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Exploring a Transit-Oriented Development (TOD) Framework for Penang's Urban Growth

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EXECUTIVE SUMMARY

- This paper explores the applicability of a transit-oriented development (TOD) framework for Penang in view of the upcoming implementation of the Penang Transport Master Plan (PTMP).
- Examples of TOD implemented in Copenhagen, Singapore, and Hong Kong are examined for lessons that can be applied in PTMP.
- Malaysia's fiscal federalism and economic policies are two broad factors hindering public transport improvement in Penang. TOD can be a solution to this, and offers a way to circumvent them.
- For PTMP to succeed, the project cannot be conceived as merely a mobility issue but as an urban development undertaking within a TOD framework.

Introduction: Transit-Oriented Development Concepts

This paper explores the applicability of transit-oriented development (TOD) framework for Penang. The first part examines TOD concepts and how they are being practiced in Copenhagen, Singapore, and Hong Kong. Following that, is a brief overview of Penang's transit and traffic conditions and how TOD can be broadly applied to the Penang Transport Master Plan (PTMP).

TOD is an urban planning framework that builds an area *by optimising and being optimised by mass public transport system*. This is the opposite of automobile-oriented framework where cities are designed for mass usage of private vehicles.

TOD has its origin back in the late 19th century when towns were developed along the route of horse-drawn streetcars followed by electric tram and underground railway (Carlton 2007, Knowles et al 2020). The concepts were later practised in cities like Copenhagen after the Second World War, and in Singapore and Hong Kong in the 1960s and 1970s until now. It was in 1993, American architect Peter Calthorpe popularised TOD as developments that are "located directly on the trunk line transit network: at light rail, heavy rail, or express bus stops. They should be developed with high commercial intensities, job clusters, and moderate to high residential densities" (1993). Geographers and planners have listed seven key characteristics of TOD (Knowles et al 2020):

1. Walkable distance to transit stations and stops.
2. Walkable accessibility around the developed area.
3. Managing demand for road transport (private car and motorcycle).
4. Highly reliable and convenient transit services.
5. Mixed land-use (residential, recreational, commercial, industrial, and institutional).
5. Dense urban grids and pedestrian friendly.
7. High density of residential units, population, jobs and activity sites.

As seen in this list, TOD is the integration of land usage and public transport to ensure high mobility and optimal utilisation of space. Thus, it is also known as "LUTI" – land usage and transport integration (Hendrigan 2020). TOD creates a 'transit city' of which the mobility demand is served by low-carbon public transport, space wastage and under-utility (used as carpark and wide road), and traffic congestion. In other words, TOD is "the coupling of public transport investments and urban development [which] yields the most efficient and sustainable type of cityscape" (Cervero 2017).

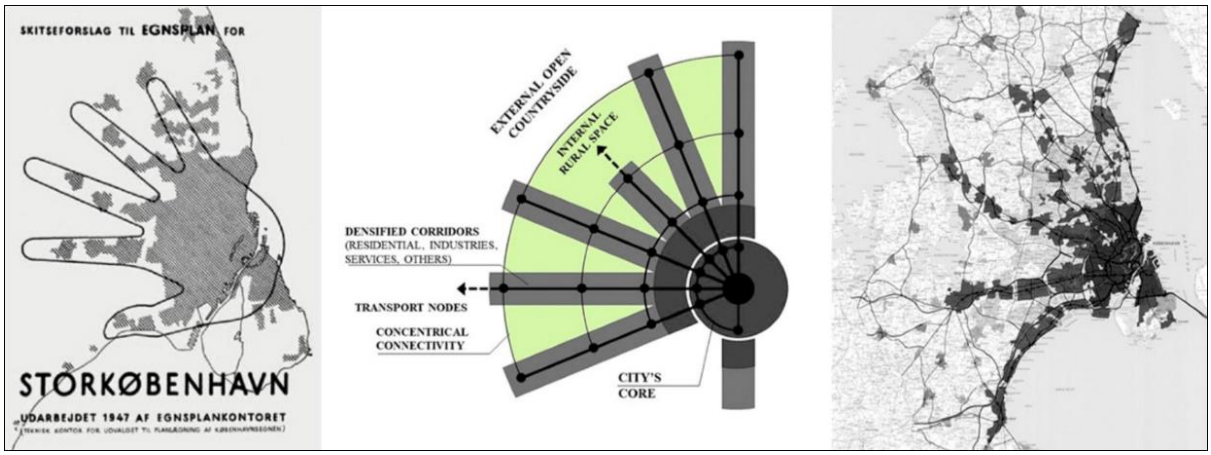
Besides environmental and social benefits, TOD enables the financing of transit infrastructure. As Penang plans to implement the Penang Transport Master Plan (PTMP), staggered over several decades, it is high time to consider using TOD as a financing mechanism for the long-term project. TOD framework is broad enough to be conceptually adapted in contexts that are as diverse as Copenhagen, Singapore, and Hong Kong.

Copenhagen's TOD

After the Second World War, the Danish Town Planning Institute proposed a development plan that connected Copenhagen's central business district (CBD) to five rail transit corridors. As the shape of the five corridors looked like a hand with five fingers, the plan was called the 'Finger Plan'.

High-density residential area and commercial space were built around rail stations along each transit corridor. The end of each corridor was to be linked with a ring road. The Finger Plan drew development inland, away from the coastal area. Two subsequent regional plans drawn in 1973 and 1989 built on the Finger Plan. Industrial and commercial development were designed and constructed within 1 km distance from rail stations (Knowles 2012, pp.252-254).

Figure 1: Copenhagen's Finger Plan concept



Source: Silva 2019.

Figure 2: Rail transit lines in Copenhagen today are broadly based on the Finger Plan

Source: Google Map.

From the 1990s onward, the focus of TOD development had shifted to Ørestad on the Amager island, southeast of Copenhagen city core. The site was reclaimed from the sea in the 1940s (Knowles 2012). The development at Ørestad, along with the construction of a fixed link to Malmö, Sweden, was necessary to save the city from the brink of bankruptcy in the early 1990s (Majoor 2008). Copenhagen's 1995 master plan was launched to build Ørestad as a sustainable development with elevated Light Rail Transit (LRT) as the backbone of public transport.

