Development Of Transit Oriented Development (TOD) in Semarang City

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Abstract. One strategy to support traffic congestion in the transit space utilization area is by applying the concept of transit-oriented (Transit Oriented Development). The purpose of this research is to identify the potential area of TOD in Semarang, to analyze the needs of developing the TOD area, and to formulate the direction of the development of the TOD area. The analytical method is a quantitative descriptive method, supported by map overlay. Data collection techniques were carried out by primary survey through questionnaires, interviews and field observations, while secondary surveys by collecting data from institutions and related literature. The analysis consists of TOD analysis, classifying regional potential, analysis of TOD development needs, and analysis of the embodiment of TOD area. Based on the results of location negotiations, the potential TOD area in Semarang City is in the Simpanglima Region. The implementation of TOD concept in the Simpanglima Region is expected can improve the accessibility and mobility, reduce the congestion, reduce the environmental pollution, as well as improve the efficient use of energy in the transportation sector.

1. Introduction

As population and economic growth in the city of Semarang, transportation problems can not be avoided. Major road sections in the city centre are congested during rush hour because the number of vehicles on the road has exceeded its capacity. This congestion occurs because of the large volume of private vehicles that pass on a road in the city of Semarang so that during rush hour there is a cumulation of vehicles. The problem of congestion often has a significant impact on the environment, social and economy of the city. Urban environmental pollution, energy waste and high social costs are the consequences of this congestion problem. Mostly, handling of congestion problems is performed by increasing the capacity/supply of the road network through widening or increasing the length of the road. This is practical as well as a temporary strategy for responding to increased transportation needs. It even encourages higher rates of growth of motorized vehicles in urban areas. Eventually, congestion becomes a vicious cycle of problems that has a long-term impact on the city's environment, social and economy.

The concept of Transit Oriented Development (TOD) is one of the innovative strategies that prioritizes the integration between land use and transportation. The idea of the TOD concept is motivated by the idea that transit points (such as terminals, stations, bus stops, etc.) not only serve as a place to raise and lower passengers, but these transit points can function as a place for urban activities (residential centres, offices, trade and services, education and so on). The application of the TOD concept is expected to increase accessibility and mobility so as to reduce congestion, reduce environmental pollution, as well as the efficient use of energy in the transportation sector. However, the concept of TOD has not been fully realized in the development of Semarang City. Therefore, this study will analyze where and how the development of TOD in Semarang City, in order to realize integration between mass public transport networks, integration between mass public transportation networks and non-motorized modes of transportation, and reducing the use of motor vehicles accompanied by the development of mixed areas with moderate to high space utilization intensity.

According to the Regulation of the Minister of Agrarian Affairs and Spatial Planning / Head of National Land Agency Number 16 of 2017 [1], Transit-Oriented Development (TOD) Development about Guidelines for Development of Transit-Oriented Areas is the concept of developing areas in and around the transit node to add value that emphasizes in the integration between mass public transport networks, and between mass public transport networks and non-motorized transportation modes, and the reduction in the use of motor vehicles accompanied by the development of mixed and dense areas with moderate to high space utilization intensity. TOD area is an area determined in the spatial plan as a centred area on intermodal and intermodal integration which is in a radius of 400 (four hundred) meters up to 800 (eight hundred) meters from the transit node of mass public transportation modes that have the function of using mixed space and dense, with moderate to high space utilization intensity. The TOD placement criteria are on the main mass transit network, in the high-frequency bus / BRT corridor, and on the bus passenger network that takes less than 10 (ten) minutes from the main mass transit network. Some of the principles and indicators of the TOD concept are:

