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Implementation of Transit Oriented Development (TOD) Concept To Increase Public Transportation User in the city of Jakarta

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Abstract. Transit Oriented Development, hereinafter referred to as TOD, is a concept of regional development based and centered on a mass public transit station, which accommodates new growth into a mixed area with an area of 350 m to 700 m from the center of the area that is integrated with the area around it through the use of ground surface space, elevated space and underground. In the existing conditions in the field and the lack of availability of public transport services to the public there are still lacks of lack of attention from transportation providers, one of which is the interconnection and integration of public transport, where the facilities and infrastructure for moving public transportation are inadequate at the beginning and end of a trip (first mile and last mile). smooth traffic is needed to meet the target of public transport services. Planning and re-evaluating traffic networks and implementing transportation policies that can support the use of public transportation. The need for integration of public transportation in order to reduce travel time, as well as to improve the standard of living of the people, then based on these considerations, the Development of DKI Jakarta TOD needs to be done as an effort to realize healthy transportation.

1. Introduction

1.1. Transportation

Transportation is an effort to move or move people or goods from the original location to the destination location for certain purposes by using certain tools. The demand for transportation arises as a result of human socio-economic activities. Humans need goods such as food items and social activities in meeting the needs of life. In this case, transportation plays a role in supporting and facilitating humans in achieving their social and economic life, so that transportation cannot stand alone but must be a whole and comprehensive unit called the transportation system [1].

The overall (macro) transportation system consists of several micro transportation systems. Some parts of the micro transportation system include: Activity Systems, Network Systems, Movement Systems, Institutional Systems [2].

1.2. Transit Oriented Development

Transit Oriented Development is an area that has mixed land uses around transit locations and trade centers. The use of land is in the form of housing, trade, markets, open space, and public facilities. In general, TOD is a mix-used community that encourages people to settle and move around the transit area to reduce people's dependency on using private vehicles and switch to using public transportation [3]. In his book entitled *The Next American Metropolis* (1993), Calthorpe explained that: "A Transit Oriented Development is a mixed-use community within an average 2000 foot walking distance of a transit stop and a core



commercial area. TODs mix residential, commercial, office, open space, and public uses in a walkable environment, making it convenient for residents and employees to travel by transit, bicycle, foot, or car."

TOD as an area concept with high development efficiency, where the efficiency is seen from the presence of mixed land uses, accessibility in reaching transit locations and pedestrian friendliness. The parameters in the development of the TOD concept are mix-used land use, regional density, regional accessibility, and the availability of pedestrian facilities to support pedestrian friendliness [4].

Summarized from several existing sources including one of the TOD concept plans that will be implemented in DKI Jakarta, especially around the following MRT corridors, are eight principles, namely :

1. Mixed functions (development of mixed functions within walking distance of each station, namely commercial functions, offices, humidity, housing, and public facilities);
2. High density (maximum transit and activeness around the transit station) in accordance with the carrying capacity of the region;
3. Enhancing the quality of connectivity (simple, direct and intuitive connections that support the mobility of users to, from, and between stations that are free of transport vehicles and have a clear system of marking towards stations in the development zone);
4. Improved quality of life (attractive, safe and comfortable space experience that supports the needs of daily passengers, pedestrians, workers, residents and visitors through roads, plazas, open spaces that can provide positive support for the identity and character of the connected transit area);
5. Social justice (enabling new communities that can survive and succeed for a long time with shelter for all socio-economic circles, maintaining existing social networks and communities in the development area, and providing social infrastructure to support stronger community relations and identities) ;
6. Reducing the Environment to the Environment with an environmentally friendly design, reducing the carbon footprint as an optimization of walking and circulation, controlling air and energy, managing natural ecosystems and cities, and managing waste for new resources);
7. Infrastructure resilience (city conservation that can withstand major disasters and have an impact on climate change); and
8. Economic renewal (local economic development that can attract investment and new job opportunities).

Basically the concept of TOD (Transit Oriented Development) has design principles, namely: a. Density: Density of the development area related to the radius of service of the transit point. b. Diversity: There must be a variety of functions in the region (mix-use). c. Design: Design an area that is integrated with one another.

