

Analysis of Transit Oriented Development Potential on Light Rail Transit Palembang, Simpang Polda Station Area

Fadhil Muhammad Fajri¹ and Jachrizal Sumabrata²

¹Civil Engineering Departement, Universitas Indonesia, Indonesia

²Civil Engineering Departement, Universitas Indonesia, Indonesia

Abstract. The government of South Sumatera Province, decided to build Light Rail Transit (LRT) in Palembang City with the route from Sultan Mahmud Badaruddin II Airport to Jakabaring area to address the health, social and economic impacts from traffic congestion. However, will the development of LRT in Palembang city be enough to prevent total traffic congestion in 2019 and utilized by the people of Palembang City who have been accustomed to using private vehicles? With this rationale, the Transit Oriented Development (TOD) theory was adopted in this study as the answer to those questions. This study focused on analyzing the potential application of the TOD concept on the Simpang Polda Station Area by using several 'TOD-ness' measurement indicators from some previous research and TOD Standard by ITDP [1]. Using 8 new potential indicators, the assessment of the potential application of the TOD concept on the Palembang City LRT Simpang Polda showed that this transit area has enough potential for the implementation of the TOD concept by applying several supporting development plans.

1 Introduction

Palembang is the capital of South Sumatera province, Indonesia. In urban areas, such as Palembang itself has problems, because urban space is increasingly widespread randomly and not evenly to the area around the city causing urban sprawl, and will experience vehicle traffic in 2019. To anticipate the congestion, the government of South Sumatera Province build Light Rail Transit (LRT) line from Sultan Mahmud Badaruddin (SMB) II Airport to Jakabaring area. Transit Oriented Development (TOD) theory adopted to analyze whether the development of LRT in Palembang City is enough to prevent the total congestion in 2019 and will be utilized by the people who have been accustomed to using personal vehicles and existing public transportation, and more importantly, whether TOD Concept can be applied in Palembang City.

Author decided to analyze the potential of TOD application in one of Palembang LRT station areas, that was Simpang Polda Station area, in hope that this research could be utilized to develop the area around the station to be transit-oriented and support LRT Palembang to become a sustainable public transportation system.

This document is structured in five main section:

Section 1 Introduction, which introduces the themes, states the main objective of the paper and displays paper's structure;

Section 2 Literature Review, where the state of problem and TOD definition are collected;

Section 3 Methodology, propose a methodology to define TOD potential of the station area;

Section 4 Result & Discussion, introduces a preliminary characterization of the station area and analysis of TOD potential of the station area;

Section 5 Conclusions & Future Steps, encompass a summing up of the points and a statement of opinion or decision reached, included the tasks to be done in the future to improve TOD potential of the station area.

2 Literature Review

2.1 Palembang City

Based on PP. 23 in 1988 [2], the area of Palembang City was 400.61 km² and administratively divided into 16 sub-districts and 107 urban villages, where according to the Palembang City Regulation 2007, had been expanding from 14 districts and 103 urban villages. With the population of 1,602,071 persons, Palembang City was classified as Metropolitan city (Statistic of Palembang Municipality, 2017) [3].

Land use in Palembang City was dominated by residential and commercial area. While the perimeter of the city was dominated by residential areas, the downtown area was dominated by commercial areas, although there were also some residential areas in some parts of the central city of Palembang.

Transportation nodes in Palembang City was already quite a lot, there are 13 bus terminals connecting areas within the city of Palembang, Kertapati railway station connecting Palembang City - Lubuk Linggau, and Palembang City - Tanjung Karang (Lampung), river

crossing port in the Palembang urban area, the Boom Baru Sea Port in Ilir Barat II connecting Palembang City - Mentok City (Bangka), Palembang City - Batam and Palembang City - Jakarta, and the Sultan Mahmud Badaruddin II International Airport. These transportation nodes can be seen on Figure 1.

