CRITICAL REVIEW ON THE IMPLEMENTATION OF TRANSIT ORIENTED DEVELOPMENT IN MALAYSIA BY COMPARISON WITH OTHER COUNTRIES

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Abstract. This paper review assesses the implementation of Transit Oriented Development (TOD) in Malaysia by comparing it with practices in other countries. The study aims to evaluate the principles of TOD and identify similarities and differences across different regions. Using a systematic literature analysis approach, the methodology involves examining manuals, journals, and government documents related to TOD policies. By employing VOSviewer software for network analysis of scientific publications, the research explores the structure of TOD principles. Key findings emphasize the importance of mixed-use development, high density, connectivity, liveability, resilience, green and low carbon principles, and resource optimization in fostering sustainable communities because some transit station in Malaysia can be improve its current infrastructure to meet TOD principles requirement. The conclusions drawn underscore the global significance of TOD practices and suggest avenues for Malaysia to enhance its urban planning policies by learning from international experiences. This study hopes to contribute valuable insights to the field of sustainable urban planning and offers implications for future research and policy development in TOD implementation.

1 Introduction

This paper aims to assess the implementation of Transit Oriented Development (TOD) in Malaysia compared to other countries and discuss the similarities and differences of the principle. Transit-oriented development (TOD) is a strategy in urban planning focused on building high-density mixed-use areas near railway stations to foster sustainable and fair communities [1]. The current land use around many MRT stations falls below the ideal benchmarks for TOD, indicating a need for better land use optimization. For instance,

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residential land use in many MRT Putrajaya Line stations is below the ideal benchmark, potentially impacting future demand for MRT services. One major issue is the lack of comprehensive and integrated land use planning, which is essential for creating mixed-use developments that encourage walking and cycling [2]. Early built transit stations like Subang Jaya Commuter Station and Tun Sambanthan Monorail Station, although having potential, lack the essential facilities and infrastructure to fully adhere to TOD principles. By encouraging compact living and diverse amenities, TOD aims to decrease car dependency, ease traffic congestion, combat air pollution, and lower greenhouse gas emissions. Additionally, it promotes lively, pedestrian-friendly neighbourhoods with accessible housing options [3]. Based on Transit Oriented Development (TOD) And Market Feasibility Study for Real Estate Development: Policies, Strategies and Urban Planning Guidelines by Alias Rameli in 2021, TOD revolves around public transport hubs, promoting connectivity, pedestrian and cyclist access, and high-density mixed-use development within walking distance. It optimizes land use inclusively to support sustainable transportation and community integration.

Originally in the 90s, Peter Calthorpe [4] elaborated and explain about TOD in The Next American Metropolis that TOD is a mixed – used community within average 2000-foot walking distance of a transit stop and a core commercial area making it convenient for residents and employees to travel by transit, bicycle, foot, or car. Globally, TOD have been implemented in many countries such as New Town in Japan during late 1950s [5], New Delhi, India in year 1995 [6], Singapore which applied TOD to cope with urbanization [7], Shenzhen a city in China [8], Subiaco Station precinct which is Perth's most well-known TOD example [9], New Jersey and San Diego in United Stated [10].

To implement TOD, each country has a set principle acting as guideline to establish TOD in real life situations. As Malaysia keep on advancing in megaproject such as Mass Rapid Transit (MRT) and East Coast Rail Line (ECRL), governments in Malysia decided to applied TOD at available station. This paper provides a deep analysis using network analysis tools that find similar papers centred around TOD principal guideline according to citation, authors, and titles. Thus, assessment from this study may be helpful in helping policymakers during the formulation of TOD policies in Malaysia [11].

1.1 Transit oriented development definition in other countries

Around the world, TOD has been applied globally and each countries have different principles to provide optimal efficiency according to each country temperature, climate, land use, and government policies. TOD in London refers to mixed-used developments of high density, oriented towards and in proximity to walkable distance of a public transport station [12]. According to Institute of Transportation and Development Policy in 2017, TOD refers is a powerful tool to help shape and assess urban development that focuses on maximizing the benefits of public transit and non-motorized mobility while placing the emphasis firmly back on the people. The guideline suggest seven key factors for a successful TOD which is transit should be at centre of the city development, high density of housing and commercial properties, neighbourhood should support walking and cycling as much as possible, driving and ownership of private vehicles should be discouraged, services should be integrated into said development, use brownfield side, and public sector involvement to helps ensure that new development is supervise and deliver across multiple urban policies. It is suggested that home should be within 5 – 10 minutes' walk of facilities to encourage walking and cycling, rather than car or private vehicle use.

