

## The Integration of TOD Based on Society 5.0 in Loop Lhokseumawe City

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### Abstract

Implementing Transit-Oriented Development (TOD) in downtown Lhokseumawe is an important step to improve transportation efficiency, improve the community's quality of life, and reduce negative environmental impacts. In this study, Thistentia identifies that TOD development has been identity orientation in the city center, existing allotment zones, metabolism of community life activities, and TOD planning embryos. Collaboration and participation from governments, communities, developers, and other stakeholders are essential to implement TOD successfully. The main focus should be integrated spatial planning, adequate infrastructure development, and good environmental management. In addition, public education and awareness about the benefits of TOD need to be increased through information campaigns and socialization programs. With these steps, TOD can be an effective solution in creating a sustainable, inclusive, and environmentally friendly city in the center of Lhokseumawe City.

**Keywords :** *Transit-Oriented, Development, Existing, Metabolism, Planning.*

### 1. Introduction

Lhokseumawe is an administrative city with an area of 253.87 km<sup>2</sup> covering 101 villages and six villages spread across five districts, namely: Banda Sakti District, Muara Dua District, Dewantara District, Muara Batu District, and Blang Mangat District. The city is a vital route of distribution and trade in Aceh. In 2021, the population of Lhokseumawe was 190,903 people with a density of 1,054 people/km<sup>2</sup> (Asri et al., 2020).

In urban development, intermodal transit facilities and transit areas are essential and cannot be separated. The area around the transit point has the potential for significant development (Kuncoro et al., Said Basalim, Hengki Purwoto, Deni Prasetio Nugroho, 2020). This is due to the ease of access offered by areas adjacent to transit facilities and activities that may arise due to transit activities in the region. In urban planning and design, various theories and concepts discuss the relationship between transit activities and regional development (Shirly WUNAS, 2018). The discussion on this subject became very interesting.

Including Transit Oriented Development (TOD) has been widely realized in various cities around worldwide—uncontrolled cities, traffic jams, air pollution, and energy waste (Gehl, 2010). By developing areas around transit points as hubs of activity and dense settlements, TOD can reduce reliance on private cars and encourage public transportation, bicycles, and walking. One of the main benefits of TOD is decreased car use and family spending on transportation (Carlton, 2007). By having easy access to stations or transit stops, residents of the TOD area can use public transportation more efficiently (Nirwono Joga, 2013). This reduces the need to own a private car, reduces transportation costs, and reduces traffic congestion.

Observational research on transit-oriented development (TOD) in a city is necessary because it involves understanding impacts, evaluating effectiveness, better urban planning,

informed decision-making, and improving future design (Taylor, 2001). This research provides an in-depth understanding of the consequences of TOD implementation, including improved public transport accessibility, air and traffic pollution reduction, land use patterns, and socio-economic changes (Hess, 2012). In addition, observational research also helps evaluate whether TOD achieves predetermined goals, such as increasing public transportation use (Radita et al., 2019). The research results become a valuable source of information for urban planners in planning future TOD projects and can help identify important factors that influence the success of TOD implementation (Newman & Kenworthy, 2015). Policy and investment decisions based on empirical evidence from observational research reinforce informed decision-making. In addition, findings and insights from current observational research can be used to refine the design and implement future TOD projects, thereby overcoming challenges and resulting in better development (Marshall, 2005). Overall, observational research on TOD plays an essential role in understanding, measuring, and improving the effectiveness of TOD development, as well as providing a solid foundation for better decision-making and urban planning in the future.