The choice for an elevated LRT system was deliberate for two reasons, that is to ensure least disruption from on-ground traffic that affects commuting time, and to present the transport system as an iconic landscape (Knowles 2012). Ørestad's parking strategy is based on space sharing concept. Residents occupy the parking space at night while employees who drive into Ørestad use them during daytime (By & Havn 2010).

The city was planned to encourage the usage of public transportation and active mobility instead of private car. In 2011, the modal split in Ørestad was 7% bicycle, 33% car, and 60% public transport (Knowles 2012).

Ørestad's TOD was designed with the intention to finance the rail transit system by land value capture and property sales. However, construction delay and cost overrun had increased the project's expenses. The global financial crisis of 2007 and external competition had led to deviations from the master plan. High-end urban architecture had to give way to less-ideal projects. Development of large office spaces such as Ørestad Downtown was cancelled (Knowles 2012, Grabar 2012, Majoor 2014 & 2015). Nonetheless, the developer did not reduce land prices for the sake of increasing land sales. The decision has proven wise as the market eventually recovered and development demand returned from 2014 onward (Katz & Noring 2017).

A profit-sharing method was implemented to fund the transit system. In all sales agreements, the property buyer is required to pay an extra $11.41 per square meter for office space and $5.71 per square meter for residential unit every year for sixty years, after a metro station is built within fifty meters from the property (Katz & Nowak 2018, Noring 2019). The collected fund is used to cover the expenses of the transit system. Ørestad has also emerged as a favoured location for education where higher-learning services had grown beyond expectation (Shahid 2018).

Figure 3: Transit-oriented development based on elevated LRT at Ørestad, Denmark, from 2001 to 2010

Source: By & Havn 2010.

Singapore's TOD

Singapore's first urban development plan is the 1971 'Ring Plan' that integrates land-use and transit infrastructure in a ring pattern (Khoo & Guo 2017, Singh 2017). The proposal was designed to meet projected population increase, transportation demand, and economic growth up to 1992.

Although the decision to build the mass rapid transit (MRT) was only confirmed ten years later, the plan had already laid out rail corridors from north to south and east to west (Singh 2017). Due to the MRT's hefty cost, Singapore was considering between the planned MRT or a road-based all-bus system as recommended by a team led by Harvard's professor Kenneth Hansen.

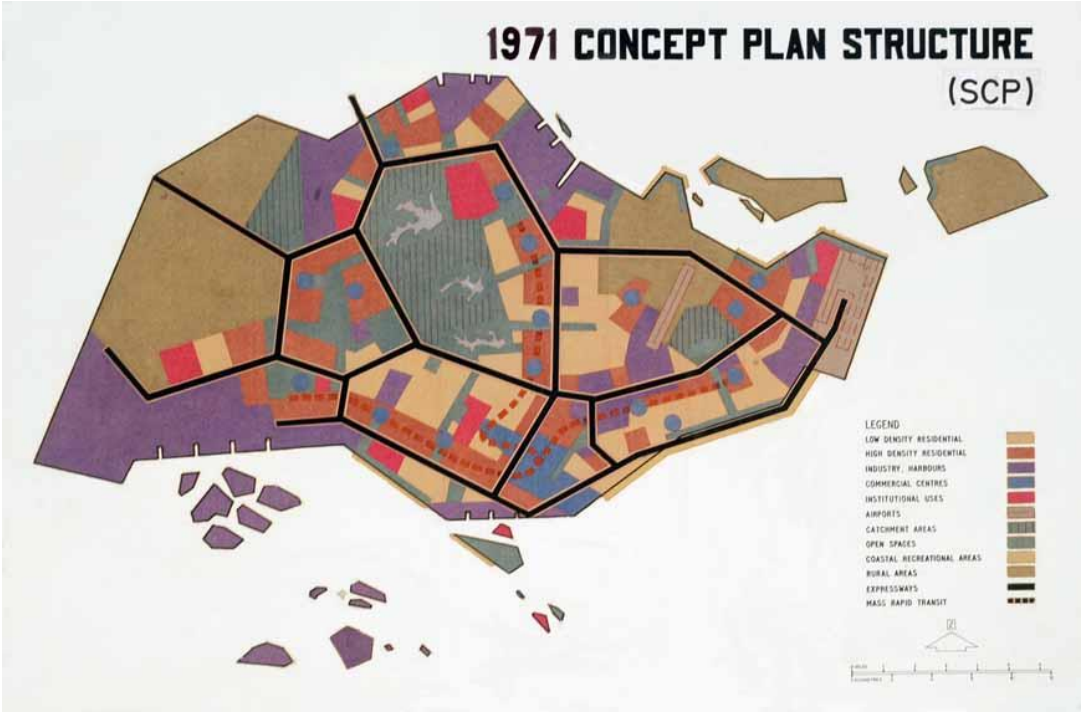
Simulations of the proposed all-bus system were made and "each scenario failed to attain a standard of service that would be attractive to commuters, leading to the conclusion that strictly road-based options would not only fail to ease traffic congestion, but might even worsen it" (Centre for Liveable Cities 2018). The all-bus system's capabilities were found to have been exaggerated while its limitations were ignored (Sun 2012).

Furthermore, the MRT was required as part of Marina South's development, which in turn was expected to generate funds for the construction of the transit system. In the words of the transport minister at that time, "If you have MRT going to Marina South, then that open space can be developed. And all that you need is to sell only part of that developable land to pay for all your MRT costs" (Centre for Liveable Cities 2018). Based on this, the planned MRT system was picked and permission to construct was given in May 1982.

In order to pay for the SG$5.3 billion MRT, careful spatial planning based on transit routes was carried out. The land value capture exercise did indeed raise land value and generated funds from land sales to finance the MRT. The total revenue from land sales during the MRT development period from 1982 to 1987 exceeded SG$12 billion (Centre of Liveable Cities 2014).

