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READINESS OF TRANSIT ORIENTED DEVELOPMENT (TOD) CONCEPT IMPLEMENTATION IN PERAK'S SUBURBAN AREAS

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Abstract

The transit-oriented development (TOD) concept is a planning strategy in metropolitan areas that involves mixed use of land for transportation systems, especially railway stations, as the basis for planning the TOD concept. The question raised is whether suburban areas are suitable and ready to implement the TOD concept which is included in the suburban districts' local plan. The aim of this paper is to evaluate the readiness of implementing the TOD concept model for 14 suburban railway station areas in seven of Perak's local government administrations. The methodology used is a mixed quantitative and qualitative approach, applying the Fuzzy Delphi Method (FDM) and case study method to develop the readiness model and evaluate the readiness level of the TOD concept in suburban areas. Twenty indicators from 4 key elements in the TOD readiness model were identified, such as population density, transit system, economic development, and land development potential. The findings indicated that all 14 railway stations involved have not yet achieved a 100 per cent level of readiness in implementing the TOD concept model.

Keywords: Transit Oriented Development, Readiness Model, Railway Station, Suburban, Design and Development Research

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INTRODUCTION

Transit-oriented development (TOD) is a development concept which focuses on human residential areas and activities that are located around transportation nodes such as railway stations, motorized stations, and air and water transport. Transportation network is a main pillar in the development of TOD, where it eases the movement of people to travel to other places. Based on several research conducted in big cities such as Doha, Copenhagen, and Perth, TOD can help to solve many problems caused by rapid development such as traffic congestion, land usage, population density, and usage of motorized vehicles (Al-Harami and Raffaello, 2019; Furlan and Saeed, 2019).

In Malaysia, the concept of TOD has been applied in several areas, especially by the Majlis Bandaraya Petaling Jaya (MBPJ) and Iskandar Regional Development Authority (IRDA) using the Local Plan and Master Plan (Abdullah et al., 2020). However, in suburban areas, the concept of TOD was not the main vision for their future development (Azmi et al., 2021). This situation can change completely according to Gomez et al (2019) if the local authority plans for future development based on four elements of TOD, which are density, potential of land use development, economic development, and transit system. The Perak State Structured Plan highlighted a proposal for TOD around the railway stations in Ipoh, Taiping, Tapah, Tanjong Malim, Batu Gajah, and Kampar (PLANMalaysia@Perak, 2020). However, only Ipoh is considered to be ready for TOD implementation due to its status as a City Council and as the capital of the state of Perak. The big question therefore is: when is it suitable for the TOD concept to be applied in a specific area, especially in suburban areas? Hence, the main objective for this paper is to assess the readiness of TOD concept implementation for future development in Perak's suburban areas.

LITERATURE REVIEW

TOD in Suburban Areas

Urbanization has produced many new townships or residential areas to accommodate the needs and demands of urban workers. These new developments are usually located at the end of the city boundary known as a suburb. These types of developments are usually in high demand among urban workers because they are suitable with their income. However, this situation results in a waste of productive time for travelling and also causes air pollution. Besides that, the optimum usage of transportation facilities only occurs at a certain time, usually in the morning, which can be viewed as a waste because building these facilities cost extremely large sums of money (Ahmad and Suratman, 2020). Hence, many countries have taken steps to implement the concept of TOD in their development planning, which can connect many areas using their transportation network and public transport as their medium for travelling.

TOD is also related to the Sustainable Development Goals (SDGs) by the United Nations, where this concept emphasizes the transportation sector as the basis for a given area's development, especially in the context of infrastructure, public transport system, service delivery system, capability, and efficiency of transportation (MacDonald et al., 2018). Sustainable transportation can also help to achieve good economic integration, preservation and conservation of the natural environment, increase social equity, health, urban resilience, urban and rural connection, and rural productivity (Ramlan et al., 2021). To achieve better TOD, there are four main principles for planning and development which can be used in suburban areas, which are:

1. Emphasis on centralized areas and types of densities and mixed land use activities.
2. Relationship between the central area and the rapid transit site such as train stations.
3. Development based on density and design requirements in each central area which are managed by a specialized development agency.
4. Financial mechanism which can allow transit and TOD to be built between the transit and central area.