1.2 Transit oriented development in Malaysia

Malaysia has an issue regarding car dependencies and traffic congestion. To solve this problem, Malaysia acknowledges the importance of efficient urban transportation system. (TOD) is increasingly seen as a viable approach to efficiently utilize land and address urban transportation challenges. Table 1 shows the TOD performance for MRT Putrajaya Line according to each station available. The trend for residential land falls below the ideal benchmark of 30-60%. This means that future demand for MRT service is also low. Also, only three stations have ideal benchmarks value for roads. This means that within 800m radius of MRT stations relies heavily on motorized vehicles. To improve the TOD performance of the stations, future development within the TOD radius of the stations must be optimized to conform to the TOD benchmark model [13].

Table 1. MRT Putrajaya Line TOD Performance.

Land Use Type	**Residential 30 – 60%**		**Mixed-Land use and Commercial 7 – 30%**		**Public Facilities and Amenities 7 - 11%**		**Green Space and Open Area 2 - 8%**		**Roads 17- 24%**	
Damansara Damai	23.15	L	10.77	I	8.41	I	8.22	H	37.09	H
Metro Prima	18.63	L	10.34	I	3.24	L	3.35	I	37.28	H
Kentonmen	20.19	L	2.10	L	29.17	H	0.69	L	26.09	H
Sentul Barat	24.82	L	4.27	L	7.81	I	14.14	H	35.15	H
Titiwangsa	17.96	L	12.63	I	27.06	H	2.14	I	28.10	H
Raja Uda	27.99	L	10.55	I	19.48	H	4.84	I	19.37	I
Ampang Park	26.58	L	14.73	I	7.92	I	7.92	I	24.12	I
Persiaran KLCC	18.23	L	22.85	I	14.33	H	4.94	I	21.84	I
Conlay	12.54	L	22.77	I	9.4	I	17.37	H	27.07	H
Chan Sow Lin	9.74	L	18.59	I	11.66	H	2.42	I	35.39	H
Bandar Malaysia North	1.33	L	0.47	L	20.63	H	1.49	L	17.57	I

L	Lower than the Ideal TOD	I	Within Ideal TOD	H	Higher than the Ideal TOD

2 Methodology

Figure 1 shows the methodology of TOD systematic literature review of this study. This study methodology divided into three main sections which are planning of the study, examination of related article and papers, and reporting of data extracted from related papers. In planning phase, this study outlined in detail the research question to prevent getting out of the study boundary. During examination phase, this study uses VOSviewer to explore and analysed structure of scientific fields based on bibliographic data, key authors, journals, topics, and trends within TOD. Next, manually removed unrelated document in VOSviewer and add related or reliable papers. Organize the data or paper into table format for cross tabulation. Cross tabulation is a method where each cell in the table indicates the frequency, either raw or proportional, of observations corresponding to the categories represented by that cell [14]. Lastly, reporting phase which extract important data during cross tabulation into writing and complied as a report for TOD comparison of Malaysia and other countries