The initial MRT network aimed to serve 40% and 30% of the business and residential areas respectively (Singh 2017). Identified land along the MRT alignment was safeguarded from other development. Proposed development plans from the Urban Redevelopment Authority required review from Public Works Department to ensure they did not encroach into or affect the safeguarded corridors. The Housing Development Board (HDB) followed the Ring Plan by building new townships with mixed development along the MRT routes (Centre for Liveable Cities 2018). Extensive highways network was also conceived and expanded from 800 km in 1960s to 3,000 km in 1990 (Singh 2017).

Figure 4: Singapore's 1971 Concept Plan

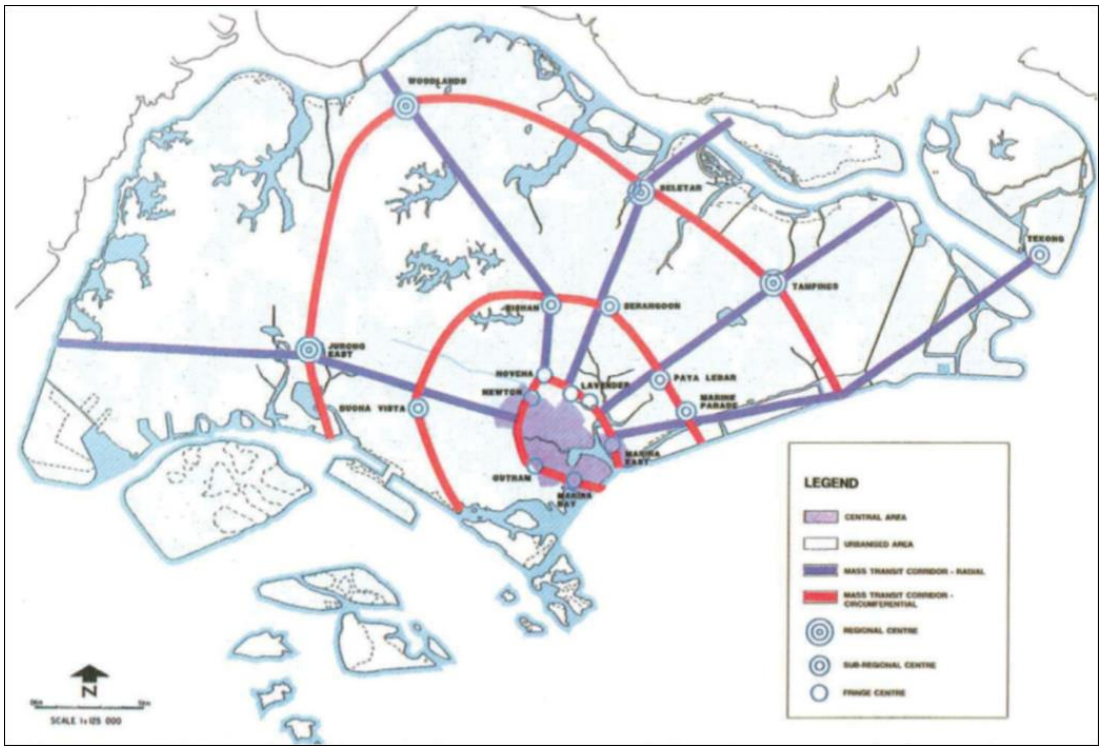


Source: Urban Redevelopment Authority of Singapore.

Following the Ring Plan, Singapore produced a new concept plan in 1991 known as the Constellation Plan. New towns and commercial centres around the CBD and along MRT corridors were designed to form a radial shape of new developments like a constellation to decentralise the increasing population (Centre for Liveable Cities 2018). This has led to the decrease of overall average density from 418 persons per hectare in 1975 to 166 persons per hectare in 2003 (Yang & Lew 2009).

The Constellation Plan continued to be referred in the 1996 White Paper for its emphases on mixed development involving residential, industrial and institutional spaces near public transport facilities (Land Transport Authority of Singapore 1996).

Figure 5: Singapore's 1991 Constellation Plan



Source: Niu et al 2019.

The expansion of the public transport infrastructure was staggered according the 2001 concept plan with projected population growth of 5.5 million between 2041 to 2051. However, the population had increased faster than expected, having reached 5.1 million by 2010, and thus subjected the MRT system under tremendous strain. The MRT suffered severe breakdowns in December 2011 (Centre for Liveable Cities 2018). Official inquiry was conducted and hundreds of millions were spent to renew the old MRT lines (Tan 2015 & 2017).

The population projection was revised in the 2011 concept plan. As the population continues to grow, the transport infrastructure continues to expand. TOD remains a guiding framework in Singapore's "high-density, high liveability" model. Singapore's mobility modal share in 2016 was split between 67% of public transport and 33% private vehicles (Abdullah & Tan 2018).

Figure 6: TOD at Jurong East MRT station, Singapore

Source: Land Transport Authority of Singapore

Hong Kong's TOD

Public transport usage in Hong Kong is the highest in the world, at more than 90%. The backbone of Hong Kong's public transport is the Mass Transit Railway (MTR) which accounts for 37% or 4.7 million daily passenger trips (Transport and Housing Bureau of Hong Kong 2017).

The origin of the MTR goes back to two reports prepared in the late 1960s – the 'Hong Kong Mass Transport Study' (1967) and 'Hong Kong Long Term Road Study' (1968). Those reports recommended a MTR system to be completed in 1985 at the cost of HK$3.4 billion based on the projected transport demand for the next 20 years.

The MTR proposal was criticised by University of Hong Kong's professor Sean Mackey for its expensive price tag (Ho 2018). After several revisions, the 'modified initial system' of the MTR began construction in November 1975 at the cost of HK$5.8 billion, that is 70.5% higher than the first proposal (The Institution of Civil Engineers 1990, Ho 2018). By 1985, with the extension of existing rail line and newly added ones, the total accumulated debts for the then rail infrastructures was HK$18.7 billion (Suzuki et al 2015).

