Urban space in transit area of South Sumatra light rail transit in Palembang

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Abstract. A new transportation system built in Palembang, the South Sumatra Light Rail Transit (otherwise known as LRT Sumsel), stretches along the road corridor from Sultan Mahmud Badarudin II Airport to the Jakabaring Sport City area. In practice, a city needs criteria that must be met to develop a city properly. One of the urban development approaches is Transit-Oriented Development (TOD), an approach that emphasizes not only transit accessibility but also a sustainable environment. Therefore, in developing a city that has mass transportation, TOD calls forth the integration of all transportation modes with the elements of the city. This is closely related to the design of urban space at the transit area and how to achieve the concept of TOD. This research was conducted to find out whether the space around the South Sumatra LRT transit area has properly fulfilled the TOD concept. To achieve the success of Palembang City development, the complexity of TOD and the quality of urban space must be integrated. The goals of this research were to identify the elements of urban space in the transit area. The South Sumatra LRT station is the case study in this research employing descriptive qualitative methods using observation, stakeholder interview, and literature study. The results of the study point out that LRT Sumsel must highlight the availability of parking and attributes, which can allow more frequent transit activities. This research hopes that it can provide consideration for the development of Palembang city in terms of architecture and transportation utilization.

1. Introduction
Palembang city is a highly developed city with the construction of a new and the first South Sumatra Province’s Light Rail Transit (otherwise known as LRT Sumsel) in Indonesia. The LRT is one of the National Strategic Projects stipulated in the Presidential Regulation of the Republic of Indonesia Number 58 of 2017. The South Sumatra LRT has a track length of 23.4 kilometers stretching in the road corridor from Sultan Mahmud Badarudin II Airport to the Jakabaring Sport City area. This project was built in 2016 and completed in 2019. The development of this course has an influence on the development of Palembang city planning, especially in the LRT corridor area. The LRT also affects the face of the surrounding area, especially in the transit area around the crossing bridge, which is the means to get to the LRT Station or transit point.

In practice, a city requires indicators that must be met in order to develop the city properly. One approach to city development is Transit-Oriented Development, including the TOD Index [1]. Transit-Oriented Development (TOD) emphasizes not only transit accessibility but also environmentally sustainable features, mixed-uses, density, and walkability [8]. In short, Transit-Oriented Development (TOD) is a city development approach that adopts mixed spatial planning and maximizes the use of mass transit. The function and purpose of Transit-Oriented Development, as a whole, is to increase...
accessibility and revive various land use functions in an integrated area by encouraging the use of transit and reducing the use of private vehicles by placing commercial functions as an attraction. TOD also improve urban environment quality [6] and make users feel comfortable, allowing them to carry out various daily activities [10]. This is closely related to how the shape and design are knotted, especially land related to urban space and landscapes at the transit node in order to achieve the success of the concept. The area around the LRT station in Palembang should be encouraged to maximize the TOD concept. There is currently a trend of TOD typology that is not in accordance with the direction of the Palembang Regional Spatial Plan, urging the need to emphasize this spatial planning concept for areas intersecting with the South Sumatra LRT transit area and the need to develop a TOD typology [4,5]

Responding to these facts, this study was conducted using a descriptive qualitative method employing observation, stakeholder interview, and literature study. The research aimed to investigate the condition of the transit area of Palembang City in the South Sumatra LRT Transit Area and to examine how the urban space formed in achieving the success of Palembang City development.

2. Methods

This study aimed to find out the current condition of urban space in the transit area of South Sumatra Light Rail Transit (LRT) station in Palembang City. This study used a descriptive qualitative method based on aspects of Transit-Oriented Development and Urban Space. The primary data involved opinions from stakeholders in Palembang city and the data from direct observations of the transit area of LRT in Palembang, South Sumatra. Furthermore, secondary data was obtained by a literature review of previous studies.