Criteria for TOD's Model: Malaysia's Policy

In Malaysia, the development concept of TOD has been discussed at the highest level in the Third National Physical Plan (NPP3) which was introduced in 2016 (PLANMalaysia, 2016). In that plan, two detailed guidelines were introduced by PLANMalaysia and *Agensi Pengangkutan Awam Darat* (APAD): the Transit Oriented Development Policy Guidelines in 2016 (APAD, 2016) and the Transit Oriented Development Guidelines in 2018 (PLANMalaysia, 2018) respectively.

The planning for TOD was highlighted in NPP3 via the First Core: Dynamic Growth of Urban and Rural Areas. To succeed in this core, public transport services in urban areas need to be upgraded to form a new stable and sustainable public transportation network. Also highlighted in this core was the Malaysian Government's aim to increase the percentage of public transportation usage in Peninsular Malaysia to 40% in 2030 and 60% in 2050, while for non-primary cities, the target is 30% in 2030 and 50% in 2050 (PLANMalaysia, 2016). To achieve this target, TOD has been proposed in several strategic locations. On the other hand, High-Speed Rail and Electric Train Service (ETS) have already been integrated together with Light Railway Transit (LRT), Mass Rapid Transit (MRT), and Bus Rapid Transit (BRT) to improve public transportation services in urban areas.

Readiness criteria in TOD

The TOD concept has been researched by many researchers to explore the best design to maintain a sustainable quality of life in surrounding areas. In general, TOD is a concept to enable a dense population area to enjoy a perfect lifestyle by using a systematic infrastructure (Rosni et al., 2018) based on four main elements in TOD, which are:

- i. **Population Density:** always reflected in local economic development (Wang et al., 2019; Hassan et al., 2018). The TOD concept has been introduced to ease the movement of people and at the same time help to manage and maintain the surrounding environment (Ab Majid et al., 2021).
- ii. **Transit System:** can be defined as a system which includes public transportation and private ownership vehicles for movement purposes (Renne, 2016; Hassan et al., 2018). To make the railway system more efficient, another public transport mode is used as a support such as public bus service (Iseki and Eom, 2019).
- iii. A dynamic **Economic Development** is essential for every country. One of the focus points of TOD is to establish a dynamic economic development, which can help to increase job and business opportunities for the people (Wang *et al.*, 2019; Samat et al., 2019), tax collection (Kaneko et al., 2019; Hendrastuti, 2021), and to increase the usage of resources (Economic theory) (Samat et al., 2019; Tahir and Malek, 2016).
- iv. **Potential for Land Development** - TOD focuses on the potential for land development in the transit infrastructure radius, which can benefit from transit investment such as the construction of pedestrian walkways, better access to job location, and reducing traffic congestion, air pollution, and greenhouse gases (GHG) (Cervero, 2020; Ma et al., 2018; Malaysian Industrial Development Finance, 2017).

A considerable amount of research listed out different TOD indicators that can be used to ensure uniformity of TOD in every area of each country. All these indicators are based on four main principles of TOD, which are, transit system, density, potential of land development, and economic development.

METHODOLOGY

In order to develop a TOD readiness model, a design and development research (DDR) approach was chosen which focuses on 4 main elements and 20 indicators of TOD (Mohd Ridhuan et al., 2014). DDR is a systematic process which is made up of three main phases, which are phase of research, phase of design and development, and phase of model implementation.