Characteristics of Transit Oriented Development

Transit Oriented Development (TOD) is a concept that focuses on land use patterns that places a strong emphasis on a mixture of types of activities, mobility, connectivity, density and high intensity and pedestrian friendliness. In this case, the TOD scale is an area that has a radius of $\frac{1}{4}$ - $\frac{1}{2}$ miles (400-800 meters) or the ease of walking for 5-10 minutes from premium transit. TOD is in an area with a compact development with high density and mix-used

oriented to urban forms that are pedestrian-friendly when traveling from other activity center transit locations (Florida TOD Guidebook, 2012).

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There are two types of Transit Oriented Development area development, namely: Urban TOD, is an area development that is located in the main network of public transportation which is close to a mixture of land use activities such as offices, housing, trade, and other activities in increasing access to community achievements efficiently. Neighborhood TOD, is the development of an area connected with local transportation or feeders that can support the needs of the community and minimize the use of private vehicles so as to support non-motorized movements such as walking or cycling [6]

Table 1. TOD Definition Table

Concept	Source	Indicator used	Variable
<i>Transit Oriented Development</i>	Cervero (2004)		Building Density
	Watson (2003)	<i>Density</i> (land use density)	Basic Building Coefficients
	Florida TOD Guidebook (2012)		
	Ververo (2004)	<i>Diversity</i> (mixed land use)	Building Floor coefficient
	Watson (2003)		Use of Housing Lanah
	Renne (2009)		Use of Office Lanah
	Florida TOD Guidebook (2012)		Use of Trade and Service Areas
	Florida TOD Guidebook (2012)		Use of Public Facilities Lanah
	Cervero (2004)	<i>Design</i> (pedestrian friendly)	Availability of Pedestrian Paths
	Renne (2009)		Pedestrian Path Dimensions
	Florida TOD Guidebook (2012)		Pedestrian Path Connectivity
	ITDP (2014)		Availability of Road Crossing Facilities
	Bicycle Path Availability		

Table 2. Building Density Benchmarks and Pedestrian Networks Based on the Minister of Public Works Regulation

Regulation	Variable	Terms	Provisions
Minister of Public Works Regulation No.20 of 2011	Building Density	Very High Density	> 1000 buildings / hectare
		High density	100 - 1000 buildings / hectare
		Medium Density	40 - 100 buildings / hectare
		Low density	10 - 40 buildings / hectare
		Very Low Density	<10 buildings / hectare
Minister of Public Works Regulation No. 3 of 2014	Pedestrian width	-	Minimum of 2 meters
	Pedestrian Paths Special Needs (disabled)	-	Miniman width of 1.5 meters
	Pedestrian distance	The distance of pedestrians to reach a stop or transit location	equipped with guide lines and guidance devices along the pedestrian network
			Maximum distance of 400 meters or maximum travel time of 10 minutes
	Crossing lane	-	There are Zebra crossings, Pelikan crossings or bridges to facilitate pedestrian crossing in different lane changes
Cycling area Green line availability	-	Miniman width of 1.5 meters Located between pedestrian and vehicle lanes	

Source: Minister of Public Works Regulation No.20 of 2011 and No.3 of 2014

2. Method

2.1. Preparation

Preparation activities include things that are supported in the beginning of the research, preparation of the implementation methodology, preparation and stabilization of the work plan.

2.2. . Data collection

In collecting data there are 2 (two) categories, namely Primary Data and Secondary Data, the data to be obtained are:

Primary Data, that is data obtained from direct collection in the field, including: Photos of data locations and information on road sections, Data deemed necessary in making road network modeling (eg geometric surveys, side obstacle surveys, etc.), Past data road network crossing, Transjakarta Busway operational data, MRT, Traffic data in and around selected TOD locations, Survey of potential development of transit-oriented areas, Needs of public transport and traffic engineering needs, including: Sarpras conditions and situations in and around the transportation node, Inventory of public transport both road and rail based, Traffic

performance during the existing conditions and after the traffic engineering; Fulfillment of public transportation services according to cross services; and Management of traffic engineering and policies that can be applied by the government.