The data collection stage was carried out using various research tactics. The first step was to identify the potentials and obstacles of TOD in the city space through interviews and questionnaires. This strategy was based on the qualitative methods to find out and measure the opinions of twenty stakeholders in Palembang city regarding the way they see the objects of urban space and TOD using a Likert scale rating. Furthermore, there were also interviews with the relevant stakeholders. The stakeholders, as a source of data, were the persons whose main criteria are those who understand the South Sumatra LRT and users of the South Sumatra LRT who were able to provide comments on the development of the LRT.

The second step was to study the objects of urban space in the concept of TOD in the transit area of South Sumatra LRT as the main object of this research. Three station points were chosen to be observed as transit area objects: Dishub Station as a sub-city Station, Ampera Station as a city Station, and DJKA Station as a neighborhood station. The researchers assessed the field conditions as a non-participant observer. Observations were made by measuring, documenting, and rating scales three times on the South Sumatra LRT operational activities, which were in the morning, afternoon, and evening.

3. Results and Discussion

This section presents the literature review about Urban Space and TOD, which will contain theories related to the research. In addition, the observation results in South Sumatra LRT are also discussed here.

3.1. Urban Space

Regional characteristics form the image of a city. There are 8 elements that make up the physical form of a city [13], namely:

- Land Use, which is a two-dimensional design in the form of land-use plan for a city. Three-dimensional spaces (buildings) will be built in places according to the function of the building.
- Building Form and Mass Building. Building form and mass discuss how the forms and mass of existing buildings can form a city and how the relationships between the masses (many buildings) exist.
• Circulation and Parking. Circulation is an element of urban design that can directly shape and control the pattern of urban activities, as is the case with the existence of a transportation system from public roads, pedestrian ways, and transit places that are interconnected to form movement (an activity).

• Open Space. Open space always involves landscaping. Landscape elements consist of hard elements (hardscape, such as roads, sidewalks, statues, rocks, and so on) and soft elements (softscape in the form of plants and water). Ordinary open spaces can be in the form of fields, roads, river borders, green belts, parks, and others.

• Signage, i.e., markings, such as road directions, traffic signs, advertising media, and various other forms of marking. The existence of markings will greatly affect the visualization of the city, both macro and micro if there are quite a lot of them with different characters.

• Pedestrian Way. The pedestrian element must be assisted by its interaction with the basic elements of urban planning and must be related to the urban environment and activity patterns, as well as be in accordance with the planned changes or physical development of the city in the future.

• Activity Support. Supporting activities are all building functions and activities that uphold the public space of a city. The shape, location, and character of an area that have special characteristics will affect its function, land use, and activities.

• Preservation, in urban design, is the protection of the living environment (settlement) and urban places (plaza, shopping area) that exist and have several characteristics, such as the protection of historic buildings.

Analytical models of passenger flow should consider explicitly how practitioners employ them in practice to better link future refinements to design practice [15]. The Linkage theory can be understood in terms of urban dynamics, which are considered as city generators. Linkage analysis can be used to observe and confirm the relationship and movement of an urban spatial layout or urban fabric. The linkage is a theory that starts from a 'line' that connects one element to another [14]. In linkage theory, there are three approaches:

• Visual linkage, in which a city is functionally united by connecting two areas and prioritizing one of them. There are several visual linkage elements, such as line, corridor, side/edge, axis/axis, and rhythm/rhythm.

• Structural linkage, in which the linkage is often used to improve the harmony of the two areas, which act as a stabilizer to reduce the impression of chaos in the area.

• Collective linkage, which consists of three spatial types, namely Compositional form, Mega form, and Group form.