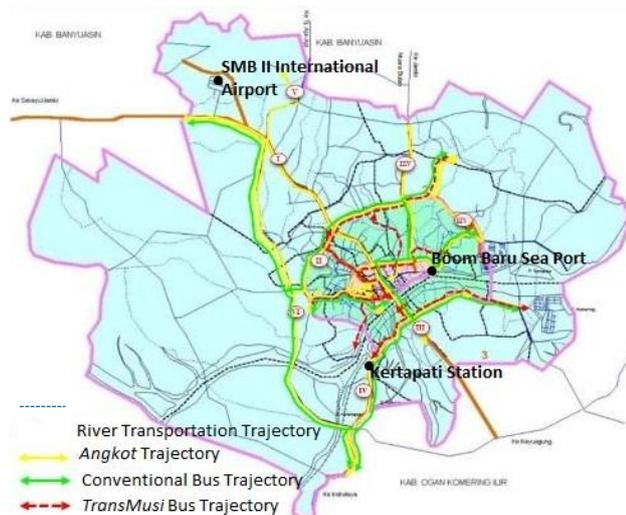


Fig. 1. Public transport nodes and trajectory in Palembang City

2.2 Light Rail Transit (LRT) Palembang

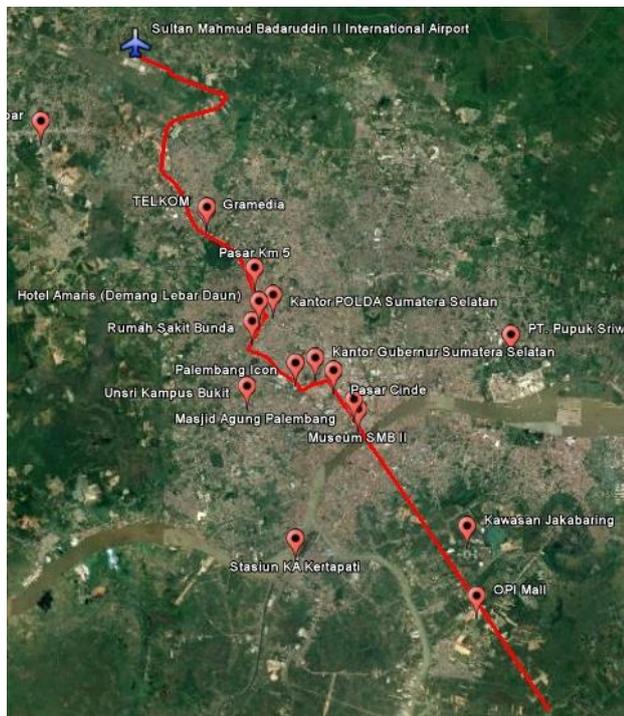


Fig. 2. Map of LRT Palembang trajectory
 Source : FS LRT Kota Palembang Dsk, 2017 [4]

Light Rail Transit (LRT) Palembang was a light rail mass transit system connected Sultan Mahmud Badaruddin II International Airport with Jakabaring Sports Complex. In order to welcome the 2018 Asian Games in Palembang City, the planned monorail development that was originally to be implemented was later canceled due to the difficulty of finding investors who could complete

the project on time and the project was considered less profitable. The monorail was later replaced by a more effective LRT. This 7.2 trillion rupiah project was required to be financed by the Central Government through the State Budget and the assignment of construction was on PT. Waskita Karya.

This project started on January 1st, 2015, and would be done at most on July 2018 (Indonesia Republic, 2015) [5]. In Figure 2 can be seen there is 13 stations, 9 electricity substations, and 1 Depot on the Palembang LRT line, with the stations order as follows:

1. Sultan Mahmud Badaruddin II Airport Station
2. Asrama Haji Station
3. Talang Buruk Station
4. RSUP Station
5. Simpang Poldas Station
6. Demang Lebar Daun Station
7. Palembang Icon Mall Station
8. Dinas Perhubungan Station
9. Pasar Cinde Station
10. Ampera Station
11. Poltabes Station
12. Jakabaring Station
13. OPI Mall Station
14. Light Rail Transit Depot

Total length of LRT Palembang was 23.40 km as can be seen in Figure 1. The train formation used is 3 cars, i.e. 2 units of motor cars and 1 unit trailer car. The capacity of the train that was 8 persons/m² and accommodate 736 passengers (PT. Tribula Magenta, PT. Waskita Karya, 2017)[4].