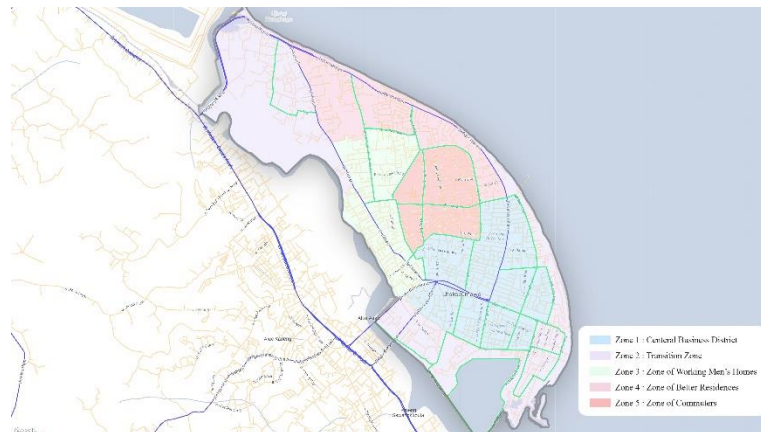
## 2. Materials and methods

Research methods and materials used to reveal the use of TOD in the city of Lhokseumawe, which is motivated by human needs and orientation in society 5.0, are used by observation; qualitative methods of observation can bring closer research answers based on honesty and validity to space needs based on the orientation possessed by the object of study (Sanders & Stolarick, 2008).

To address the deep interest in sustainable urban planning, TOD is essential because it encourages sustainable mobility by promoting public transport, cycling, and walking. Transit-Oriented Development (TOD) can be classified physically and non-physically to understand its planning and implementation (Gifarry et al., 2022). Physically by prioritizing good transportation accessibility, TOD helps reduce dependence on private cars and reduce traffic congestion, which Ernest W. Burgess will use—and non-physically used the understanding of Calthorpe and Poticha in the book "The Next American Metropolis," which explains the main components of TOD non-physically.

### 2.1 Physical Transit-Oriented Development

In concentric theory, the tendency to expand outward from the area within is a significant feature. This process is often referred to as a series of invasions. The speed of development of a city will depend on the rate of economic growth and the number of its inhabitants. However, if the population decreases, the area outside will likely remain stable while the transition area will shrink towards the inner business district.



**Figure 2.1.** Mapping zoning area of Lhokseumawe City

Based on the concentric model proposed by Burgess, cities are divided into circular and layered zones, namely:

- Zone 1: Activity center area
- Zone 2: Transition zone
- Zone 3: Worker settlement zone
- Zone 4: Better residential zones
- Zone 5: Zone of commuters

### 2.1 *Non-physical Transit-Oriented Development*

Non-physical transit-oriented development (TOD) is a concept Peter Calthorpe and Shelley Poticha proposed in the book "The Next American Metropolis." This concept proposes several non-physical components that are important in the planning and implementing TOD. One crucial component is organizing regional urban growth to be cohesive and transit-friendly (Calthorpe, 1993). This involves urban development in an integrated manner with the public transportation system, thus facilitating transportation accessibility for residents. In addition, TOD also encourages the placement of commercial, residential, and workplaces within walking distance of transit stations, thereby increasing accessibility and use of public transportation (Duany et al., 2001). This concept also promotes the construction of pedestrian-friendly road networks, creating diverse housing types and protecting sensitive habitats and high-quality open spaces (Frederic Stout, 2003). Implementing these non-physical components is hoped that TOD can create a more sustainable, inclusive, and environmentally friendly city. Some of the non-physical components considered in TOD include:

- Orchestrating growth at the regional level to be cohesive and transit-friendly:  
Consider overall urban development on a regional scale by prioritizing land use that is transit-friendly and integrated with public transportation systems.
- Place commercial, residential, workplace, and civilian uses within walking distance of transit stops:  
Place commercial facilities, housing, work areas, and public facilities such as schools and parks within walking distance of stations or transit stops, thereby improving accessibility and use of public transportation.
- Create a pedestrian-friendly road network that directly connects local destinations:  
Develop a well-designed road network that prioritizes pedestrians and bicycles and provides direct access to local destinations such as transit stations, shopping malls, and community centers.

