carry commuting trips from buffer zones of Jakarta City. On the other hand, for the planned service lines soon, only the LRT Bekasi – Dukuh Atas line has a reduction rate equivalent to that of commuter rail lines. Based on the scenarios and assumptions defined in this study, the teleworking policy for workers working in Jakarta does not change the infrastructure needs as represented by the potential demand of the Jakarta rail transport network plan.

5. CONCLUSION

This study conducted a comprehensive analysis of teleworking schemes, focusing on reducing the workforce per day across various company types, and examined the impact of such schemes on the demand for transportation infrastructure. The preference survey revealed no significant difference in the choice of teleworking schemes among the participating companies. A detailed simulation of the Greater Jakarta transport model found that implementing a teleworking policy with a WFH scheme marginally affects the reduction of transit trips. Consequently, the projected need for rail-based mass transit network capacity remains largely unaltered.

However, the analysis highlighted that the teleworking policy notably influences the reduction of trips made by private vehicles, particularly among motorcycle users. This finding suggests that while the demand for public transit infrastructure may not significantly change, there is a pronounced shift in private vehicle usage patterns. Given this shift, there is a necessity for further studies to explore the implications of teleworking policies on highway usage and associated pollution levels.

REFERENCES

Alvinsyah and Hadian E. 2018. A Demand and Capacity Analysis on Bus Semirapid Transit Network (Case: Jabodetabek Public Transport Network), *the 1st International Symposium on Transportation Studies in Developing Countries (ISTSDC) MATEC Web Conf. Volume 181*, Article Number 10001.

Bernardino, A. 2017. Telecommuting: Modelling the Employer's and the Employee's Decision-Making *Process. Taylor & Francis*

Choo, S., Mokhtarian, P.L., Salomon, I. 2005. Does telecommuting reduce vehicle miles traveled? An aggregate time series analysis for the U.S. *Transportation (Amst). 32*, 37–64. doi:10.1007/s11116-004-3046-7.

De Borger, B., Proost, S., 2022. COVID-19 and Optimal Urban Transport Policy. *Transportation Research Part A. 163*, 20–42.

Drucker, J., Khattak, A., 2000. Propensity to Work from Home: Modeling Results from the 1995 Nationwide Personal Transportation Survey. *Transp. Res. Rec. J. Transp. Res. Board 1706*, 108–117. doi:10.3141/1706-13

Eisenmann, C., Nobis C., Kolarova V., Lenz B., and Winkler C. 2021. Transport Mode Use During the COVID-19 Lockdown Period in Germany: The Car Became More Important, Public Transport Lost Ground. *Transport Policy, Vol. 103*, pp. 60–67.

Eurofound and International Labour Office 2017. Working Anytime, Anywhere: The Effects on the World of Work; Publications Office of the European Union: Luxembourg; International Labour Office: Geneva, Switzerland.

Grawitch, M.J., Barber, L.K. 2010. Work flexibility or nonwork support? Theoretical and empirical distinctions for work–life initiatives. *Consult. Psychol. J. Pract. Res. 62*, 169– 188.

Hadian E., and Alvinsyah 2017. Impact On Ridership of New Railbase Transit Due To The Operation Of Extensive Bus Semirapid Transit Network (Case Study: Jabodetabek Public Transport Network), *Proceeding of the 15th International Conference Quality In Research (QiR) July 24th-27th.*

Helminen, V., Ristimäki, M., 2007. Relationships between commuting distance, frequency, and telework in Finland. *J. Transp. Geogr. 15*, 331–342.

JakPro. 2019. Feasibility Study, Funding Schemes and Basic Engineering Design for LRT in the DKI Jakarta Provincial Area, *Final Report, PT. Jakarta Propertindo*.

Kim, S.N. 2017. Is telecommuting sustainable? An alternative approach to estimating the impact of home-based telecommuting on household travel. *Int. J. Sustain. Transp. 11*, 72– 85.

Kirk, J., Belovics, R. 2006. Making E-Working Work. *J. Employ. Couns. 43*, 39–46.