2.3 Transit Oriented Development (TOD)

Peter Calthorpe, a student of the environmental sustainability movement, developed TOD to address the ecology of communities. Peter Calthorpe codified the concept of Transit-Oriented Development (TOD) in the late 1980's and, while others had promoted similar concepts and contributed to the design, TOD became a fixture of modern planning when Calthorpe published "The New American Metropolis" in 1993 (Caltron, 2007) [6]. TOD has been defined generally as "a mixed-use community that encourages people to live near transit services and to decrease their dependence on driving (Still, 2002) [7]." Calthorpe saw it as a neo-traditional guide to sustainable community design. Beyond its definition of built form, it was also a community design theory that promised to address a myriad of social issues.

3 Methodology

3.1 Data Collection Method

The data collection in this research was conducted by conducting field survey to get the data of land use, building density, road condition (for pedestrians and motor vehicles), and transportation system in Simpang Poldas Station area of LRT Palembang City within 800 m radius with Simpang Poldas Station as its buffer point. In addition, other data such as population density, frequency and

capacity of LRT Kota Palembang, and the prediction of the number of LRT users of Palembang City was obtained from the parties related to the Palembang LRT development project, namely the Local Government of Palembang, *BAPPEDA* South Sumatra Province, Statistics Palembang, PT. Waskita Karya Tbk, Geography Laboratory of Universitas Indonesia, *RTRW Kota Palembang*, and Google Earth. Data collection in this study was conducted in April 2018.

3.2 Analysis Method

The data obtained were then analyzed by TOD measurement method by Sulistyningrum, S. (2017) [8] and TOD Evaluation by Galelo, Ana *et al.* (2014) [9], i.e. by quantifying the data of population density and building density in the area of the station used as the data collection location, namely the Simpang Polda Station area. In addition, to know the "TOD-ness" of the area, was also used TOD Standard v2.1 issued by Institute for Transportation & Development Policy (ITDP) (2014) [1] as the measurement index.

Based on the assessment system of TOD Standard [1], TOD measurement method by Sulistyningrum, S. (2018) [8], and TOD Index [9], the indicators and proposed TOD assessment system on this paper was walkways amenities, ratio of pedestrian intersections to motor vehicle intersections, total road bed area used for motor vehicle travel and on-street parking as percentage of total developed area, building density, percentage of residential building on developed area (mix-use), population density, transit system service, and the number of interchanges to other modes of transportation.

4 Results & Discussion

4.1 Walkways Amenities

The convenience of pedestrians in accessing stations in the Simpang Polda Station area could be assessed from pedestrian facilities on every street, such as sidewalks and sharing roads, zebra-cross, and pedestrian bridges that are in good condition. However, only 250 meters pedestrian walkways on both lane at Demang Lebar Daun Street and 250 meters at Sudirman Street had width of more than 2 meters, while other sidewalks along the arterial road this area was 2 meters or less with poor conditions. Meanwhile, on the local roads were applied share roads (without walkways), but in terms of road safety was still less safe for pedestrians so that pedestrians needed to walk on the main road that were at risk of accidents and disrupt the smooth flow of traffic on the road.

In addition, the road crossing facility in Simpang Polda Station area was rather inadequate, because in that area there were only 2 (two) pedestrian bridges located close to Simpang Polda Station and zebra-cross at Simpang Polda junction. The distance from one pedestrian bridge to the other one was 585 meters, where the minimum crossing standard was less than 500 meters. Meanwhile, the distance from zebra-cross to the nearby pedestrian bridge was 290 meters. Beside those three crossing facilities, no

other crossing facilities were found on arterial roads in the area. In addition, the crossings still did not support wheelchair users to cross roads, like pedestrian bridges that have no rail for wheelchairs. As for the crossings on the small roads were not provided special facilities so pedestrians could cross anywhere. This gave minus points for this indicator because of the risk of accidents and the inhibition of road traffic caused by the system.