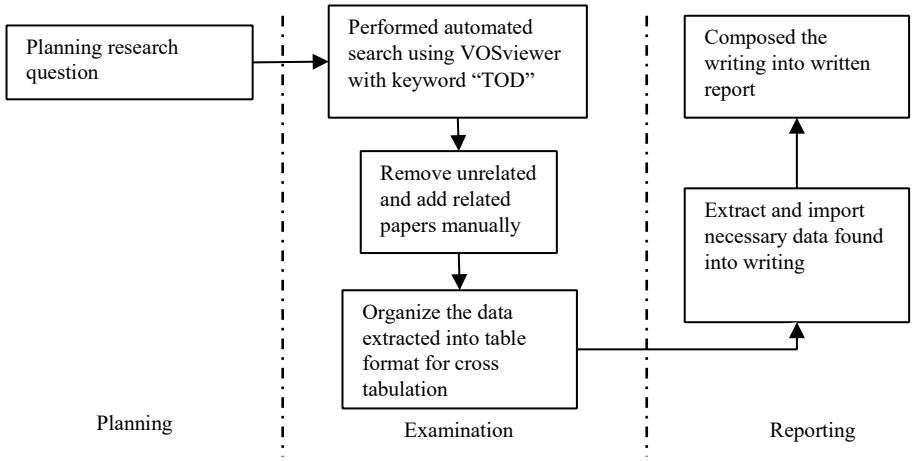

Fig. 1. Methodology of TOD Systematic Literature Review

3 Analysis and discussion

In recent years, PLANMalaysia guideline include all nine principles of TOD which is mixed-used development, high intensity development, connectivity, inclusive, liveable, resilient, smart, green and low carbon, and optimise resource. Based on Table 2, there are improvement in Malaysia TOD principle as the trend keep on updating from 2014 until 2021. In 2014 and 2016, the TOD principles do not include smart, resilient or connectivity in its concept but in 2017 all the principles are included in PLANMalaysia guideline.

Table 2. TOD Principle in Malaysia

Guideline Title	**Principle**								
	Mixed-used development	High intensity development	Connectivity	Inclusive	Liveable	Smart	Resilient	Green and low carbon	Optimise Resources
Transit Oriented Development (Tod) And Market Feasibility Study for Real Estate Development: Policies, Strategies and Urban Planning Guidelines (PLANMalaysia, 2021)	√	√	√	√	√	√	√	√	√
Role Of Planmalaysia Towards Spurring Low Carbon City in Malaysia (PLANMalaysia, 2021)	√	√	√	√	√	√	√	√	√
Ringkasan Eksekutif Rancangan Struktur Negeri Terengganu (PLANMalaysia Terengganu, 2019)	√	√	√		√	√	√	√	√
Garis Panduan Perancangan Pembangunan Berorientasikan Transit (PLANMalaysia, 2018)	√	√	√	√	√	√	√	√	√
Rancangan Struktur Negeri Selangor (Jabatan Perancangan Bandar dan Desa Negeri Selangor, 2017)	√	√	√	√	√	√	√	√	√

Draft Rancangan Tempatan Petaling Jaya 2 (Majlis Bandaraya Petaling Jaya, 2016)	√	√		√	√	√		√	√
Habitat Magazine (Ministry of Wellbeing, Housing, and Local Government Malaysia, 2016)	√	√	√	√	√			√	√
Planning for Transit Oriented Development in Malaysia (Federal Department of Town and Country Planning Ministry Of Urban Wellbeing, Housing and Local Government Malaysia, 2014)	√	√	√	√	√			√	√

Mixed-use development in TOD integrates residential, commercial, retail, office, and recreational spaces within a single site, creating vibrant, walkable, and sustainable communities. It prioritizes convenience, accessibility, and a sense of place by combining various uses in proximity, promoting walkability through pedestrian-friendly streetscapes and shared spaces. This approach supports higher-density zoning, transit-oriented development, and reduces urban sprawl, enhancing land use efficiency and fostering sustainable growth. Economically, it attracts businesses, residents, and visitors, creating a diverse economic ecosystem and supporting local entrepreneurship. Socially, it encourages community engagement and social interaction through shared amenities and public spaces, fostering a sense of belonging. Environmentally, it reduces car dependency, supports public transit, and incorporates green building practices, contributing to a more resilient urban environment. Overall, mixed-use development offers a holistic urban planning strategy that enhances quality of life, economic vibrancy, and social well-being.

High-intensity development, as defined by PLANMalaysia TOD principles, focuses on maximizing land use intensity within transit-oriented areas. This approach involves creating compact, mixed-use developments with higher building and population densities than traditional suburban or auto-centric areas. The goal is to foster vibrant, pedestrian-friendly environments where people can live, work, and play near transit stations, reducing car dependency and promoting sustainable transportation. High-intensity development features taller buildings, diverse land uses, and a mix of residential, commercial, and public spaces to support transit ridership and economic activity while enhancing urban sustainability. An example is the TOD station development in Terengganu, which categorizes zones based on their proximity to the station, with density increasing closer to the station.