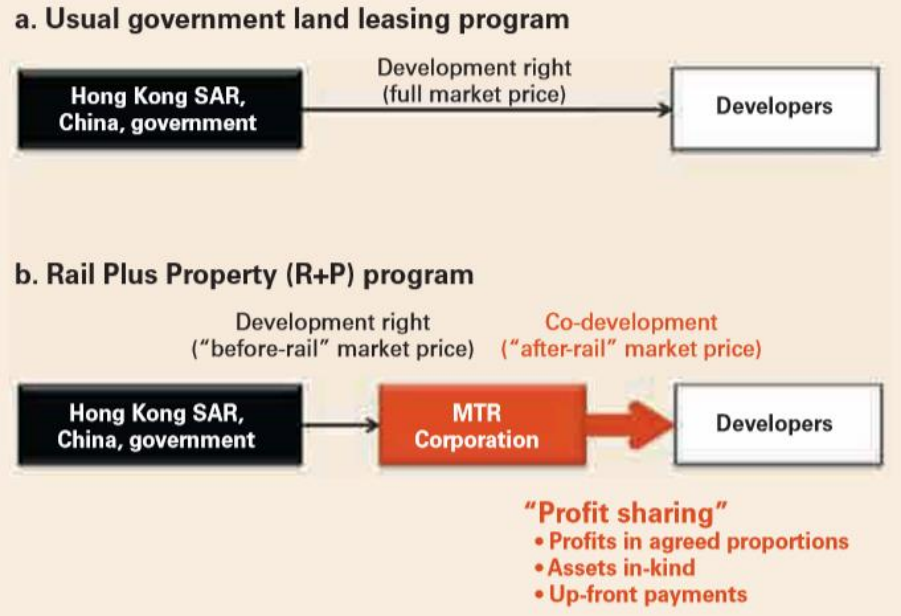
The high construction costs were anticipated and addressed by a business model which came to be known as 'rail plus property' (R+P) development. Under the R+P arrangement, land rights around proposed MTR stations and depots were granted exclusively to the MTR Corporation at a "before rail" market price, that is land value without the railway. MTR Corporation will then partner with qualified bidder to co-develop the land, where the latter is required to pay for the development rights valued at the higher "after rail" price, that is with MTR railway.

The guiding principle is that the difference between the "before rail" price and "after rail" price has to be sufficient to pay for the transit's cost (Suzuki et al 2015). TOD project in Hong Kong is estimated to obtain a premium of at least 30%. The 2016 extension of the Kwun Tong Line has increased residential property value up to 95% (Loo et al 2018).

This differs from other land value capture models where land plots around transit stations are sold to fund the transport system's construction cost. Under the Hong Kong's R+P, the MTR Corporation receives front-end payment for development rights from successful bidder, retains full ownership over the plot of land, and shares in the future profit gained from the developed property (Cervero & Murakami 2009, Suzuki et al 2015, Leong 2016).

In 2019, MTR Corporation owned, developed, and/or managed 47 commercial and residential properties. Not only was MTR able to pay off the HK$18.7 billion construction cost of the initial rail lines, it also recorded a total profit of HK$139.67 billion from 2009 to 2019 (MTR Corporation 2020). In August 2019, MTR Corporation was valued at HK$301.5 billion in market capitalisation (Tai 2019).

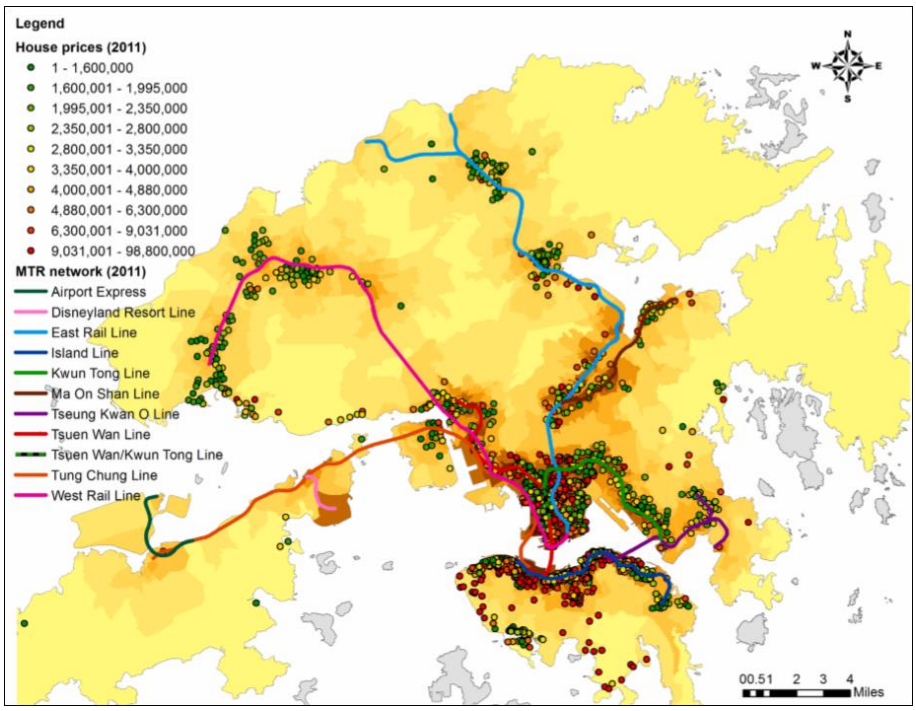
Figure 7: Comparison between usual government land leasing program and R+P



Source: Suzuki et al 2015.

Nonetheless, there was downside to this model. The R+P scheme premised on the maximisation of profit had to prioritise development of lucrative property. This has led to severe housing problems among low-income groups. In March 2020, the average waiting time for the 153,500 applications to rent public housing unit was 5.4 years (Hong Kong Housing Authority 2020). Since 2018, MTR Corporation has been in discussion with the authorities to include development of public housing in TOD. Hong Kong government aims to build 430,000 residential units by 2029, of which 70% will be public housing (Cheng 2020).