Secondary data, i.e. data obtained from literature studies, including secondary data in the form of information and policy regulations from various relevant agencies both private and government agencies, the results of previous research on transportation and related traffic, map data, includes maps of road networks, maps of spatial and territorial plans, and other maps required.

2.3. *Analysis*

After obtaining the data, then the data is processed and analyzed. Analysis of the results of the secondary survey was carried out to obtain an initial overview of the study and as a basis for preparing plans and developing terms of reference for the purposes of improving the report. Analyzing the primary survey results so that a detailed picture of the location on the field is obtained along with the problem. Compile survey data, both in the form of soft and soft materials in which the compilation results become data for Transit Oriented Development (TOD) development.

Perform modeling simulations using a softening system of the transportation network system capable of conducting transportation analysis including traffic, which is related to the capacity and speed of the vehicle flow in accordance with the background and location of the study and analyzing the results of the modeling along with conclusions and recommendations on a series of alternative solutions that might be carried out as the consequences of the results of the modeling above.

The analysis was carried out in achieving the three research objectives namely identifying the criteria of the TOD concept that are in accordance with the study area, analyzing the suitability of the characteristics of the transit area with the TOD area criteria and determining the priority of the transit area development criteria with the TOD concept.

2.4. *TOD Design Concepts*

The TOD concept can be built in an area that is considered to have experienced a decline in both its physical function and quality and must undergo a process of redevelopment (rebuilding). In addition, this concept can also be applied to infill sites (land that is already developing) and new growth areas (new development lands). This TOD concept usually provides or creates new functions and improves the transit system network within the region or creates a new transit system network. In a TOD area development there are several variables that must exist in the region, namely:

1. Commercial Central Region

The commercial function in the TOD concept is a core part of the area that is integrated with the transit function. The integration of the transit and core commercial functions in the region will be able to attract people to come to the region and use transit services to the region. Placement of the core commercial to be created must keep in mind the balance of comfort, visibility and accessibility of pedestrians and vehicles.

2. Residential Area

The TOD area must also be able to facilitate the function of the surrounding dwelling. Buildings suitable for one TOD area in an urban area are apartment buildings given the high intensity in one urban area.

3. Parks, plazas and public buildings

The development pattern of TOD is by placing it that is easily accessed by various facilities and public spaces. The function of public space here is to meet the demands that public space as a place for people to do social interaction. Besides the open space in the form of parks and plazas is a binder between building masses.

4. Transit System The location of the transit stop is located in the central part of the TOD area adjacent to the core commercial area. The commercial function must be easily seen and accessed from the transit stop.

5. Mixed Use

New functions that will be included in the planning area are mixed use functions in the form of commercial functions (malls, department stores, retail, street vendors), residential functions, offices, public and social facilities (train stations and their facilities, security offices, mosques, and parking building), etc. The purpose of incorporating various functions into the area is to create an area that lives for 24 hours. Supervision is carried out continuously and together by the security forces and the residents of the area, so that then environmental security can be maintained properly.