Connectivity is connection between location to station such as transit facilities, pedestrian walkway and cycling pathway. Good connectivity encourages community to use public transport and non-motorized vehicles. This is the reason it is included in current PLANMalaysia guidelines to encourage the development of low carbon city. Although before PLANMalaysia guidelines in 2021, there are certain TOD guidelines that does not include the importance of connectivity in its planning. In Draft Rancangan Tempatan Petaling Jaya 2, connectivity was not included in the TOD principles mainly because Petaling Jaya already have good connectivity. Most walkway centred around public transport station have covered walkways and connecting bridges.

Inclusive principle is to provide a minimum of 30% affordable residential premises and create a barrier – free environment for all including person with disability (PWD). In Terengganu TOD principle does not include inclusive principle which is affordable housing and job opportunity. This may be because housing or cost living in Terengganu already low and affordable compared to major cities and job opportunity is available with Terengganu rapid development.

Liveable principles provide public facilities near residential area and develop green and blue network that connect all major land use. liveable principles also provide safe environments through Crime Prevention Through Environmental Design (CPTED).

Terengganu include CPTED in its design and it is implemented in Kuala Nerus, Terengganu such as green building, small office home office (SOHO), and green area that is connected to residential and commercial area. [15].

Resilient principles ensure adequate safety measures to reduce risks of accidents and natural disasters. As Terengganu is prone for flood, implementation of warning system at main water basin is installed.

Smart principles involve the integration of high-capacity Information and Communications Technology (ICT) and the Internet of Things (IoT) throughout the TOD area. The absence of smart and resilient features in Malaysia's 2014 and 2016 guidelines may be attributed to the less critical role of technology at the time, as most smart characteristics in TOD rely on IoT. The significance of technology in Malaysia became evident during the COVID-19 pandemic, demonstrating the need for both physical and online systems for managing public access to markets and places. The Malaysian government began implementing IoT usage nationally in 2015 [16]. Energy-saving equipment and heat-reflective building materials are key components of the green and low-carbon principles in TOD. While Malaysia has made progress in green building development, issues such as unclear government policies have caused delays [17]. Consequently, Malaysian government organizations have gradually adopted green and low-carbon principles in their guidelines, as seen in the Ministry of Energy, Science, Technology, Environment, and Climate Change (MESTECC) building in Putrajaya and Menara Ilham in Kuala Lumpur.

Lastly, optimization resources that promote development of brownfield site to revitalize TOD area. The most prevalent example of brownfield site is KL Sentral area. The project aimed to consolidate various modes of transportation, including rail, bus, and taxi services, into a single integrated hub while also creating commercial, residential, and recreational spaces. Now, KL Sentral serves as the primary transportation hub in Kuala Lumpur, connecting various rail lines, including KTM Komuter, LRT, MRT, ERL (Express Rail Link), and intercity train services. It also provides connectivity to bus services, taxis, and private vehicles.

Table 3. TOD principles in other countries

Guideline Title	**Principle**								
	Mixed-used development	**High intensity development**	**Connectivity**	**Inclusive**	**Liveable**	**Smart**	**Resilient**	**Green and low carbon**	**Optimise Resources**
China Sustainable Cities Integrated an Approach Pilot Project (Ministry of Housing and Urban-Rural Development, 2023)	√	√	√	√	√		√	√	√
Accessibility in the Seoul Metropolitan Area: Does Transport Serve All Equally? (International Transport Forum, 2023)	√	√	√	√	√		√		√
Advisory On Transit Oriented Development (Ministry of Housing and Urban Affairs Government of India, 2023)	√	√	√	√	√		√	√	√
Japan's TOD Guidebook (Ministry of Land, Infrastructure, Transport and Tourism, 2021)	√	√	√	√	√	√	√	√	√

Adendum Andal MRT Jakarta Fase 2A (Perseroan Terbatas Karsa Buana Lestari, 2020)	√	√	√		√	√	√	√	√
Transport Oriented Development Standard in New York (Institute for Transportation and Development Policy, 2017)	√	√	√	√	√		√		√
A Framework for Transit Oriented Development in Florida (Renaissance Planning Group, 2011)	√	√	√	√	√	√	√	√	√

Table 3 shows the principles from various countries emphasizing the importance of mixed-use development, albeit with different terminologies. For example, Japan and Florida use "mixed-use development," while countries like India, China, and Seoul prefer "mixed land use." Regardless of the terms, the common goal is to integrate residential, commercial, and recreational spaces near transit hubs to create vibrant, sustainable communities that reduce the need for car travel, support transit ridership, and enhance the overall quality of life.