From the theory of urban design above, there are many elements that can be seen from an urban area. This study looks at the urban elements of the visual linkage associated with urban space. The elements observed focused on the visual connection of Land Use, Markers, Open Space, Circulation and Parking, and Supporting Activities

3.2. Transit-Oriented Development

Transit-Oriented Development is a planning and design strategy to ensure the development of a compact, multi-use, pedestrian- and bicycle-friendly, and dense city organized around a transit station. TOD adheres to the idea that loosening facilities, jobs, shops, and housing around transit hubs promotes the use of transit and motorized travel. A well-planned TOD is inclusive and integrates resilience to natural hazards [3,7,11]. The benefits of TOD in outline are as follows:

• Make cities more competitive, increase real estate value, and contribute to growth;
• Save time and money;
• Reducing greenhouse gas emissions and increasing resilience to natural disasters.

Furthermore, Transit-Oriented Development (TOD) itself is a mixed community where the average distance is 2,000 feet or about 500 meters from transit stops and major commercial areas [2]. TOD combines residential, retail, office, open space, and public function areas in a walkable environment, making it easier for residents and employees to travel. Furthermore, by creating a compact mixed-use function within a five- to fifteen-minute walk in transit areas, it is hoped that several benefits will be obtained, including internalization of movement between residences, offices, and other functions in a building, centralized district. The accumulation of this pattern at the regional level is expected to encourage people to use transit facilities instead of private vehicles. There are many pieces that need to be in place for TOD to succeed in the inner city while the local communities and the private sector are certainly the actors in this process [9,12].

Seven principles of urban design in Transit-Oriented Development include:
• Organizing growth at the regional level to become more compact and supportive of the transit function.
• Placing commercial, residential, work, and public functions within walking distance of transit functions.
• Creating a pedestrian-friendly road network that directly connects destinations.
• Providing a mix of types, segments, and settlements
• Conserving ecology, and creating high-quality open spaces.
• Making public space the focus of building orientation.
• Encouraging development that is infill and redevelopment in the transit area.

TOD Index composed of observable indicators can measure the success of the TOD area on a local scale [1]. There are several rules in urban development that are directly related to TOD. These rules include:
• Rule 1: Urban density is important for developing TOD
• Rule 2: Diversity of land use makes the place lively and vibrant around the nodes
• Rule 3: Urban space design makes walking- and bicycle-friendly areas essential in TOD
• Rule 4: Economic development within the area encourages high TOD.
• Rule 5: The transit system must have sufficient capacity. Overcrowded capacity cannot attract more passengers
• Rule 6: User-friendly systems need to encourage people to use transit systems
• Rule 7: Better access nodes that provide high accessibility—which can increase the chances of making TOD
• Rule 8: Car and bicycle parking supplies can help people in transit to longer journeys

The criteria and indicators that can be measured to see the success and application of the Transit-Oriented Development Index in urban development can be seen from density, land use diversity, walkability and cyclability, economic development, capacity utilization of transit, user-friendliness of the transit system, and accessibility.

3.3. Theory Summary
Based on the theory presented, synthesis has been determined regarding the objects related to research indicators. The indicator contains several relevant components for research related to the quality of urban space based on Transit-Oriented Development. The related indicators obtained from the results of the theoretical study can be seen in Table 1 below.
### Table 1. Research criteria and indicator

| Architecture Object | TOD Object     | Research Criteria                                                                 | Indicator                                                                                             |
|---------------------|----------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| Land use            | Land use diversity | Categories of land use diversity around the station include utilization, trade and services, offices, public facilities. | Categories of land use diversity (number of land and building functions)                              |
| Circulation and parking | Station parking | Parking at the stations and circulation                                            | Vehicle circulation, transportation and car and bicycle parking facilities                            |
| Open space          | User-friendliness of transit system | Space for user to undertake transit activity                                        | Availability of transit facilities as a meeting point, commuter safety at transit stop points, basic facilities at the station and, existence of information display |
| Pedestrian way      | Walkability and cyclability | Paths that support walkability and cyclability                                      | The combination of land use, total length of walking/bike paths (meters), intersection density (number of intersections/km²), impedance of the pedestrian catchment |
| Activity Support    | Accessibility   | Accessibility of opportunities for supporting transit activities                   | Frequency of transit services (number of trains operating/hour), transit route switching (number of routes), transit mode switching, access opportunities within walking distance (number of jobs or activities) |