Based on these analysis, to support the implementation of the TOD concept in this region and refine the scores on this indicator, it was expected for the government to immediately improve pedestrian facilities so that pedestrian facilities meet the safety, liveliness, and comfort principles and enliven the pedestrians in the region. Therefore, 8 points was given on this indicator.

4.2 Ratio of Pedestrian Intersections to Motor Vehicle intersections



Fig. 2. Pedestrian intersections (yellow) and motor vehicle intersections (red) in the Simpang Polda Station area

In Figure 3 can be seen total pedestrian intersections in the area were 122 intersections, while total motor vehicles intersections were 132 intersections. Thus the ratio of pedestrian intersections to motor vehicles intersections was 0.924: 1. Since the pedestrian intersection ratio was less than 1, it means the area was still on the side of the vehicle compared to the pedestrians. Based on this value, to support the implementation of the TOD concept in this region and refine the value on this indicator, it was expected for immediate alteration the designation of the existing road to be made more pro-pedestrians. Therefore, 4 points was given on this indicator.

4.3 Total Road Bed Area Used for Motor Vehicles and On-Street Parking Area

In the this area, the length of the road that has a width of 28 meters of road was 2,537.18 meters, the length of the road that has a width of 9 meters of road was 4,558.12

meters long, the length of the road that has a width of 5 meters road was 13,256.56 meters, and a total parking area of 71,343 m². Thus, the total area of roads in the area was 249,689.92 m², i.e. 16.46% of the total developed area. Since the area of road bed was above 15%, to support the implementation of the TOD concept in this region and improve the value of this indicator, it was necessary to do the widening of the walkways or sideways and the addition of the canopy on the side of the arterial and shoulder roads on local roads so pedestrians can feel more comfortable and secure. Therefore, 8 points were given on this indicator.

4.4 Building Density

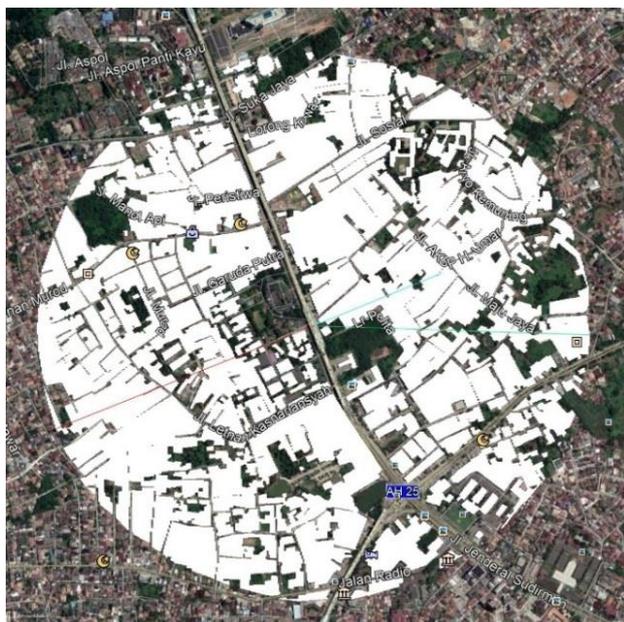


Fig. 3. Building area on Simpang Polda Station area

The building area in this region was 1,266,846.7 m², while the total area was 2,011,428.57 m² (Figure 4). Thus, the percentage of developed area in this area was 62.98%. On the basis of the assessment of analyzing the potential of the assessed area as a TOD-based area, this area could be said to have potential for application of the TOD concept since the percentage of developed area in this area was lower 70%. Based on the analysis, to support the implementation of the TOD concept in this region and improve the value of this indicator, vertical development (densification) needed to be enforced, such as apartment and other hi-rise building construction. Therefore, 12 points were given on this indicator.