1. Density or densify in the formation of tight and dense spatial patterns and planning, emphasizing the growth of the city vertically (densification) rather than the growth of the city horizontally (sprawl) [2]. According to [3] and [4], the occupancy or property density levels are indicators that can explain the density principle. While [5] tends to pay attention to the level of land use density based on the value of the basic building coefficient (KDB) and the building floor coefficient (KLB). The density of land use will bring various activities closer so that the utilization of public transportation modes can be maximized.
2. Land-Use Mixes aim to support mobility efficiency and increase the area's livability by integrating housing with workplaces, shopping areas, and schools. The principle of mix aims to bring the related land uses closer together so that it will encourage walking and cycling activities in the surrounding community [5]. [3] divides the mixed-uses indicator into two things: the number of mixed-uses land uses and the presence of retail with a variety of service scales.
3. Pedestrian lanes are needed to support movements that oriented towards the use of mass public transportation, by providing an infrastructure capable of providing comfort and safety for pedestrians, including cyclists.
4. Interconnection of road and block networks is needed to form a walkable environment. An indicator that can be used is by counting the number of intersections in an area. The more intersections found, the higher the level of interconnection of the road and block networks.
5. Parking in the TOD concept is directed at a parking restriction system by providing fewer parking spaces at the centre of the transit area compared to the suburban/secondary area [4].
6. Open space acts as a forum for social interaction while at the same time creating a harmonious landscape amidst the high intensity of land use. The location of open space can be near a transit point, road border, residential area, or in the area around the retail designation.

In 2010, Reid Ewing and Robert Cervero in their journal entitled Travel and the Built Environment: A Meta-Analysis, introduced the 5D principle (Density, Diversity, Design, Destination Accessibility, and Distance to Transit). The 5D principle is an indicator of success in implementing the TOD area.

1. Density
   The higher the density of residential buildings, the better the TOD can run in the area. The density of residential buildings should be more than 20 units/ha. Residential building density criteria can be adjusted for each state of the country.
2. Diversity of Land Use (Land Use)
   To maximize TOD performance, a minimum of 4 types of land use are needed in the area under review with a composition of settlements of 50%-80%, commercial/office buildings 10%-40%, and public 10%-15%. With this diversity, the surrounding population does not need to travel long distances to meet their daily needs so as to minimize the use of private vehicles.
3. Design
   The TOD area must be designed to increase interest and facilitate pedestrian activities, for example by providing sidewalks and other pedestrian support facilities, placement of transit points (shelters, shelters, stations, etc.) in the centre of the area to facilitate access and the availability of parking areas.
4. Distance to transit
   The transit point will be planned to be the centre of the TOD concept area. Therefore, it must be planned in such a way that the transit point is easily accessible from settlements or other centres of activity. For this reason, criteria for the affordability and connectivity of the area to the transit point have been determined, which is a maximum of 600 meters from commercial, service or office areas, and 600 meters from residential areas. However, this criterion can adapt to certain circumstances.
5. Destination accessibility
   Ease of access and mobility of a location within the TOD concept area must be considered and planned well, both within a TOD region itself, as well as between TOD areas within a city.

2. Methodology

The data collection stage is carried out by primary and secondary survey methods. Secondary data includes the Semarang City transportation system plan [6], Semarang City Spatial Planning (RTRW) [7], while the primary data collected related to the characteristics of the study location include the condition of regional transportation, space utilization, the intensity of space utilization, activity intensity, building density, and transportation support facilities. The results of this data collection are input in the analysis process. The analysis to be carried out in this study consists of identifying the location of potential TOD areas by using descriptive qualitative analysis supported by map overlay techniques, identifying the characteristics of TOD areas based on TOD criteria by using quantitative descriptive analysis, analyzing the needs of developing TOD areas based on TOD criteria using descriptive analysis quantitative, and analysis of the embodiment of the TOD region by using descriptive qualitative analysis. The results of the entire analysis process will be concluded to be the conclusions and recommendations of this study.

3. Result and discussion

Potential areas for applying TOD in Semarang City are determined using several criteria, namely located at the transit node of a railroad-based high-capacity mass transit network, in this case the City of Semarang is not yet available LRT but there are plans to build an LRT, meet the requirements of intermodal and intermodal transit, that is, close to bus stops or terminals, the pattern of the road network must be integrated with high to low intensity of movement (ease of accessibility to the whole area), the function of the road is able to serve the mass transportation system, served at least 1 (one) short distance transit mode and 1 (one) long-distance transit mode, in accordance with the direction of the development of service centres and activities in accordance with the spatial structure of the city in the Semarang City Spatial Plan, located in an area with low disaster vulnerability, seen from the condition of landslides and

flood-prone in Semarang City, and located in an area that does not interfere with important installation of the country.