Phase 1: Phase of research

Phase 1 is important in order to ensure there is a need for the TOD readiness model to be developed. This phase also explains the extent to which TOD is needed in suburban areas and whether the areas are ready or not for TOD implementation. A questionnaire form was used in this phase. 35 respondents took part in this phase from different positions in 7 local authorities in Perak state. Each of these local authorities was chosen based on their homogenous population density around the existing train station in their jurisdiction area. The final findings in this phase are shown in the indicator list, which can be chosen to develop a readiness model in the next phase.

Phase 2: Phase of design and development

In this phase, the respondents were made up of 20 experts in different fields such as urban planning, transportation planning, land use, and land management. An interview session was conducted among these 20 experts to design and develop the model using the Nominal Group Technique (NGT) method. These 20 experts gave their expert opinions related to the 20 indicators, which are found from the literature reviews and questionnaires from Phase 1. The final findings in this phase will be used for the Fuzzy Delphi Method in Phase 3.

Phase 3: Phase of model implementation

Fuzzy Delphi is a method used in Phase 3, which can be used to assess the usability of the model in suburban areas and to determine the ranking order for each indicator based on importance to TOD. All 20 experts in Phase 2 were chosen to be part of Phase 3. The final findings from this phase is a complete model of TOD readiness based on 20 indicators, which were properly aligned based on importance ranking and complete with a measurement for each indicator.

Case Study of Perak using TOD Readiness Model

The TOD readiness model was used for an in-depth analysis by implementing an assessment of the readiness of railway stations with the local authorities involved in suburban areas through a case study approach (qualitative analysis). This approach was implemented in the study area in 14 railway stations involving 7 local authorities in Perak. These 7 local authorities were categorised as suburban areas due to their status as a Municipal Council. All of the railway stations existing land use within a radius of 800 meters from the station (Figure 1) were considered to determine development of TOD. Several methods of data collection were involved based on 20 indicators (Table 1) along with measurement recommendations for those indicators such as primary data, survey, physical observation, and secondary data from government agencies. After the evaluation of each train station in each local authority, the analysis of the level of readiness

of TOD in the affected areas was explained to find out the current position of the level of readiness of railway stations and local authorities in developing the concept of TOD.