4.5 Percentage of Residential Building on Developed Area (Mix-Use)

Mix-use here was referred to the percentage of building area designated for residence in the total developed area in this area. Number of resident in this region reached 70% of the total developed area in this area. Based on the analysis, 6 points were given to this indicator. Based on the analysis, to support the implementation of the TOD concept in this region and refine the value of this indicator, the land in this area needed to be utilized for development

that encourages the integration of land use, such as supporting development in the commercial and retail sectors of the region. Therefore, 6 points were given to this indicator.

4.6 Population Density

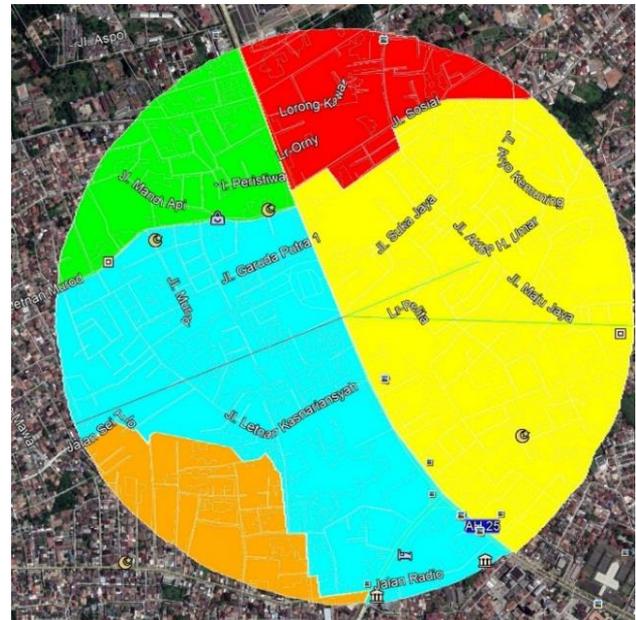


Fig. 4. Area distribution by sub-district (red: Sukarami; yellow: Kemuning; green: Alang-Alang Lebar; blue: Ilir Timur I; orange: Ilir Barat I)

The population of Palembang City in 2016 was 1,602,071 persons. Population density in Palembang City in 2016 reached 3,999.08 inhabitants/km². Population density in 16 sub-districts was quite diverse with the highest population density located in Ilir Timur I sub-district with population density of 11,137 inhabitants/km² and the lowest was in Gandus sub-district of 916 inhabitants/km².

In the Simpang Polda Station area with an 800 meters buffer, the sub-districts included in this area were Sukarami, Kemuning, Alang-alang Lebar, Ilir Timur I and Ilir Barat I sub-district (Figure 5). With a total area of 2,011,428,57 m², this area consisted of Sukarami sub-district area of 195.160 m², Kemuning sub-district of 770,436 m², Alang-Alang sub-district of 209,681 m², Ilir Timur I of 650,456 m², and Ilir Barat I of 185,696 m². By factoring the population with the area of each sub-district in the area, it was estimated that the total population of the region was 17,186 persons, which is the population density of this area was 8,544 inhabitants/km². By comparison the TOD area around the train station in Florida, which was about 17,000 inhabitants/km² (Florida Department of Transportation, 2009) [10], to support the application of the TOD concept to the region and to refine the value of this indicator, as mentioned in point 4.6, vertical development needed to be developed to diversify the area and integrated the development of the non-residential sector in the region as mentioned in point D so that all daily activities could be carried out within this area and draw the

masses to condense this region. Therefore, 6 points was given on this indicator.

4.7 Transit System Service

LRT will operate for 18 hours every day with peak-hour scheduled for 3 hours i.e. 06.00-09.00 am and 04.00-07.00 pm. The frequency of service at off-peak hour is every 30 minutes and at peak-hour morning and night is every 15 minutes. LRT travel time from SMB II to OPI Mall is about 37 minutes where most runs 30 minutes. At peak-hour, time headway is 15 minutes with average waiting time of 7.5 minutes. In the off-peak period, headway can be reduced to 30 minutes. So the travel time of one way is 37 minutes with a 10 minute layover which is used as the basic assumption to calculate the need of the facility. The travel time used on alternating trips is 94 minutes.