From these criteria, weighting and scoring analysis is then performed. Based on the weighting and scoring of TOD placement criteria, the Simpanglima area is considered more potential to be developed as a TOD area because it is located at the transit node of a railroad-based high-capacity mass transit network, fulfilling intermodal and intermodal transit requirements, served by short-distance and transit modes long distance, high intensity of traffic movement, and in accordance with the direction of the development of service centres and activities as the centre of Semarang City. Deliniation of the Simpang Lima TOD area is determined within a radius of 800 meters from its transit point (Citraland front stop), administratively entering the area of South Semarang District and Central Semarang District, with an area of 101.94 Ha. Map of the Simpang Lima TOD delineation can be seen in figure 1.

Figure 1. Delineation of TOD area in Simpanglima

3.1 Land-Use mixes

Community activities in the Simpanglima area began to be crowded from 06.00 WIB (office activities) to 23.00 WIB (trading activities). After 23:00 WIB there is still community activity but the intensity was reduced (at least 17 hours), even the community could move until early morning (around 21 hours) [8]. The character of regional development as a city service centre, an economic centre that has primary functions and regional culture, and has a regional service scale. From the time/duration criteria for the activity to take place, the Simpanglima TOD area has met the parameters of the downtown TOD area.

The percentage of the housing area in the Simpanglima area is 33%, while the non-housing area is 67%. The percentage of the area of housing and non-housing has met the TOD area parameters (an indicator of the area of housing and non-housing 20-80% to 40-60%) with the developed residential area being balanced. The types of dwellings developed are luxury dwellings with a height of 1-2 floors and

high-intensity vertical dwellings (apartments). Since the Simpanglima area is a strategic and economic area, it is not developed for simple houses.

Types of land use in the Simpanglima area are trade and service areas, offices, public service facilities, settlements and green open spaces. The domination of land use in Simpanglima TOD Area is in the form of settlements (33%), then trade and services (28%). The number and types of space utilization activities have met the parameters of the TOD area, land use in the TOD area is 5 (five) types with various activities in it. The various types of spatial use activities exhibit high urban characteristics, that will increase the intensity of community activities and the attractiveness of the community for activities in the city centre. The diversity of activities causes a high level of human movement and the high intensity of activity, so it is necessary to provide diverse complementary facilities.

The service scale of commercial activities in the Simpanglima Region has reached the regional service scale. This is related to the situation of Simpanglima area as a downtown area and a landmark of the City of Semarang so that many people from outside the City of Semarang visit this area to just shop and travel. The scale of service of commercial activities in Simpanglima Region has met the parameters of the TOD area, namely the scale of services of commercial activities is regional. Occupancy in the Simpanglima Region consists of 1 (one) floor, 2 (two) floors to more than 10 (ten) floors (apartment) vertical dwelling. The types of dwellings in the Simpanglima area have met the TOD area parameters, namely high rise buildings, midrise apartments and condominiums.

3.2 Open spaces

The Simpanglima area has an open green space in the form of Pancasila Field with a regional service scale, which is in front of the transit point of the BRT stop, easily accessible from all areas, has an attraction especially in the afternoon until the evening. In addition there are parks with local service scale in the form of active parks (playgrounds) and passive parks (greening areas). Private green open space is in the form of a garden. The area of green space in the Simpanglima TOD area is only available at 7.78% of the area, while the open space area is 21.7 Ha (21.3%) in the form of roads, pedestrian, infrastructure networks. The area and type of open space have met the TOD area parameters, but the special provision of green open space is still lacking (10-15% open area indicator, public green space 20%), therefore the need to increase green space. The TOD area must provide an open space that acts as a forum for social interaction while creating a harmonious landscape amidst the high intensity of land use. The location of the open space must spread in the pedestrian area, comfortable and attractive.