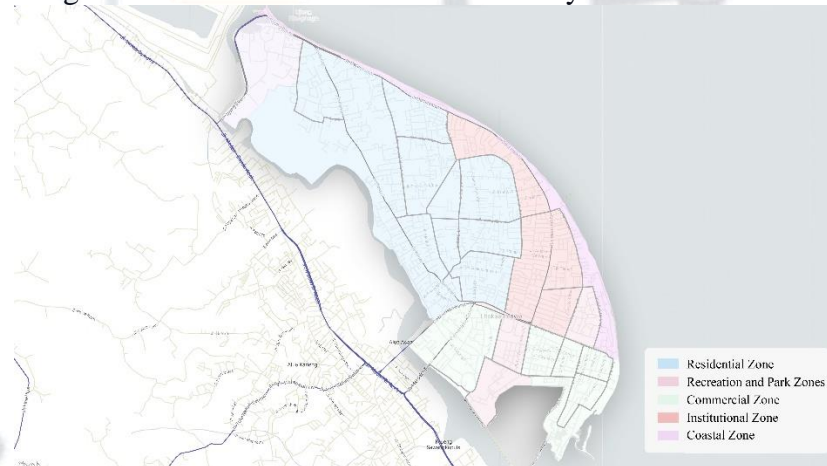


- Provides a mix of house types, density, and cost:  
Creating diversity in the available housing types, adequate density, and considering the availability of affordable housing for various community groups.
- Protect sensitive habitats, riparian zones, and high-quality open spaces:  
Pay attention to environmental conservation by protecting sensitive habitats, maintaining the quality of riparian zones (watersheds), and allocating high-quality open space for the benefit of the community.
- Making public space the focus of building orientation and environmental activities:  
Build attractive and comfortable public spaces, such as parks, squares, or community centers, which become centers of activity and connect various buildings around them.

### **3. Results and discussion**

#### **3.1 Existing Zone Designated for Lhokseumawe City**

Existing zones of urban designation refer to the grouping and regulation of land use within a city. The government usually determines this zoning through spatial regulations or urban spatial plans (Priadmaja et al., 2017). The purpose of the existing zone for the city is to regulate land use following the needs and characteristics of the city. Some of the standard designation zones that can be found in many cities are divided as follows:



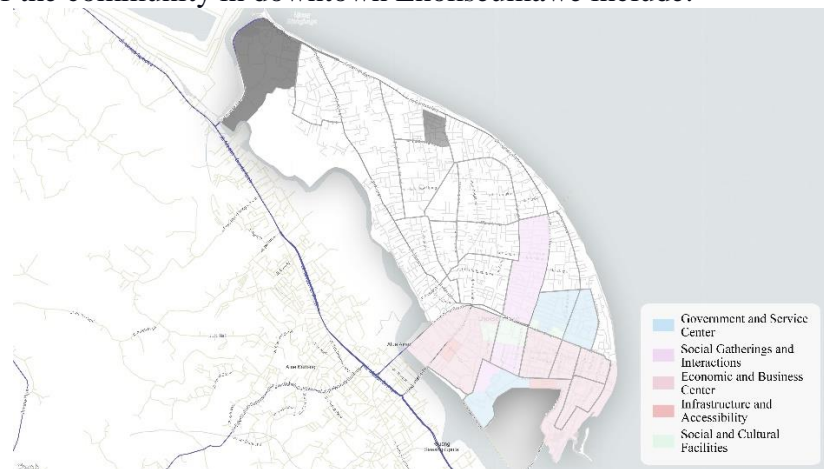
**Figure 3.1.** Mapping the existing zoning area of Lhokseumawe City

- **Residential Zone:** This zone is intended for residential development, both single-housing and multi-story housing. Residential zones include densely populated residential areas, medium-sized, luxury, etc.
- **Commercial Zone:** This zone is designated for commercial activities such as shopping malls, shops, offices, and other retail facilities. Commercial zones are often found in city centers or areas with high accessibility.
- **Industrial Zone:** This zone is designated for industrial and manufacturing activities. These include factories, warehouses, and other production facilities. Industrial zones are usually placed in areas separated from residential areas to reduce negative environmental and societal impacts.
- **Recreation and Park Zones:** These zones are designated for recreational areas, city parks, and other recreational facilities. This zone includes parks, sports fields, swimming pools, and other places of public recreation.

- Institutional Zone: This zone is intended for public institutions and facilities such as schools, hospitals, university campuses, government, and other social facilities.
- Coastal Zone: This zone is located along a coastline, covering land bordering the ocean or sea. Coastal zones have distinctive and essential characteristics in urban planning and environmental management.