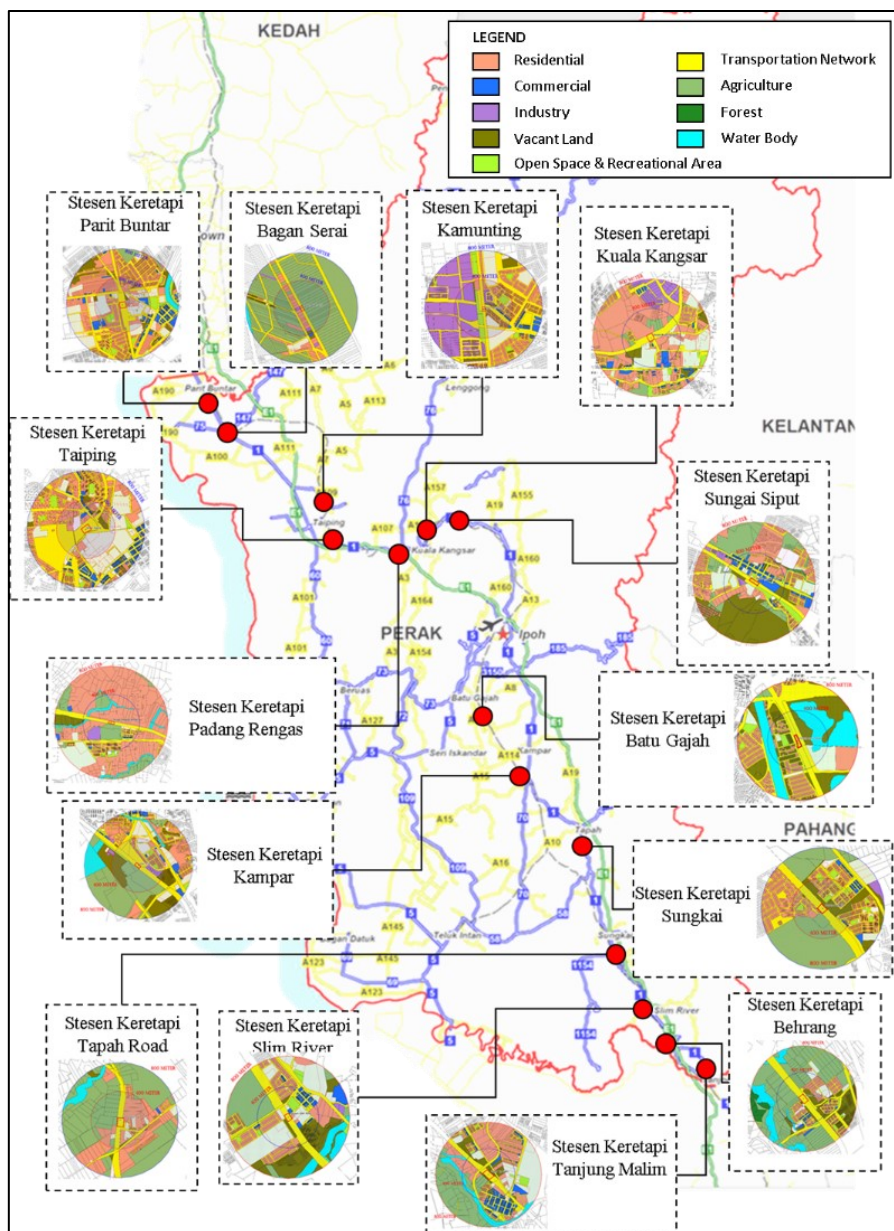


Figure 1: Existing Land Use within 800 Meter Radius from Railway Station

RESULTS AND FINDINGS

The findings of this study can be divided into two sections, which are the proposed indicators and measurements which can be used to assess TOD readiness, and the application of this model in selected areas in Perak’s suburban areas.

Indicators and Measurements for TOD Readiness

At the end of DDR, a complete model for TOD readiness was produced complete with suggested measurements from the experts’ opinions. This model can be used in a suburban area to determine whether it is ready for TOD implementation or not. The complete model for TOD readiness is as in Table 1.

Table 1: Complete Model of TOD Readiness

Rank	TOD Element	TOD Indicator	Measurement
1	Population Density	Population Density	Minimum 1500 persons/km ² /LA
2	Potential of Land Development	Mixed Land Use	Minimum 100% from TOD zone can be developed.
3	Economic Development	Level of Mixed Land Use	Minimum 50% from TOD area is mixed land use.
4	Transit System	Number of Interchange with Different Mode	Minimum 1 mode of public transportation connected with station.
5	Transit System	Accessibility to Station	Minimum distance is 400 / 800 m from station.
6	Transit System	Connectivity with Other Routes	Minimum 1 route is connected to the station.
7	Transit System	Parking- Car	Existing parking for cars
8	Transit System	Frequency of Transit System Service	Minimum 78 trips/ day
9	Economic Development	Taxes Received by Local Authority	Minimum RM 100 million/ year (<i>Majlis Perbandaran</i>) Minimum RM 50 million/ year (<i>Majlis Daerah</i>)
10	Transit System	Parking- Bicycle	Existing parking for bicycles
11	Transit System	Parking- Specific Group	Existing parking for specific group of people such as disabled persons
12	Economic Development	Amount of Existing Businesses	Minimum 20% from Local Authority jurisdiction
13	Population Density	Commercial Density	Minimum 20% from TOD zone
14	Transit System	Security	Existing security aspects at station such as CCTV and security guard
15	Population Density	Employment Density	Minimum 20% from TOD zone
16	Economic Development	Private Investment in Local Authority Jurisdiction	Minimum 30% of land use are industry and commercial
17	Transit System	Peak-hour Passengers	300 passengers (2 trips)
18	Transit System	Facilities	Existing proper facilities for train station such as seating, toilets, cafeteria, and good ventilation system
19	Transit System	Non-Peak Hour Passengers	100 persons (1 trip)
20	Transit System	Information Display	Existing information display aspects such as information board, LED and direction board

