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TRANSIT-ORIENTED DEVELOPMENT MODEL BASED ON SUSTAINABLE URBAN TRANSPORT IN THE COVID-19 PANDEMIC

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Abstract: The purpose of this study is to determine the alternative modeling of Transit-Oriented Development (TOD) based on sustainable urban transportation in this COVID-19 pandemic era. In general, some of the problems with TOD in the Jababeka area, Cikarang, Bekasi Regency, as the object of research are the unconnected and integrated Jababeka city as a whole; the housing, the distinctive urban space, the ease of access-scale-absorption, the combination of differences, as well as being more sustainable and healthier lifestyle. This study is a two-year research with the first-year study using a qualitative descriptive approach, with surveys, interviews, and benchmarking. The results of this study can develop the TOD area around new or existing transit stations that can be served by a regular and efficient transit system, using the Jababeka, Cikarang, Bekasi area model. TOD is also expected to improve accessibility by providing relatively high levels of transport connections and high density, mixed-use, cycling, and pedestrian-friendly land use. The key finding of this research, TOD is very important to be implemented through shifting private transportation in their respective regions. The potential for TOD in the Jababeka Area, Cikarang, Bekasi for the long term is very likely to be implemented. As forthe research output, based on two chosen TOD alternatives, shows that the Sub-City TOD and Environmental TOD can be developed into TOD design models in further research.

Keywords: Transit-Oriented Development, Mixed-Use Development, Regular Transit Systems, Transit Stations, Sustainable Urban Transport

1. Introduction

The development of the TOD Modeling model in Indonesia, especially in the Jababeka area, Cikarang, Bekasi will collaborate with potential user partners relevant to this research, namely, the Jababeka group of companies as Research Partners. The Jabodetabek Transportation Management Agency (BPTJ) plays a role in the implementation of TOD as stated in the Regulation of the Head of BPTJ 2017, in the implementation of public transportation-oriented areas in the Jabodetabek area (BPTJ, 2017). BPTJ provides technical recommendations to ensure that the development plan in the TOD area in the Jabodetabek area has fulfilled the transportation aspects and provides guidance in the form of implementing regulation, control, and supervision. The development of the Cikarang-Jababeka TOD Area in Bekasi Regency, as informed by the Head of BPTJ, includes five areas that will be developed by BPTJ, as well as Grandhika City in East Bekasi. (Business, 2020).

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The development of TOD in the Jababeka area is one of the efforts to attract people to use public transportation. The development of transportation nodes, especially in the Jababeka area, such as stations and terminals as regional and environmental-scale activity centers, is based on the integration of intermodal services and mixed-use development. Based on information from the TOD implementer as was done by one of the TOD developers (DKI, 2019), some obstacles are still found such as not entirely applied regulations in development areas, in terms of spatial planning they are not a TOD area, but demands for the fulfillment of the area are requested like a TOD area. Some problem identifications are; (1) The Jababeka area is not yet connected and integrated with residential areas, (2) The Jababeka area does not have a unique space, (3) There are barriers to access to the station location as a transit location.

Some research in the TOD area, (Cervero & Murakami, 2009) explained that TOD emphasizes the planning of residential complexes, commercial areas, retail, and public services around the old and new transit stations with an orderly and efficient transit system service. The success of transit corridors in driving sustainable regional growth depends on location decisions made by private sector developers (Guthriea & Fan, 2016). From social benefits, to be interconnected and close to each other, TOD must be supported by the government because it will increase the value of the land and is useful for urban regeneration in the former industrial area. (Hutchings, 2013). However, By simply mentioning a TOD area development, the construction site will cause new traffic jams (Ricardianto et al., 2020). It is added that transit-oriented development (TOD) according to HM Lund *et al.*, (2004) can respond to these challenges by supporting the use of transport and providing needed housing and forms of development.

Literature Review

Transit-Oriented Development

Theoretically, the notion of TOD, according to Calthorpe in 1980 and published in 1993 with the principle of TOD is Density, Mix, and Design, then supplemented into 5 Ds (Calthorpe, 1993) which added accessibility and distance to transit.