### 3.2 *Community Orientation in Lhokseumawe City Center*

The orientation of the community in downtown Lhokseumawe refers to the tendency of residents and activities concentrated in the downtown area. As the main city in Aceh province, Lhokseumawe serves as the region's administrative, economic, and social center (Qanun et al. Number 12 of 2016, 2016). Some of the factors that influence the orientation of the community in downtown Lhokseumawe include:



**Figure 3.1.** Mapping the existing zoning area of Lhokseumawe City

- Government and Service Center: As an administrative center, Lhokseumawe offers many government facilities and public services. Residents tend to direct their administrative activities, such as taking care of papers, paying taxes, and other public services to the city center.
- Economic and Business Center: Lhokseumawe city center is also the economic and business center of the region. Various shopping centers, shops, banks, and financial institutions attract people to shop and conduct business transactions. In addition, many companies, industries, and government offices are located in the city center, offering employment and economic opportunities to locals.
- Infrastructure and Accessibility: Lhokseumawe city center generally has good infrastructure and easy accessibility. A well-connected road network, available public transportation, and other supporting facilities exist. This makes the city center a place that is easier to reach by the community, both by private vehicles and public transportation.
- Social and Cultural Facilities: Lhokseumawe city center also offers a variety of social and cultural facilities. There are art centers, social activity centers, places of worship, and entertainment venues that attract people to participate in social, cultural, and

recreational activities.

- Social Gatherings and Interactions: Downtowns are often places where people gather, whether for business, social gatherings, or daily interactions. This creates a lively and vibrant atmosphere in the city center, so people feel connected to the surrounding environment and their fellow city dwellers.

The orientation of the community to downtown Lhokseumawe can affect the city's overall development. Government and urban planning must pay attention to the needs and expectations of the community in developing a better urban center (Cut Azmah Fithri, Soraya Mathura Hassan, 2017). This includes the development of better infrastructure, adequate public facilities, empowerment of the local economy, and maintenance of distinctive culture and environment.

### 3.3 *Metabolism of Community Life Activities of Lhokseumawe City*

The metabolism of people's life activities in Lhokseumawe City reflects various processes and interactions that occur in the urban environment. It involves several factors: mobility, energy consumption, resource use, waste production, and social interaction. The following is an overview of the metabolism of people's life activities in Lhokseumawe City:

- **Mobility:** The people of Lhokseumawe City are involved in daily mobility, such as commuting to work, education, shopping malls, and social activities. People use various types of transportation, including private vehicles, public transportation, bicycles, and walking. These mobility activities affect traffic patterns, congestion levels, and energy consumption in transportation.
- **Energy Consumption:** The daily life of the people of Lhokseumawe City requires energy consumption for lighting, cooling or heating rooms, transportation, and the use of electronic equipment. This energy consumption involves electricity, fossil fuels, and other energy sources. It is essential to improve energy efficiency and encourage using renewable energy sources to reduce environmental impact and dependence on non-renewable energy sources.
- **Use of Resources:** The people of Lhokseumawe City use water, land, construction materials, and energy daily. Prudent management of these resources is essential to maintain environmental sustainability. It involves efficient water management, optimal land use, use of environmentally friendly raw materials, and recovery of recyclable resources.
- **Waste Production:** The daily activities of the people of Lhokseumawe City produce waste in various forms, including solid waste, water waste, and gas emissions. Good waste management and proper treatment systems are necessary to reduce environmental negative impacts. They are encouraging recycling practices, effective waste treatment, and the use of environmentally friendly technologies.
- **Social Interaction:** The metabolism of Lhokseumawe City's community life activities includes social interaction, business meetings, information exchange, and participation in cultural activities. These activities create relationships between individuals and communities, strengthen social networks, and provide opportunities to build identity and a good quality of life.

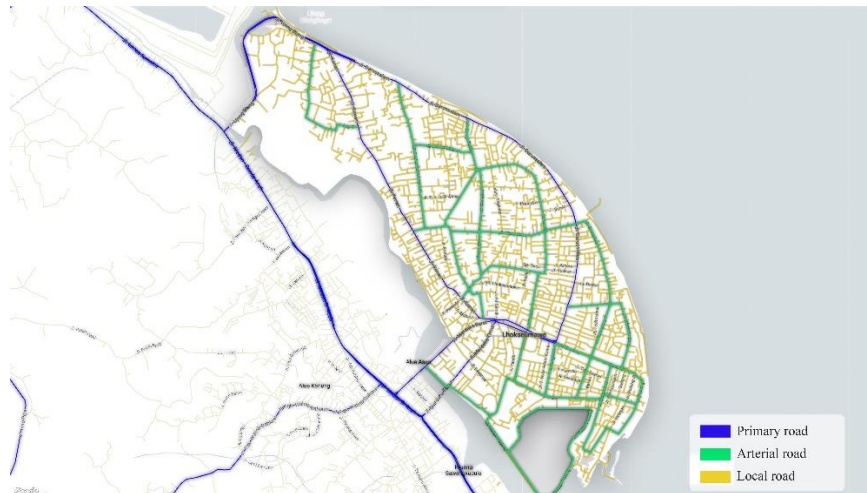
In managing the metabolism of life activities of the people of Lhokseumawe City, it is essential to consider sustainability, efficient use of resources, environmental protection,