Application TOD Readiness in Perak's Suburban

There are 14 train stations from 7 different local authorities in Perak's suburban areas that were identified to test the completed TOD readiness model (Table 2). As a result, all 14 train stations are still not ready to implement TOD at present. 4 stations, namely Sungkai Railway Station, Kuala Kangsar Railway Station, Taiping Railway Station, and Kamunting Railway Station are 45% ready for TOD implementation, while another 10 stations are only about 40% ready. This percentage is seen to be an obstacle to successful TOD when all these railway stations do not meet the definition of the TOD concept, which consists of four main elements, namely population density, potential of land development, economic development, and transit system. From 4 main elements of TOD, only one element of the transit system was achieved in all 14 train stations, while only 3 train stations had completed the element of potential for land development. In terms of density, none of the stations achieved the minimum population for TOD; despite that it is the most important factor for consideration to apply the concept of TOD in an area. Since all these stations did not achieve the target of 100%, it will make it difficult for the local authorities to implement TOD in the near future.

Table 2: Complete Model of TOD Readiness

Element	Indicator	MDTM		MDT		MDKpr		MDBG		MPKK		MPT		MDK	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Population Density	Population Density	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Potential of Land Development	Mixed Land Use	X	X	X	X	√	X	X	X	√	X	√	√	X	X
Economic Development	Level of Mixed Land Use	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Transit System	Number of Interchanges with Different Modes	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Transit System	Accessibility to Station	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Transit System	Connectivity with Other Routes	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Transit System	Parking- Car	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Transit System	Frequency of Transit System Service	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Economic Development	Taxes Received by Local Authority	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Transit System	Parking- Bicycle	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Transit System	Parking- Specific Group	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Economic Development	Amount of Existing Businesses	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Population Density	Commercial Density	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Transit System	Security	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Population Density	Employment Density	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Economic Development	Private Investment in Local Authority Jurisdiction	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Transit System	Peak-hour Passengers	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Transit System	Facilities	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Transit System	Non-Peak Hour Passengers	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Transit System	Information Display	√	√	√	√	√	√	√	√	√	√	√	√	√	√
TOD READINESS (PERCENTAGE)		40	40	40	40	45	40	40	40	45	40	45	45	40	40

Railways Legend:

1=Tanjung Malim Railway Station; 2=Behrang Railway Station; 3=Slim River Railway Station; 4=Tapah Road Railway Station; 5=Sungkai Railway Station; 6=Kampar Railway Station; 7=Batu Gajah Railway Station; 8=Sungai Siput Railway Station; 9=Kuala Kangsar Railway Station; 10=Padang Rengas Railway Station; 11=Taiping Railway Station; 12=Kamunting Railway Station; 13=Bagan Serai Railway Station; 14=Parit Buntar Railway Station.

CONCLUSION

In conclusion, the developed model of TOD readiness was successfully developed, which involves 20 indicators in four elements, where previous studies had not considered implementing a study of the level of readiness of TOD, especially in suburban areas. This model can serve as a tool to evaluate and measure the level of readiness of a railway station and also local authorities in the planning and development of the TOD concept, where it was proven to be successful. This model may also be used as a proposed study in the development of guidelines for TOD in the suburbs, especially for the Local Authorities which have a TOD concept in their Local Development Plan.

In the context of Perak, all railway stations in Perak’s suburbs are not ready to accept, implement, and adopt the concept of TOD in their areas. In order to implement TOD in suburban areas in Perak, all the proposed indicators must be prepared such as population density, potential of land development, economic development, and transit system in these areas. However, the aspect of population density is the most important element in implementing TOD because with high demand, the TOD development will appear more effective.

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