Lachapelle, U., A Tanguay, G., Neumark-Gaudet, L., 2017. Telecommuting and sustainable travel: Reduction of overall travel time, increases in non-motorized travel, and congestion relief? Urban Stud. 4209801770898.

Lier, T. van, Witte, A. de, & Macharis, C. 2014. How worthwhile is teleworking from a sustainable mobility perspective? The case of Brussels Capital region. *European Journal of Transport and Infrastructure Research, 14*(3).

Lin P. S., Zhou H., Hagen L., Winters P. L., 2006. Effective Teleworking to Reduce Traffic Demand and Energy Consumption. *The 6th Asia-Pacific Transportation Development Conference and the 19th ICTPA Annual Meeting May 29 – June 1*, Hong Kong / Macau.

Mokhtarian, P.L., Collantes, G.O., Gertz, C. 2004. Telecommuting, Residential Location, and Commute-Distance Traveled: Evidence from State of California Employees. *Environ. Plan. A 36*, 1877–1897.

Mokhtarian, P.L., Salomon, I., 1997. Modeling the desire to telecommute: The importance of attitudinal factors in behavioral models. *Transp. Res. Part A Policy Pract. 31*, 35–50.

Molloy, J., Schatzmann T., Schoeman B., Tchervenkov C., Hintermann B., and Axhausen K.W. 2021. Observed Impacts of the Covid-19 First Wave on Travel Behaviour in Switzerland Based on a Large GPS Panel. *Transport Policy, Vol. 104*, pp. 43–51.

Nilles, J., Carlson F., Gray P., and Hanneman G. 1976. Telecommuting - An Alternative to Urban Transportation Congestion. *IEEE Transactions on Systems, Man, and Cybernetics, Vol. 6*, No. 2, 1976, pp. 77–84.

Ortuzar, J.D., and Willumsen, L.G. (2011), Modelling Transport Fourth Edition. *Wiley Inc., West Sussex, UK.*

Papacostas, C.S. and Prevendeuros, P.D. (2001), Transportation Engineering & Planning, 3rd, Prentice Hall Inc., New Jersey, USA.

Reiffer A., Magdolen M., Ecke L., and Vortisch P. 2023. Effects of COVID-19 on Telework and Commuting Behavior: Evidence from 3 Years of Panel Data, *Transportation Research Record, Vol. 2677(4)* 478–493, National Academy of Sciences: Transportation Research Board.

Singh, P., Paleti, R., Jenkins, S., Bhat, C.R., 2013. On modeling telecommuting behavior: option, choice, and frequency. *Transportation (Amst). 40*, 373–396.

Spiess H., and Florian, M., (1989), Optimal Strategies: A New Assignment Model for Transit Networks, Transportation Research Part B*: Methodological, Volume 23B No. 2*, pp 83-102

Suzuki Goshima, C. Y., Dias, V. C., Pedreira Junior, J. U., Pitombo, C. S., 2023. Relationships between Teleworking and Travel Behavior in the Brazilian COVID-19 Crisis. *Future Transp., 3,* 739–767.

TomTom. 2022. Traffic Index Ranking, https://www.tomtom.com/traffic-index/ranking/ Traffic Index. 2023. *Worldwide Traffic Congestion Ranking,* https://www.trafficindex.org/

Tsavdari D., Klimi V., Georgiadis G., Fountas G., and Basbas S. 2022. The Anticipated Use of Public Transport in the Post-Pandemic Era: Insights from an Academic Community in Thessaloniki, Greece. *Social Sciences 11*: 400.

Yooshin. 2022. Feasibility Study for Development of MRT Phase 4 in Jakarta, Indonesia; Travel Demand Forecast, Draft Final Report, Yooshin JV - Korea Overseas Infrastructure & Urban Development Corporation (KIND).

Zhu, P., Mason, S.G. 2014. The impact of telecommuting on personal vehicle usage and environmental sustainability. *Int. J. Environ. Sci. Technol. 11*, 2185–2200.