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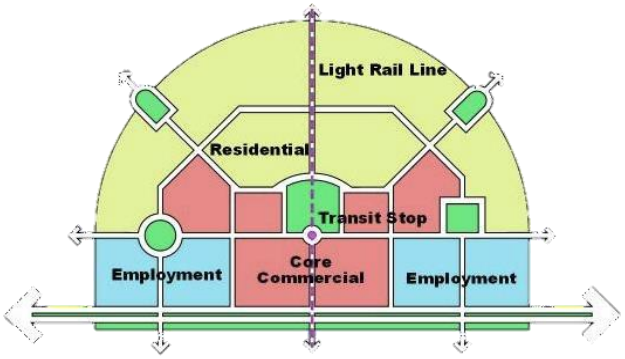

Source: TOD concept concept(Calthorpe, 1993)

Figure 1. Transit-Oriented Development (TOD)

In general, Calthorpe, states that TOD is a multi-purpose community that encourages people to live near public transport services and to reduce their dependence on driving (Carlton, 2009). Based on a World Bank study, one way to overcome the challenges of traffic congestion is through TOD, which is a multidisciplinary planning and design strategy to promote sustainable urban development (Ollivier & Basat, 2020). TOD, is "Mixed-use residential and employment areas, designed to maximize access to public transport through higher-density development and pedestrian-friendly street environments" (TOD Guide, 2010). In addition, TOD is defined as a mixed residential and work area, designed to maximize access to public transport through a higher density of development and a pedestrian-friendly road environment. TOD is a multipurpose community that encourages people to live near transit services and reduce their dependence on driving (Santasieri et al., 2014). According to Bay Area Rapid Transit (BART), TOD is the new construction or rebuilding of one or more buildings whose design and orientation facilitate the use of public transport (Dittmar & Ohland, 2012).

Therefore, based on the opinion of several TOD experts as well as several institutions such as the World Bank and transportation institutions, it can be concluded that TOD is a mixed residential and commercial area with high accessibility to mass public transportwhere mass public transport stations and mass public transport terminals are the centers of the area with high-density buildings.

2. Methods

This study used qualitative descriptive methods, through observation, and in-depth interviews with several key informants, and the triangulation process. This study

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compared several previous studies on Transit Oriented Development from several cities in Indonesia, countries in Asia, Europe, and America.

3. Discussion and Result

Result of State of The Art

This literature review as a State of The Art is a publication of previous research that will be used as a basis for thinking or as an analogy. In this relevant previous study, several shortcomings will be shown as elements of the gap in the previous research. TOD presented are in several city-states in Japan, the United States, and Southeast Asia studied (Kidokoro, 2020) among others, Toyama in Japan, Kuala Lumpur in Malaysia, and Jakarta in Indonesia. The Transit-Oriented Development literature review will be described by comparing several research results from various TOD developments in Indonesia and outside Indonesia.

TOD research results in Europe and America

Finding by Thomas *et al.* (2018) pointed several factors that complicate policy transfers. Research by Singh *et al*. (2017), in Western Europe, explained that TOD planning around transit nodes in the city area of Arnhem and Nijmegen, Netherlands, can be effective if a baseline situation assessment is carried out properly, within walking distance of the transit nodes, by measuring the various criteria that define TOD. In Lisbon, Portugal carried out a high-density mixed area that is still within walking distance of public transport with high capacity stations (Galelo *et al*., 2014). Cities and territories across the USA are promoting transit-oriented development (TOD) near train stations to increase transit use and the number and range of housing opportunities (H. Lund, 2006). In another study in the USA, Mudigonda *et al*. (2014) explained that several sites throughout New Jersey were evaluated to determine the cost of driving versus the cost of using rail transit to work destinations in New Jersey and New York City. Finally, the conclusion of several researchers that a strong local economy is a key to TOD's success in the USA, offers clues as to why newly built TODs are largely absent in many slow-growing old cities such as Buffalo, New York, and St. Louis, Missouri (Hess & Lombardi, 2005).

TOD research results in Asia

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All over the world according to Lyu *et al.* (2016), TOD, explains that there are six types of metro station areas identified in Beijing demonstrating how context-specific typologies can support local urban and transport planners, designers, and policymakers when considering future interventions. Meanwhile, in the modern context, (Cervero & Murakami, 2009) explains TOD with, the Rail + Property model in Hong Kong, which is perfect for financing rail infrastructure and advancing transit-oriented design in fast-growing cities in mainland China.

Meanwhile in other Asian regions, such as TOD in New Delhi, India, according to Ann *et al*. (2019) there are accessibility differences that must be taken into account when considering multimodal accessibility and multimodal based TOD. Based on the analysis of the suitability of transportation capacity and land use patterns in the city of Tehran, Iran with the TOD principle was not successful in terms of pedestrians, accessibility, cycling, and spatial distribution of land use in proportion to population capacity (Kalantari *et al*., 2020).