6. Road and Circulation System.

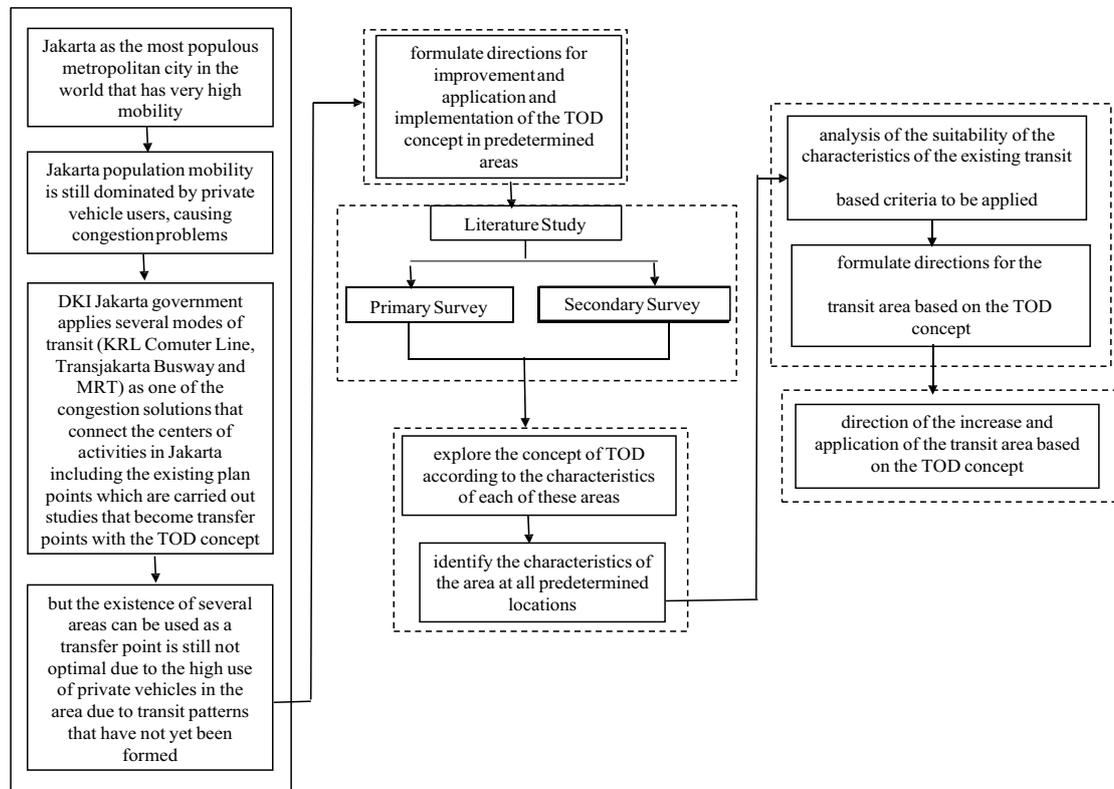
The road network must be able to create safety and provide a comfortable walkway that is separated from the vehicle lane and pedestrian.

7. Parking Needs Parking facilities in the TOD area must pay attention to:

- a. In accordance with the needs of the region for minimum and maximum needs.
- b. Placement of the parking lot must be integrated with the pedestrian path and the distance to the building is not too far away. The parking function can be done by dividing the time, where the daytime is used for parking office functions and at night is used as a parking space for residential functions.

8. Pedestrian Paths Pedestrian paths are made to connect functions that are in the area so that the achievement of one function to another can be accessed easily by road users. Pedestrian paths are comfortably made and have direct access to commercial and transit areas. The pedestrian path must also be integrated with the function of open spaces and plazas.

The compilation of the design and description of the plan from the results of the study, as a result or product of the calculation carried out, and the handling solution in the form of construction and other infrastructure improvements needed in the implementation of the TOD.



methodology chart

3. Conclusions and suggestions

Make conclusions from the whole set of analyzes as a material for thought and compile recommendations and priority scenarios so as to produce maximum TOD concept results.

The results of the analysis of determining the node as an intermodal connectivity point in DKI Province consists of 9 node points, namely (1) the dukuh atas area (2) the pegangsaan area (3) the pulomas area (4) kampung rambutan terminal (5) grogol terminal (6) senen terminal (7) manggarai terminal (8) rawa buaya terminal (9) lebak bulus terminal.

The use of mixed land and pedestrian-friendly design are as follows

1. Need to regulate the proportion of the use of trade and service land
2. Need to adjust the proportion of Office Land Use
3. Increase Increasing the availability of pedestrian paths on all roads in the transit area.
4. Encourage the diversity of land use functions and maintain land use areas for public facilities in the transit area.
5. Pedestrian Connectivity by Developing connecting or translucent roads, applying grid pattern road networks and building road crossing facilities (JPO) to avoid pedestrian crossing with vehicles.
6. It is necessary to regulate and determine the Building Floor Coefficient (KLB) in accordance with the planned TOD development.
7. Increase the average value of KLB in blocks 1, 4 and 7 which are limited by KKOP.
8. Add or prepare a pedestrian path in accordance with the standard dimensions issued by the Ministry of Public Works.

9. Organize and increase the value of Building Density, especially in the transit area or node
10. Provide facilities and infrastructure that support cyclist activity in the form of integrated bicycle lanes.

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