Source: Author’s Document

In the table above, the author tried to determine the object to be studied based on similarities in architectural aspects and aspects of TOD that intersect with each other. It can be seen that there is a relationship between the elements of urban space and the development of the transit area. Therefore, some elements of the city can be seen as objects that support the success of the Transit-Oriented Development concept. The related objects include categories of land use diversity, the parking area at the stations and circulation, space for the user to undertake transit activity, paths that support walkability and cyclability, and the accessibility of opportunities for supporting transit activities.

### 3.4. South Sumatra Light Rail Transit, Palembang

In this section, a general description of South Sumatra LRT Palembang as the research area is described. South Sumatra LRT Palembang or LRT Sumsel has a station corridor with the characteristics of a Mixed-Use Area, which results in abundant activities and movements in the corridor. The LRT station corridor area has a transit point orientation in the form of 13 stations, which include SMB II Airport Station, Hajj Dormitory Station, Punti Kayu Station, Hospital Station, Garuda Dempo Station, Demang
Station, Sriwijaya Earth Station, Dishub Station, Cinde Station, Ampera Station, Polresta Station, Jakabaring Station, and DJKA Station.

In this study, observations were made to the condition of the South Sumatra LRT transit point, which is in the station area to find out how the condition of urban space was formed after the construction of the LRT in the city of Palembang. After that, this research sought the stakeholder’s perspective about the condition. The following are the results and discussions that have been made.

Table 2. Urban space in LRT Sumsel

| Indicator                                      | LRT Sumsel Condition                                                                 | Discussion                                                                 |
|------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| Land use diversity around the station          | The station has made the area as a transit point that is close to various building functions and formed a different city space before the LRT was built. Several functions of the building were added to take advantage of the crowds of passengers, such as the commercial and recreational functions. Land use around the varied according to the region type, such as office functions, sports, airports, health, settlement, and commercial. |
| Parking at the Stations and Circulation        | Every station did not have a communal parking lot, so the vehicles were parked in the parking lot of nearby buildings or in the pedestrian paths and roads. This was the main problem, which can interfere with the circulation of vehicles around the station. The stakeholders added that this is related to community land, which is difficult to implement. |
| Space for user to undertake transit activity   | Information display is easy to see and every station has a transit point area in which buses can stop. Waiting activities are quite safe with the presence of security officers. Transit facilities and station basic facilities are very good, albeit quite small and still needing CCTV to improve safety. |
Paths that support walkability and cyclability

The walking paths for pedestrians around the station were good and the facilities met the standards for disabled people. However, there was still impedance for the user, like the floor elevation that is too high for bicycles, vehicle doors, and footsteps. Parking for bicycles was provided, but for special paths, they were not available. Many pedestrian paths were separated and not connected to the surrounding buildings. The stakeholders agreed that this indicates the need to improve urban attributes.

Accessibility of opportunities for supporting transit activities

The frequency of transit services decreased during the Covid-19 pandemic. But every station still had transit mode switching with TemanBus and BRT Transmusi, which can be accessed by users within walking distance. LRT is currently the main point of application of other modes of transportation.

4. Conclusion

The South Sumatra LRT station as the main transit point for transportation modes in the city of Palembang currently affects the condition of the surrounding area. Regarding the urban space formed by the LRT transit area, if viewed from the concept of Transit-Oriented Development, the component that is of great concern is the availability of parking, so that it can accommodate the needs of passengers using private vehicles. Therefore, they will not interfere with the function of the pedestrian path. In addition, land use must maintain its diversity and adapt to urban plans, increase security and expand waiting areas, must consider attributes that support walking and cycling activities, and increase access to other modes of transportation so that transit activities become more frequent.

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