TOD research results in Indonesia

The results of research on the island of Java, particularly the Greater Jakarta area including Jakarta, Bogor, Depok, and Tangerang, require an effective restructuring of urban land use growth or regaining a share of public transport modes, but also improving the quality of the urban environment (Hasibuan *et al.*, 2014; Taki & Maatouk, 2018). Especially in the city of Bekasi, based on the results of an assessment that has been carried out by Aldiki & Herlambang (2020), it is evident that the development of the TOD area in Gateway Park for Jati Cempaka LRT line has not been able to enter the lowest standard of TOD area issued by ITDP, because it is still ineffective considering the too exclusive construction and disintegration with the surrounding area. Other research results in the city of Bekasi by Al-Muwahidin & Muta'ali (2019) showed that there are TOD areas that are lagging, developing, and advancing.

In the Central Java area, the application of TOD at Kedungsepur commuter train station in the city of Semarang, Central Java, stated that the connectivity between the station and the feeders in eight locations is also quite good but needs to be supported by adequate pedestrian infrastructure (Ramadan & Pigawati, 2019). In Surakarta, The Director-General of Land Transportation of the Indonesian Ministry of Transportation

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has designated Tirtonadi Terminal as a transit area with the TOD concept.

Results of Identification of TOD Implementation in Jabodetabek

The implementation of the TOD area in Jabodetabek has obstacles, namely in several aspects including regulations, coordination between institutions, funding, and priorities of regional leaders. One of the main problems is the absence of a policy that stipulates the use of land in an area for transportation purposes by the interests of TOD. In addition, regulations regarding alternative land acquisition mechanisms for the benefit of TOD area development as well as technical regulations for regional planning procedures, licensing up to the implementation of TOD area development are not yet optimal.

Potential of TOD Application in Jababeka

The application of the TOD area in Jababeka is very possible in locations where MRT route will end in Jababeka. The development of the Jababeka Industrial City and the availability of land for TOD facilitate the realization of this concept. Several intermodal connectivities will be prepared to start from the MRT, Tram, Jabodetabek Residence (JR) Connexion, CommuterLine and others. Of course, it is hoped that with the availability of this land, the construction of TOD will be by the ideal concept. In addition, Transit-Oriented Development consists of 8 (eight) TOD principles, namely; Walk / pedestrians, Cycle/cyclists, Connect, Transit / Public Transportation, Mix-Use / Assimilation, Densify / Compact, Compact / Close and Shift / Switch, in an area with a radius of 800 meters from the Transit Center.

The current TOD principle must pay attention to health aspects because since the COVID-19 Pandemic, the movement of people and goods should follow the health protocols known as 5M, namely washing hands, wearing masks, maintaining distance, avoiding crowds, and restricting mobility. If later applied to the TOD concept, of course, users will feel healthy, and safe. This research is in line with several theories and previous studies which explain that the monitoring of transit phenomena will also help control emissions and mitigate greenhouse gases and will help in improving the urban environment and regional climatic conditions (Ali *et al*., 2021; Habitat, 2021).

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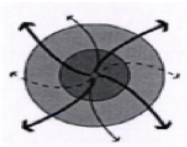
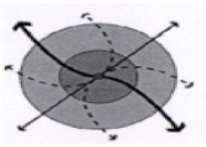
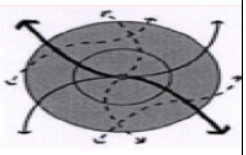
Based on the definition of the area consisting of activity, type of space utilization, type of occupancy, population, density, block dimensions, and network pattern; three sub-typologies of TOD can be determined, such as City TOD, Sub-City TPD, and Environmental TOD (Table 1).