3.3 Densify

Estimated population of Simpanglima is 100,871 people consisting of 2,624 permanent residents (3%) and non-permanent residents (workers) of 98,247 people (97%). Net building density is 25 units / Ha. The net population density reaches 2,372 people / Ha, while the gross population density reaches 990 people / Ha. The more densely populated the higher the level of movement of people and transportation. The population density in Simpanglimas Area is 990 people/ha. This number has met the minimum population density parameter in the TOD area which is 750 people/ha. The density of the working population of 1,674 people/ha has fulfilled the minimum worker density parameter of 200 people/ha.

KDB in Simpanglima Region is quite varied starting from KDB 40% to 100%. KDB 40% in residential buildings while KDB 100% are usually found in trade and service buildings. KDB dominates in the form of KDB 90%. The KDB dominance of the building has met the TOD area parameters (KDB indicator is 80%). The greater the KDB, the higher the intensity of space utilization, the number of building users will increase. The unbalanced KDB between buildings causes the impression of a disproportionate area, therefore KDB arrangements need to be made so that the land plot is not fully developed (leaving an area for green space).

The minimum KLB in the Simpanglima area is 0.4 while the maximum KLB is 18. The dominance of the building outbreak has met the TOD zone parameters (KLB indicator> 5.0). The greater KLB, the

higher the intensity of space utilization. Minimum net building density is 25 units/ha. High building density meets the TOD area parameters (high building density indicator). High building density indicates the intensity of space utilization is getting higher. However, development control is needed so that development is more organized and does not create the impression of being dense and uncomfortable.

The density of net occupancy in the Simpanglima area reaches 62 units/ha. This has met the TOD area parameters (an indicator of residential density 20-75 units / 100 m2). Need to control residential development so that development is more orderly and does not create the impression of being dense and uncomfortable. The height of buildings in the Simpanglima TOD area is between 1 floor to 20 floors. The height of the building is in the form of a 2-story building. 20-storey building in the form of an apartment building (highrise building). The number of building floors meets the TOD area parameters (an indicator of the number of building floors> 11-40 or more). The number of building floors also shows the higher intensity of space utilization.

3.4 Transportation

The pattern of the road network in the Simpanglima area has been integrated with high to the low intensity of movement (ease of accessibility to the whole area). The pattern of the formed road network is a grid. The function of the road serves the mass transportation system with the types of modes of public transportation, namely urban transportation and BRT with the farthest route to Terminal Mangkang, Penggaron Terminal, Terboyo, Ungaran. Frequency of public transportation headway, especially BRT less than 5 (five) minutes. Distance from the transit point to the surrounding area is quite close. The Simpanglima area is a public transportation node, which also needs to be supported by the provision of BRT stops at the centre of the region and in the main corridors of the region. The location of the station close to the centre of the activity already fulfils the TOD area parameters, it's just that it does not yet have a clue and a gate as a guide to the station. The bus stop is at the centre of regional activities, so it is quite easily accessible to the community.

3.5 Cycle

The Simpanglima area is available by bicycle lane, but only on major roads such as Jalan Pahlawan with a width of 2 meters, which is separated from the vehicle lane and separated from the pedestrian lane. Other road segments are not yet available on bicycle paths. Bicycle lanes can be provided using the same lane as vehicle lanes only separated by road markings. There are no special bicycle lanes so the Simpanglima area is considered not to meet the cycle parameters in the TOD area. Therefore it is necessary to add bicycle lanes on environmental roads, especially from the residential zone to the office zone.

3.6 Pedestrian path

Most of the Simpanglima area has pedestrian paths available on the main road, which are separate from the vehicle lane. In addition there are crossing lines, equipped with supporting infrastructures such as seating, pedestrian lights, trash bins, and pedestrian designs that accommodate diffable. The width of the pedestrian path on the main road in the area is 4 (four) meters, while the pedestrian path on the neighbourhood road is 2 (two) meters wide. There are also some local roads or neighbourhoods that are not yet available pedestrian paths. The pedestrian lane is only on a few main roads, the environmental road is not yet available, so it does not meet the TOD area parameters. Movements oriented towards the use of mass public transportation must be supported by providing an infrastructure capable of providing comfort and safety for pedestrians, including cyclists. The pedestrian path must be continuous so pedestrians can access the entire area. The pedestrian path must be equipped with a bench (within a certain radius), green line as a shade.