Figure 8: Hong Kong's rail transit and house prices in 2011



Source: He 2020.

Hong Kong's TOD has contributed to high usage of the MTR. This has enabled MTR to retain low commuting cost while achieving enviable 'farebox recovery ratio' between 150%-180% (Wong 2015).

MTR has become an essential part of Hong Kong today, recording 5.61 million weekday trips in 2019. Despite the initial academic criticism over the MTR proposal for its cost, the system has proven to be extremely successful that MTR Corporation is contracted to operate and manage rail systems and TOD projects in the United Kingdom, Sweden, Australia, and several cities in China (MTR Corporation 2020).

Penang's Transit and Traffic Conditions

In 2013, Penang's mobility modal split among the 225,000 person-trips taken during peak hours with a population of 1.56 million was between 89% private vehicles and 11% shared transport services. If the population increases to 2.45 million in 2030, and if without traffic mitigation, person-trips will hit 335,000 while the level of modal split will remain the same (Pejabat Setiausaha Kerajaan Negeri Pulau Pinang 2013). To put it simple, congestion will get from bad to worse.

Table 1: Mobility modal split in Penang in 2013

Mode of Transport	Modal Share (%)	Private Vehicles & Shared Services (%)
Car	56	Private vehicles
Motorcycle	33	89
Factory or school buses	8	Shared services
Public transport	3	11

Source: Pejabat Setiausaha Kerajaan Negeri Pulau Pinang 2013.

Even though 85% of Penangites surveyed were willing to pay an average of RM2 per transit rail trip to go to work, there was no comprehensive rail system available (Lee & Cheah 2014). The public transport modes available at that time were Rapid Penang buses, taxi, Rapid Ferry (for cross-channel travel), and intercity coaches. Other modes such as trishaw (only within George Town heritage zone), KTM train (only on mainland), and funicular train (Penang Hills) were not major contributors to peak hours mobility.

In recent years, Penang's public transport had diversified with the emergence of disruptive technology and implementation of new policy. Uber e-hailing service was launched in 2014 in Malaysia before taken over by Grab in 2018. The local council initiated public-private bicycle-sharing service *LinkBike* in 2017. The state government implemented the 'Congestion Alleviation Transport' scheme in 2018, providing free bus services on both mainland and island.

Although these projects have added variety to Penang's transport mode, that does not necessarily reduce modal share of private vehicle usage since 'cannibalisation' among different public transport usage do occur, for example, 57.6% of public bus users in Penang would opt to use e-hailing (Mah 2018).

Furthermore, the registration of private cars in Penang has increased by 31% in five years, from 780,519 in 2008 to 1,024,197 in 2013. Motorcycles have risen by 22%, from 1,033,025 to 1,264,046 (Penang Institute 2015). In 2017, there were 1,130,601 private cars and 1,408,528 motorcycles registered in Penang. (Lee 2017).

The rising number of vehicles on the road has led to the worsening of traffic condition in Penang. The 'level of service' among Penang's major roads and connections are graded 'D' and 'F' by the Ministry of Works, indicating bad and severe condition of traffic congestion.

Table 2: Traffic condition of Penang's major roads and connections in 2015

Highway Segment	Average Daily Traffic (Vehicle/Day)	Peak Hour Traffic (Vehicle/Hour)	Level of Service
Lebuhraya Tun Dr Lim Chong Eu (Jelutong)	100,571	10,986	F
Lebuhraya Tun Dr Lim Chong Eu (Bayan Lepas)	63,543	7,228	D
Jalan Sultan Azlan Shah (Jelutong)	81,583	7,872	F
Jalan Sultan Azlan Shah (Gelugor)	62,207	6,999	B
Jalan Paya Terubong-Ayer Hitam	31,036	2,561	F
Penang Bridge	81,022	8,000	F

Source: Kerajaan Negeri Pulau Pinang 2018.

The estimated economic loss from wasted time due to delays caused by traffic jam in a Malaysian city is RM11 billion a year (World Bank 2015). The social cost in term of the number of traffic accident is likewise worrying, with reported cases increasing from 33,719 in 2009 to 45,734 in 2018, which translates to a 35.6% spike (Ministry of Transport of Malaysia 2019). Besides the economic and social losses, the projected environmental cost from congestion is as high as RM2.68 billion in a year (World Bank 2015).

Factors Hindering Public Transport Improvement in Penang

Reasons for the proliferation of the present transit and traffic conditions in Penang can be broadly grouped into two categories, which are governance and economic policies. In term of governance, the fiscal federalism in Malaysia that limits the states' receipt of tax revenue has rendered the states dependent on the central administration for funding. The federal's shifting from grants to loans has further worsened the states' financial standing (Yeoh 2019). Without strong financial backing, the prospect for states to implement a comprehensive public transport plan on their own is near impossible.