Table 1. Typology of Transit-Oriented Development

ITEM \ TIPOLOGI	TOD CITY	TOD SUB CITY	ENVIRONMENTAL TOD
Area delineation	Areas within a radius of 400 m - 800 m are limited by physical limitations		
Activity	18 hours	16 hours	14 hours
Type of Space Utilization	5 kinds of mix; residential, office, commercial, entertainment, and public facilities (including green open space)	4 kinds of mix; residential, office, commercial, public facilities (including green open space)	2 types of mix; housing, supporting facilities (including green open space)
Residential Type	Height > 11-40 floors KDB 90%	Medium height, > 3-5 floors KDB 80%	medium - low height, > 2-3 floors KDB 70%
Population	> 750 people/ha, KLB >5	> 450 - 1500 people/ha, KLB 3.0 - 5.0	350-1000 people/ha, KLB 2.0 - 3.0
Density	Height 20-75 units/1,000 m2	High - medium 12-38 units/1,000 m2	Medium 15-20 units/1,000 m2
Block Dimension	70- 130 meters	70-200 meters	70-270 meters
Network Pattern	INTEGRATED TRANSIT SYSTEM	INTEGRATED TRANSIT SYSTEM	INTEGRATED TRANSIT SYSTEM
Transit Station Primary Transit Secondary Transit Feeders *High* **Intensity** *Low*			

In developing the TOD concept in Jababeka, of course, there are several development options according to the typology table above, if you look at the density of this Industrial city (Table 1), then there are two alternatives, namely Sub-City TOD and Environmental TOD.

4. Conclusion

The implementation of TOD in Indonesia, at this time still has problems in the development and implementation. Therefore, TOD is very important to be implemented through shifting personal transportation in their respective regions. The potential for TOD in the Jababeka Area, Cikarang, Bekasi for the long term is very likely to be implemented. Based on two TOD, alternatives are chosen, the Sub-City TOD and Environmental TOD that can be developed into TOD design models in further research. The Jababeka area will become a city area during the pandemic as a safe area with more sustainable and healthier lifestyles.

References

Al-Muwahidin, NH, & Muta'ali, L. (2019). Strategy for the Development of the Transit-

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/altr

Oriented Development (TOD) Area in Bekasi City. Indonesian Earth Journal, 8(4), 1–15.

Aldiki, B., & Herlambang, S. (2020). Evaluation of TOD Concept at LRT Station in Bekasi City (Case Study: Jaticempaka LRT Station–Gateway Park). Journal of Science, Technology, Urban, Design, Architecture (Stupa), 1(2), 2159-2168.

Ali, L., Nawaz, A., Iqbal, S., Aamir Basheer, M., Hameed, J., Albasher, G., & Bai, Y. (2021). Dynamics of transit-oriented development, the role of greenhouse gases and the urban environment: a study for management and policy. Sustainability, 13(5), 2536. https://doi.org/doi.org/10.3390/su13052536

Ann, S., Jiang, M., & Yamamoto, T. (2019). Influence Area of Transit-Oriented Development for Individual Delhi Metro Stations Considering Multimodal Accessibility. Sustainability, 11(6), 4295.

Business. (2020). BPTJ Arranges Criteria for Transit-Oriented Development. Bisnis.Com. Jakarta. https://urbanjakarta.co.id/bptj-susun-kriteria-transit-oriented-development/?lang=id. June 18, 2020.

BPTJ, PK (2017). BPTJ Head Regulation No. PR.377 / AJ.208 / BPTJ-2017 concerning Technical Guidelines for Transportation Aspects. In organizing public transport-oriented areas in the Greater Jakarta area.

Calthorpe, P. (1993). The Next American Metropolis. Princeton Architectural Press, Inc.

Carlton, I. (2009). Histories of transit-oriented development: perspectives on the development of the TOD concept (No. 2009, 02).

Cervero, R., & Murakami, J. (2009). Rail and property development in Hong Kong: Experiences and extensions. Urban Studies. Urban Studies, 46(10), 2019-2043. https://doi.org/10.1177/0042098009339431

Dittmar, H., & Ohland, G. (2012). The new transit town: Best practices in transit-oriented development. Island Press.

DKI, P. (2019). DKI Jakarta Governor Regulation Number 44 of 2019 concerning the Development of Transit Oriented Development Areas. Governor of DKI Jakarta.

Galelo, A., Ribeiro, A., & Martinez, LM (2014). Measuring and Evaluating the Impacts of TOD Measures–Searching for Evidence of TOD Characteristics in Azambuja Train Line. Procedia-Social and Behavioral Sciences, 111, 899–908.

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/altr

https://doi.org/10.1016/j.sbspro.2014.01.124

Guthriea, A., & Fan, Y. (2016). Developers' perspectives on transit-oriented development Author links open overlay panel. Transport Policy, 51, 103–114. https://doi.org/10.1016/j.tranpol.2016.04.002

Habitat, UN (2021). Cities and Pandemics: Towards a More Just, Green and Healthy Future. Nairobi, Kenya: United Nations Human Settlements Programme.