Based on feasibility study conducted by PT. Waskita Karya and PT. Trisula Magenta (2017) [4] potential demand for travel along the LRT corridor of Palembang City reaches 637,881 passengers/day. Based on these data, the analysis of mode selection predicts LRT users of Palembang City in 2017 was estimated at 74,288 passengers/day. While at Simpang Polda Station, passengers of LRT of Palembang city predicted 8,786 passengers/day with 7,406 passengers/day heading toward Jakabaring and 1,380 passengers/day heading toward SMB II airport and 8,392 passengers/day drop off the station. The number of passengers LRT Palembang in this region as much as 2,853 trips per day with the average number of trips per-day population of this area about 1.43 trips per day.

The LRT operating pattern assuming 10% of total travel would occur at peak-hour and there was no difference between passenger volumes both directions along the corridor, then peak hour demand would be split evenly to 725 passengers per-hour per-direction (pphd). For off-peak state, the passenger demand would be about 480 pphpd. Considering that passenger demand at peak-hour was less than 800 passengers and off-peak condition was less than 500 passengers, the LRT system could be optimized using 2-3 carriages for all fleet with capacity of 8 passenger standing/m².

Based on the analysis, to support the implementation of TOD concept in this region and improve the value of this indicator, it was necessary to improve the operational performance of LRT of Palembang City to increase the amenities and interest of the community in using LRT Palembang City accompanied by densification of Simpang Polda Station area. Therefore, 7 points were given in this indicator.

4.8 Number of Interchanges to Other Modes of Transportation

Other transportation modes in Simpang Polda Station i.e.:

1. TransMusi corridor I (Alang-alang Lebar – Ampera) on JPO KM 5 A, Muhammadiyah, and Gloria bus stops;

2. TransMusi coridor II (Terminal Sako – PIM) on Rumah Kemuning A bus stop, Bayangan RRI Terminal;
3. TransMusi coridor V (Bandara SMB II – Bukit Siguntang) Karya Sejati, Rimba Kemuning bus stops;
4. City transport (*angkot*) on Ampera – Perumnas line, could be stopped along the road; and
5. Taxi and online-based transportation.

However, TransMusi and *angkot* was only passing through the city artery road (Sudirman Street, Demang Lebar Daun Street, and Basuki Rachmat Street) and not through the local roads. Based on this analysis, to support the implementation of the TOD concept in this region and refine the value of this indicator, there was a need of a perfect integration between each type of public transport that was active in this area so that the public transport range could be more widespread and avoid the use of the same line by the transport different public. Therefore, 6 points were given on this indicator.

4.9 TOD Potential Assessment of Simpang Polda Station Area

Based on the analysis that had been done, the result of TOD potential indicator assessment of Simpang Polda Station area can be seen on Table 1.

Table 1. TOD potential indicators assessment of Simpang Polda Station area

Indicators	Max. Point	Point
Walkways amenities	15	8
Ratio of pedestrian intersections to motor vehicle intersections	10	4
Total road bed area used for motor vehicle travel and on-street parking as percentage of total developed area	10	8
Building density	15	12
Percentage of residential building on developed area (mix-use)	15	6
Population density	15	6
Transit system service	10	7
The number of interchanges to other modes of transportation	10	6
Total	100	57

As the total point of TOD potential of Simpang Polda Station area is more than 55, it can be said that, overall, the Simpang Polda Station area had enough potential for the implementation of TOD concept

5 Conclusion & Future Steps

With the aim of directing the people of Palembang City to move from the habit of using personal vehicles to become using public transportation and the establishment of a sustainable city, the authors tried to analyze the potential of implementing the TOD concept in the Palembang LRT Simpang Polda Station within 800 meters

radius. This study used the TOD measurement method by Sulistyningrum, S. (2017) [9] and TOD Evaluation by Galelo, Ana et al. (2014) [8], and the TOD Standard issued by ITDP [1] to form 8 indicators to measure the potential implementation of the TOD concept in the Palembang LRT Regional Police Station intersection.