and quality of life (Bambang et al., 2015). Collaboration between governments, communities, and the private sector is needed to encourage sustainable practices, such as promoting sustainable transportation, using renewable energy, good waste management, and developing environmentally friendly public spaces (Besser & Dannenberg, 2005).

### 3.4 Embryo Planning TOD in Downtown City Lhokseumawe

The embryonic planning of TOD (Transit-Oriented Development) in downtown Lhokseumawe involved integrating the public transportation system with land development around major transit stations. Some steps that can be taken in starting TOD planning in downtown Lhokseumawe include:



**Figure 3.4.** Accessibility mapping of Lhokseumawe City

- **Identification of Major Transit Stations:** The first step is identifying major transit stations that can become TOD hubs. This may involve train stations, bus terminals, or other direct access points to public transport. The station's strategic location and accessibility will be essential in choosing a central transit station.
- **Potential and Needs Analysis:** A potential and needs analysis is conducted to identify potential land development around transit stations. This includes mapping available land, housing needs, offices, shopping centers, public facilities, and other supporting infrastructure. This analysis will help in planning development that suits the needs and potential of the city.
- **Public Consultation and Participation:** Involving communities and stakeholders in planning is essential. Public consultation and stakeholder participation will help get input and aspirations from the community regarding the development of TOD in downtown Lhokseumawe. It also helps build understanding and support from various relevant parties.

**Spatial Planning:** Spatial planning is carried out that pays attention to land development around transit stations. This planning includes determining land zoning, mapping appropriate land use, and establishing regulations that support TOD development. This planning should consider accessibility to the station, proper density, separation between residential and commercial zones, and open space utilization.

- Infrastructure Development and Supporting Facilities: TOD development requires adequate infrastructure and supporting facilities. This includes expanding and improving public transportation networks, developing sidewalks and road bikes, and constructing shopping centers, recreational facilities, public open spaces, and other supporting infrastructure. This development should involve cooperation between the government, developers, and other relevant parties.

#### 4. Conclusion

Implementing Transit-Oriented Development (TOD) in downtown Lhokseumawe is essential in improving transportation efficiency, improving the community's quality of life, and reducing environmental impact. Collaboration and active participation from government, community, developers, and other stakeholders are needed in implementing TOD. Key focuses include integrated spatial planning, adequate infrastructure development, and sound environmental management. Education and public awareness about the benefits of TOD need to be increased through information campaigns and socialization programs. With these steps, it is hoped that TOD can be an effective solution in creating a sustainable, inclusive, and environmentally friendly city in the center of Lhokseumawe City.

This study identifies the potential for TOD development based on community orientation in the city center, existing allotment zones, metabolism of community life activities, and TOD planning embryos. Observational research on TOD in a city is necessary because it involves understanding impacts, evaluating effectiveness, better urban planning, informed decision-making, and improving future design. This research provides an in-depth understanding of the consequences of TOD implementation, including improved public transport accessibility, air, and traffic pollution reduction, land use patterns, and socio-economic changes. Observational research also helps evaluate whether TOD achieves established goals, such as increasing public transportation use. The results provide a valuable source of information for urban planners in planning future TOD projects and can help identify important factors that influence the success of TOD implementation. Policy and investment decisions based on empirical evidence from observational research reinforce informed decision-making. In addition, findings and insights from current observational research can be used to refine the design and implement future TOD projects, thereby addressing challenges and resulting in better development.

The research methods and materials used in this study are qualitative methods of observation that can bring answers closer to honesty and validity to space needs based on the orientation of the object of research. The importance of TOD implementation in urban development in Lhokseumawe is also supported by theories and concepts in urban planning and design that discuss the relationship between transit activities and regional development.

This study presents an overview of the existing Lhokseumawe City zone, which involves grouping and regulating land use in a city. The existing zone for the city includes residential zones, commercial zones.



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