3.7 Park

Each building has provided a parking area inside the building lot. In addition there is a special public parking building provided by the building owner. In fact, there are still vehicles parked on the shoulder of the road. Bicycle parking is also not yet available in the Simpanglima area. Therefore, parking criteria in the Simpanglima Region have not fully met the TOD area parameters. Existing parking is expected to be able to accommodate parking needs at the transit point and or transit area by increasing land efficiency and limiting individual parking lots. Parking with this method is conducting by providing a parking building, parking bags, or parking facilities for transit points. Additionally, parking time restrictions on the area's main roads and efficient parking patterns can be made.

3.8 Road network interconnection

Connections between transportation networks within the Simpanglima Region have met the TOD area parameters. Connections between networks are integrated, continuous, and allow pedestrians to walk freely in all directions. The quality and width of the existing road are quite good so as to facilitate the movement of the vehicle.

4. Conclusion

The conclusions that can be formulated related to the development of the Simpanglima TOD Area are Simpanglima area as potential TOD area and some directions for the development of Simpanglima TOD area. Simpanglima area is the centre of economic activity and activities (Central Business District) in Semarang City. The Simpanglima area has a transportation node, traversed by several modes of public transportation (BRT, public transportation, and LRT plans), as a centre for trading and service activities, offices and public service facilities. The Simpanglima area has a high population density and high building density. Delineation of the Simpang Lima TOD area is administratively included in the area of South Semarang District and Central Semarang District, with an area of 101.94 Ha. The transit point is set at the Simpang Lima BRT stop (in front of the Ciputra Hotel).

Directions for the development of the Simpanglima TOD Area are including regional development by encouraging sustainable mobility through increased use of mass public transportation, development of transportation integrated with transit nodes, arrangement of building layout, provision of green open space, provision of supporting infrastructure to provide comfort, security for users of the area such as pedestrian, bicycle lane.

The topic for further studies are including involvement of all stakeholders involved, both the city government, the private sector and the community, especially the community that uses the Simpanglima TOD area and changing of the behaviour/culture of the community to prefer walking and using public transportation. Besides, the involvement of building owners in the Simpanglima TOD Area to support the realization of a safe, comfortable and attractive area of TOD, as well as the embodiment of the Simpanglima TOD Area from technical, institutional and financial studies, should be taken into account.

References

[1] Kementrian Agraria dan Tata Ruang/ Kepala Badan Pertanahan Nasional Republik Indonesia 2017 Peraturan Menteri Agraria Dan Tata Ruang/ Kepala Badan Pertanahan Nasional Republik Indonesia Nomor 16 Tahun 2017 Tentang Pedoman Pengembangan Kawasan Berorientasi Transit. *Jakarta: Kementrian Agraria dan Tata Ruang/ Kepala Badan Pertanahan Nasional Republik Indonesia*

[2] Calthrope Associates 1993 *Transit Oriented Development Design Concepts* San Jose: Transpotation Agency

[3] TCRP (*Transit Cooperative Research Program*) 2002 Transit-Oriented Development and Joint Development in the United States: A Literature Review Washington DC: *Transportation Research* (http://online pubs.trb.org/onlinepubs/tcrp/tcr p_rrd_52.pdf.)

[4] TCRPC (*Treasure Coast Regional Planning Council*) 2012 Florida TOD *Guidebook Tallahassee: Florida Department of Transportation*

[5] Institute for Transportation and Development Policy 2017 *TOD Standars 3rd.ed*. New York: ITDP

[6] Dinas Perhubungan Kota Semarang 2014 Tinjauan Ulang Tataran Transportasi Lokal (TATRALOK) Kota Semarang *Semarang: Dinas Perhubungan Kota Semarang*

[7] Dinas Penataan Ruang Kota Semarang 2011 Peraturan Daerah Kota Semarang No. 14 Tahun 2011 tentang Rencana Tata Ruang Wilayah Kota Semarang *Semarang: Dinas Penataan Ruang Kota Semarang*

[8] Pratama M A 2017 Analisis Kinerja Jalan Pandanaran Semarang. Semarang: UNISSULA

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