Based on the analysis that had been done, the result of TOD potential indicator assessment of Simpang Polda Station area showed that, overall, the Simpang Polda Station area had enough potential for the implementation of TOD concept in this region by applying several development plans, such as:

1. development of pedestrian facilities to meet the principles of safety, liveliness, and amenities and enliven the pedestrian in this area,
2. alteration of the existing road to be made more pro-pedestrians,
3. widening walkways or sidewalks and adding canopies on the side of arterial roads and local roads so pedestrians could feel more comfortable and safe on foot,
4. vertical development (densification) such as the construction of apartments and other hi-rise building and integrating the development of non-residential sector in this area so that all daily activities could be done within the region and attracted the masses to compact the area,
5. land-use utilization for the development that encouraged the integration of land allotment such as supporting development in the commercial and retail sectors in this region,
6. improvement of LRT Palembang City service and capacity along with the densification of the area, and
7. the provision of perfect integration between each type of public transport that was active in the area so that the public transport range could be more widespread and avoid the use of the same path by different public transport.

However, the scoring system in this study was still subjective and needed to be calibrated so that would be created a more accurate assessments. It indicated that there is a need for a professionals to form indicators that assessed the potential of the area to apply the concept of TOD, not just TOD evaluation indicators.

This research was expected to be utilized to develop the area around the station to be transit-oriented and supported LRT Palembang to become a sustainable public transportation system.

Acknowledgements

The authors are grateful to DRPM Universitas Indonesia for the financial support through PITTA 2018 grants and Mr. Jachrizal Sumabrata who had guided the author in completing this research.

References

1. Institute for Transportation & Development Policy, 2014. *TOD Standard*. v2.1 ed. s.l.:Despacio.
2. Indonesia Republic, 1988. Peraturan Pemerintah Republik Indonesia Nomor 23 Tahun 1988 tentang Perubahan Batas Wilayah Kabupaten Daerah Tingkat II Palembang, dan Kabupaten Daerah Tingkat II Musi Banyuasin dan Kabupaten Daerah Tingkat II Organ Komerling Iilir. In: *Lembaran Negara Republik Indonesia Tahun 1988 Nomor 3383*. Jakarta: State Secretariat.
3. Statistic of Palembang Municipality, 2017. *Palembang Municipality in Figures*. Palembang: Statistic of Palembang Municipality.
4. PT. Tribula Magenta, PT. Waskita Karya, 2017. *Feasibility Study LRT Kota Palembang*. Palembang: Transportation Office of Sumatera Selatan Province.
5. Indonesia Republic, 2015. Peraturan Presiden Republik Indonesia Nomor 116 Tahun 2015 tentang Percepatan Penyelenggaraan Kereta Api Ringan/Light Rail Transit di Provinsi Sumatera Selatan. In: *Lembaran Negara Republik Indonesia Tahun 2015 Nomor 236*. Jakarta: State Secretariat.
6. Caltron, I., 2007. *Histories of Transit-Oriented Development: Perspectives on the Development of the TOD Concept*. Berkeley: Institute of Urban and Regional Development.
7. Still, T., 2002. Transit-Oriented Development: Reshaping America's Metropolitan Landscape. *On Common Ground*, Issue Winter.
8. Sulistyningrum, S., 2017. *Pengembangan dan Implementasi Pengukuran Indikator Untuk Menentukan Level Transit Oriented Development (TOD) di Kota Depok Pada Area Buffer Titik Transit Stasiun Kereta Depok Baru, Pondok Cina, dan Universitas Indonesia*. Jakarta: Sekolah Kajian Strategik dan Global.
9. Galelo, A., Ribeiro, A. & Martinez, L. M., 2014. Measuring nad Evaluating the Impacts of TOD Measures - Searching for Evidence of TOD Characteristics in Azambuja Train Line. *Meeting of the EURO Working Group on Transportation*, 16(111), pp. 899-908.
10. Florida Departement of Transportation, 2009. *Transit Oriented Development Design Guidelines*. s.l.:Florida Departement of Transportation.