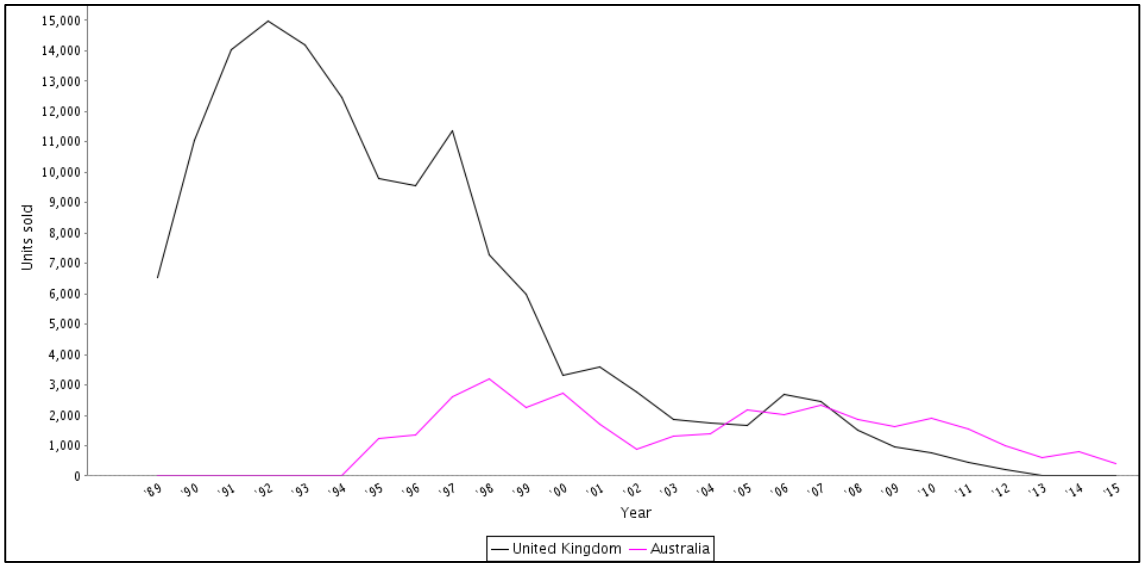
The second factor proliferating the present mobility condition in Penang is the federal economic policies. The federal government's fossil fuel industry (Petronas), import-substitution industrialisation, and trade policies to keep national automakers (Proton, Perodua, and Modenas) afloat have discouraged investment in nationwide public transport infrastructure. Development planning was bias toward subsidised fuel consumption and private vehicles ownership (Terpstra et al 2013).

To be clear, national vehicles initiatives do not necessarily hinder the development of good public transport system. South Korea and Japan have excellent public transport infrastructure despite owning globally renowned automakers. The difference between Malaysia and the two other countries lies in the differing economic policies.

Malaysia adopted an import-substitution approach while South Korea and Japan have pushed for export-oriented industrialisation, aggressively innovating and competing in international market, reducing reliance on domestic demand (Lansbury et al 2007, Doner & Wad 2014). As a result, Proton cars could not compete in foreign market even though they were priced below production cost and far cheaper than in Malaysia (Wad & Govindaraju 2011). This failure meant that local demand has to be engineered through trade protectionism to ensure the survival of local automakers, to which the combined sales of Proton and Perodua at their peak represented 76% of domestic market share (Terpstra et al 2013).

Since early 1990s, national automakers had depended mainly on local demand to survive. Expensive import tariff had benefited Proton in the early years, which made the company thrived largely through domestic demand. Even with the ASEAN Free Trade Area Agreement (AFTA) in place that was supposed to open up Malaysia's automobile market, the government responded by implementing excise duties to provide lifeline to loss-making local automakers (Wad & Govindaraju 2011, Terpstra et al 2013, Doner & Wad 2014).

Figure 9: Annual sales of Proton cars in United Kingdom and Australia, from 1989 to 2015



Source: Commons.wikimedia.org

Strong domestic demand has to be perpetually engineered in order to keep these companies afloat. Excellent public transport infrastructure will deter the local market from this purpose, which explains in part why urban development in the country is often automobile-oriented rather than transit-oriented.

These two factors are beyond Penang state government's control. However, since land affairs are under the state's purview, TOD framework can be applied to improve Penang's land use, generate funds for transit infrastructure, and spur socioeconomic development.

A TOD Framework for Penang

The first phase of the Penang Transport Master Plan (PTMP) is to build a Light Rail Transit (LRT) on the island's east coast, which is the corridor with the highest average daily traffic of 64,144 compared to west coast (22,365) and mainland (52,205) (Ministry of Transport of Malaysia 2019). This paper proposes 10 locations around Penang for TOD – four on island, six on mainland. This proposal takes into account the following three factors:

1) **Geography**: Penang comprises of island and mainland. Transit corridors have to include multiple cross-strait routes to decentralise traffic and development.

2) **Built environment**: Many areas along the proposed transit routes – especially on the island – are already developed (see Figure 10). Residential areas are usually urban sprawl. Implementing TOD at these areas is more complicated and requires longer timeframe for breakeven due to possibly higher re-developmental cost.

3) **Climate**: TOD in Penang has to be suitable to tropical climate. While TOD in other cities like Copenhagen and Amsterdam incorporate mass bicycling, this might not be feasible for Penang. The downpour in Penang is on average 290% more than Amsterdam, and 560% more than Copenhagen during the wettest month. To put it even more starkly, Penang's driest month (January, 70 mm) has more rainfall than Copenhagen's wettest month (September, 58.9 mm). Bicycling in a tropical city like Penang is difficult and extremely dangerous. Even on dedicated cycling lanes, it is hazardous to pedal and balance against strong wind and rain water. Cyclists' accident risk is also high as road visibility is low during heavy downpour.

Table 3: Comparison of rainfall among Amsterdam, Copenhagen, and Penang

	Amsterdam (millimetres)	Copenhagen (millimetres)	Penang (millimetres)
Average rainfall per month	69.8 mm	43.5 mm	205 mm
Rainfall during wettest month	89.6 mm	58.9 mm	390 mm

Source: Weather Atlas website

Ten Potential TOD Spots in Penang

Six of the 10 TOD spots will be on mainland with four on the island. Of the 10 spots, only three will be located at developed areas, which are George Town, Penang Sentral, and Bayan Baru area (Jalan Tun Dr Awang). Although implementing TOD at these areas is more costly and requires longer timeframe for breakeven, their strategic location are suitable as transit hubs.

George Town is not only an administrative, commercial, and tourism site but also the interchange point for rail transit to Air Itam and Tanjong Tokong, with ferry and catamaran services to the mainland and possibly other coastal parts of Penang. Pedestrian infrastructure to improve walkability from transit stations (LRT, water, tram, and feeder bus) to the surrounding area is a necessity. Sheltered walkway from transit stations stretching up to 1 km will be ideal. Jalan Dato Keramat and Jalan Burma will be the two transit routes with concentrated TOD facilities.