Hasibuan, HS, Soemardi, TP, Koestoer, R., & Moersidik, S. (2014). The Role of Transit-Oriented Development in Constructing Urban Environment Sustainability, the Case of Jabodetabek, Indonesia. Procedia Environmental Sciences, 20, 622–631. https://doi.org/10.1016/j.proenv.2014.03.075

Hess, DB, & Lombardi, PA (2005). Governmental Subsidies for Public Transit: History, Current Issues, and Recent Evidence. Public Works Management & Policy, 10(2), 138–156. https://doi.org/10.3141/1887-04

Hutchings, J. (2013). Transit-oriented development (TOD) –integrating rail and commercial development schemes. 3rd Annual Modern Railways Conference, Singapore.

Kalantari, M., Ahadnejhad Roshti, M., Meshkini, A., & Noroozi, MJ (2020). Structural-functional explanation of the Physical development on transit-oriented development in metropolitan cities (Case study: Tehran metropolitan). Regional Planning, 10(38), 125-142.

Kidokoro, T. (2020). Transit-Oriented Development (TOD) Policies and Station Area Development in Asian Cities. IOP Conference Series: Earth and Environmental Science (Vol. 532, No. 1, p. 012001)., 1–8. https://doi.org/10.1088/1755-1315/532/1/012001

Lund, H. (2006). Reasons for living in transit-oriented development, and associated transit use. Journal of the American Planning Association, 72(3), 357-366. https://doi.org/10.1080/01944360608076757

Lund, HM, Cervero, R., & Willson, R. (2004). Travel characteristics of transit-oriented development in California.

Lyu, G., Bertolini, L., & Pfeffer, K. (2016). Developing a TOD typology for Beijing metro station areas. Journal of Transport Geography. https://doi.org/10.1016/j.jtrangeo.2016.07.002

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/altr

Mudigonda, S., Ozbay, K., Ozturk, O., Iyer, S., & Noland, RB (2014). Quantifying transportation benefits of transit-oriented development in New Jersey. Transportation Research Records, 2417(1), 111–120.

Ollivier, GP, & Basat, G. (2020). Transit-Oriented Development for Sustainable Cities (No. 148840, pp. 1-2). https://documents1.worldbank.org/curated/en/136041590645680032/pdf/Transit-Oriented-Development-for-Sustainable-Cities.pdf

Priadmaja, AP, & Anisa, A. (2018). Application of the concept of Transit Oriented Development (TOD) in regional planning in Tangerang City. PROTOTYPES Journal of Architecture, 1(2), 53-60.

Ramadhan, RA, & Pigawati, B. (2019). Transit-Oriented Development (TOD) on the Commuter Train Network. IOP Conference Series: Earth and Environmental Science (Vol. 313, No. 1, p. 012030).

Ricardianto, P., Marlita, M., Widiyanto, P., & Krisnawati, S. (2020). The Role of Transit-Oriented Development in the Urban Area Development with Railway-Based Transportation. Elixir Transport Management, 143(2020), 54455–54462.

Santasieri, CL, Vroom, SC, Hughey, R., Bay, P., & Dunphy, R. (2014). Planning for Transit-Supportive Development: A Practitioner's Guide (No. 0054). In Executive summary (No. FTA Report No. 0052). The United States. Federal Transit Administration.

Singh, YJ, Lukman, A., Flacke, J., Zuidgeest, M., & Van Maarseveen, MFAM (2017). Measuring TOD around transit nodes-Towards TOD policy. Transport Policy, 56, 96–111. https://doi.org/10.1016/j.tranpol.2017.03.013

Taki, HM, & Maatouk, MMH (2018). Spatial Statistical Analysis for Potential Transit-Oriented Development (TOD) in Jakarta Metropolitan Region. Journal of Geoscience, Engineering, Environment, and Technology, 3(1), 47-56. https://doi.org/10.24273/jgeet.2018.3.01.1091

Thomas, R., Pojani, D., Lenferink, S., Bertolini, L., Stead, D., & van der Krabben, E. (2018). Is transit-oriented development (TOD) an internationally transferable policy concept? Regional Studies, 52(9), 1201-1213. https://doi.org/10.1080/00343404.2018.1428740

TOD Guide. (2010). Transit-oriented development: a guide for practitioners in

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/altr

Queensland. In Transit-oriented development guide (pp. 1–47). Department of Infrastructure and Planning.