High-density or compact development is another crucial TOD principle, with countries like Japan, Florida, India, and China adopting terms such as "compact design" or "compact development." This approach focuses on maximizing land use efficiency around transit nodes, supporting pedestrian-friendly environments, and curbing urban sprawl. The emphasis is on creating well-connected, liveable communities that enhance transit accessibility and reduce reliance on private vehicles.

Connectivity, especially through pedestrian and bicycle-friendly infrastructure, is prioritized across countries like Japan, Florida, India, and New York. By enhancing safety, accessibility, and comfort for pedestrians and cyclists, these countries aim to promote active transportation, reduce car dependence, and foster sustainable, inclusive communities that support environmental sustainability and public health.

In terms of inclusivity, most countries in the study emphasize the provision of affordable housing near transit stations to accommodate diverse income levels and promote social equity. While the specific terminology varies, the shared objective is to create diverse and equitable communities that enhance the quality of life within TOD areas. Malaysia, although still developing its inclusive TOD principles, could benefit from adopting similar practices in future TOD phases.

Liveability is another key focus, with countries like Japan, China, and New York stressing the importance of convenient access to public transportation to reduce car dependency and promote sustainable mobility. The integration of various public transportation modes is crucial in developing well-connected, vibrant communities that prioritize transit ridership and overall mobility.

While countries like New York, Seoul, and China do not explicitly prioritize smart principles in their TOD guidelines, they have already integrated advanced technologies such as IoT and ICT. These technologies are considered essential, making further emphasis on them in TOD planning processes less critical. Instead, these countries focus on creating resilient, well-connected urban areas that bring together people, activities, buildings, and public spaces with excellent transit service.

Resilience is a significant aspect of TOD, with different countries emphasizing various forms of resilience. For instance, Japan and China focus on environmental resilience by incorporating green infrastructure, while Florida emphasizes economic resilience. New York, Seoul, and Jakarta highlight community resilience by engaging local communities and building social cohesion. Additionally, policy resilience is emphasized in Seoul and Jakarta through robust land use policies and planning frameworks.

Sustainability and environmental benefits are aligned with Malaysia's TOD principles, such as promoting green and low-carbon practices. Countries like Japan, India, and Jakarta focus on sustainable practices like energy efficiency and reduced car dependency to lower greenhouse gas emissions. While Malaysia shares these goals, it faces challenges like car dependency and traffic congestion, necessitating clearer policies to support green buildings and advanced technology integration.

Finally, resource optimization is a common focus in TOD practices across countries. This includes land development, energy efficiency, and sustainable infrastructure. While Malaysia shares these priorities, the country could improve by optimizing land use around transit stations and enhancing connectivity through better pedestrian and cyclist access. Additionally, clearer policies supporting green buildings and smart technology integration could enhance Malaysia's TOD effectiveness and sustainability. Engaging with the community and incorporating cultural elements into TOD projects could also enrich the urban landscape and ensure that developments align with local needs.

4 Conclusion

In conclusion, this review paper provides a detailed analysis of Transit Oriented Development (TOD) practices across various countries, including Seoul, Jakarta, India, New York, Florida, China, and Japan. It highlights the diverse strategies employed to promote sustainable urban development through TOD projects. Key principles such as high-density development, energy efficiency, waste recycling, and connectivity are emphasized, showcasing different approaches to fostering sustainable communities. The review underscores the importance of economic benefits, resource optimization, waste reduction, and sustainable transportation options in TOD implementation. This study highlights the significance of inclusive principles, cultural sensitivity, diverse housing options, and technological advancements in enhancing TOD projects. The analysis offers valuable lessons for policymakers, urban planners, and researchers to enhance TOD practices, create more efficient, inclusive, and environmentally friendly urban spaces, and contribute to the development of more liveable and sustainable urban environments. Lastly, this study provides detailed analysis of

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