When the proposed rail lines and tram line are operational, parts of the heritage core zone can be turned into car-light areas where goods vehicles are only allowed to enter during specific hours. Although e-hailing or taxi services can be allowed, most mobility demand in the area should be served by tram, (electrified) trishaw services, bike-sharing, bicycle, and pedestrian walkway. At least two 'Park & Ride' facilities will be needed at the opposite edges of the area, equipped with bicycle rental and trishaw services.

Figure 10: TOD at George Town

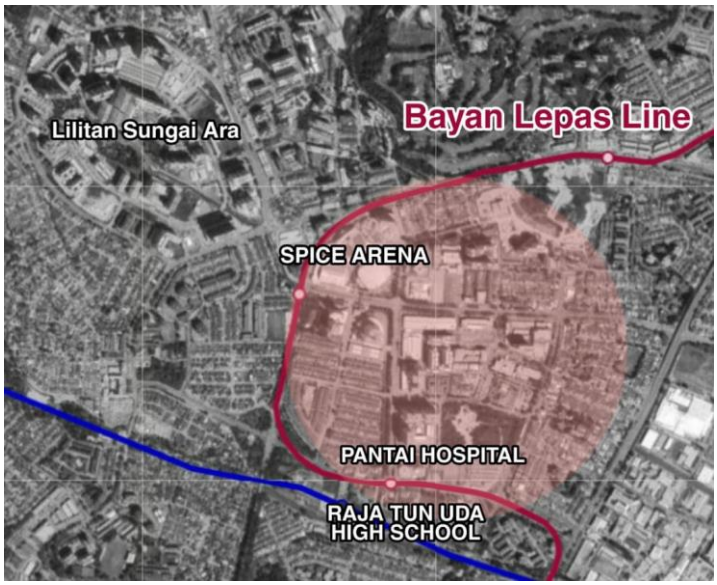
Penang's only TOD project is the Penang Sentral where open space, commercial buildings, and residential units are being built near KTM train station, ferry services, and bus terminal (NST Business 2018). The integrated hub is being developed on a land that measures at 9.2 hectares, modelled after KL Sentral's TOD. The project's estimated cost is about RM230 million, with RM2.9 billion of total gross development value (Kaur 2020). Under PTMP, there is a LRT line connecting Penang Sentral to the island.

Figure 11: TOD at Penang Sentral

Source: Institute of Landscape Architects Malaysia

Bayan Baru has several high-density medium-priced properties at Lilitan Sungai Ara area, located within 1.5 km to the west of the proposed LRT station at SPICE Arena. The present commercial lots, residential units, Pantai Hospital, and Raja Tun Uda High School are within 1 km from the two LRT stations, suitable for further redevelopment as TOD.

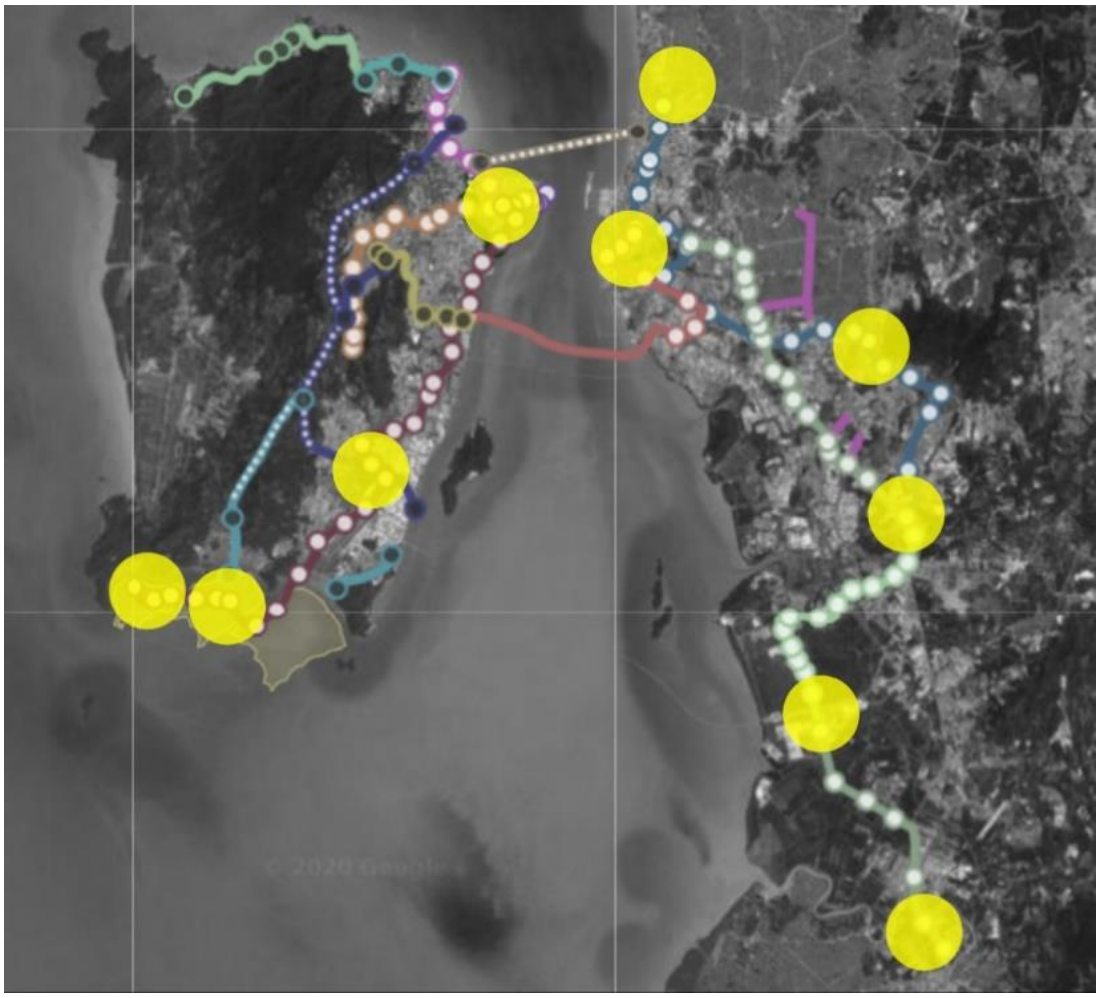
Figure 11: TOD at Bayan Baru



One concern over developing TOD in a matured estate is gentrification, where redevelopment leads to replacement of existing residents by those with higher income. The causal relation between TOD and gentrification has been studied and found inconclusive. Each redevelopment is unique to its own local sociocultural context, residents' interest, and government's policy. A recent review of 40 TOD examples in the United States, Canada, Colombo, Taiwan, India, and England has concluded that "gentrification is more closely associated with existing local dynamics, built environment attributes, and accompanying policies than transit-oriented development" (Padeiro et al 2019). When planned well, TOD will enhance liveability.

The other seven TOD are recommended to be located at semi-developed, undeveloped, and land reclamation areas (see Figure 12). The on-going Master Design Competition for the reclaimed island is expected to choose from five different TOD proposals (The Edge Financial Daily 2020). Near the end of 2019, the state government has also announced the preparation of TOD guidelines for future development on both the island and mainland (Penang Property Talk 2019). As Batu Kawan (Bandar Cassia) is being developed, it is important to not turn the area into another urban sprawl. TOD plan that aims at achieving high density and high liveability should be in place to guide the area's development so that it can fund the mass transit system at Seberang Perai.

Figure 12: 10 Spots TOD framework based on PTMP transit routes



Source of PTMP transit routes: Penang Transport Master Plan website. The 10 spots are added.

Lessons from Copenhagen, Singapore, and Hong Kong

TOD in Copenhagen, Singapore, and Hong Kong uses rail transit as the backbone for their public transport system. Since rail transit is expensive, the cost is often subjected to criticism, as seen in the case of Singapore's MRT and Hong Kong's MTR. However, TOD when planned well, is able to finance the transit infrastructure, as in the case of Copenhagen's profit-sharing mechanism, Singapore's land value capture method, and Hong Kong's R+P. Today, no one can imagine a Singapore without the MRT or Hong Kong without the MTR. TOD in the three cities have proven effective not only in creating a 'transit city', but also to fund transport infrastructure.

In general, land value around rail-based TOD can vary from 20% to 25% for residential and more than 50% for commercial land (Newman et al 2015). Other modes of public transport such as bus rapid transit (BRT) have been observed to have lesser incremental value, partly due to higher investment risks. As reported by the California Department of Transportation, the impermanence of BRT infrastructure "greatly increases the risk of investing in transit-supportive land-use development" (quoted in Knowles et al 2020).

TOD in different settings has its own set of problems and requires different solutions. Copenhagen softened its rigid commitment to high-end urban planning during crunch times, Singapore adjusted concept plan and upgraded rail infrastructures to solve overcrowding, and Hong Kong began to include public housing into TOD projects to meet housing demand. In summary, the five lessons that Penang State Government can take away from the experience of these three cities are:

1) Retain land ownership by leasing out for development.

2) Co-develop land for mix-use (residential, commercial, industrial, recreational).

3) Reserve 20% to 30% of residential development in TOD area for public housing.

4) Continuously upgrade and maintain the transit system.

5) Ensure TOD projects possess the seven key characteristics of TOD.

Despite differences in context, the fundamental principle underlying challenges posed by TOD remains the same, which is to develop an area by optimising, and being optimised by, the mass public transport system. In other words, for a transit system to succeed, it cannot be conceived as merely a mobility issue but as an urban development undertaking.

References

Abdullah, Zhaki & Tan, Christopher. (2018). More opting to travel by public transport: Survey. *The Straits Times*. 1 September. Retrieved from https://www.straitstimes.com/singapore/transport/more-opting-to-travel-by-public-transport-survey

Bertolini, Luca; Curtis Carey; Renne, John L. (2009). Introduction. In Bertolini, Luca; Curtis Carey; Renne, John L. (Eds.), *Transit Oriented Development: Making it Happen*, pp.3-12. Ashgate.

By & Havn. (2010). *Copenhagen Growing: The Story of Ørestad*. CPH City & Port Development. Retrieved from https://docplayer.net/21721859-Copenhagen-growing-the-story-of-orestad.html

Calthorpe, Peter. (1993). *The Next American Metropolis: Ecology, Community, and the American Dream*. Princeton Architectural Press.

Carlton, Ian. (2007). *Histories of Transit-Oriented Development: Perspectives on the Development of the TOD Concept: Real Estate and Transit, Urban and Social Movements, Concept Protagonist*. Institute of Urban and Regional Development. Retrieved from https://escholarship.org/uc/item/7wm9t8r6

Centre for Liveable Cities. (2014). *Financing A City: Developing Foundations for Sustainable Growth*. CLC Publications. Retrieved from https://www.clc.gov.sg/research-publications/publications/urban-systems-studies/view/financing-a-city-developing-foundations-for-sustainable-growth

Centre for Liveable Cities. (2018). *Integrating Land Use & Mobility: Supporting Sustainable Growth*. CLC Publications. Retrieved from https://www.clc.gov.sg/research-publications/publications/urban-systems-studies/view/integrating-land-use-mobility

Cervero, Robert & Murakami, Jim. (2009). Rail and Property Development in Hong Kong: Experiences and Extensions. *Urban Studies*, vol.46, issue 10, pp.2019-2043.

Cervero, Robert; Guerra, Erick; Stefan, Al. (2017). *Beyond Mobility: Planning Cities for People and Places*. Island Press.

Cheng, Lilian. (2020). Hong Kong government plans to build 9,000 public housing flats on land near Kam Sheung Road MTR station. *South China Morning Post*. 10 March. Retrieved from https://www.scmp.com/news/hong-kong/society/article/3074501/hong-kong-government-plans-build-9000-public-housing-flats

Doner, Richard F. & Wad, Peter. (2014). Financial Crises and Automotive Industry Development in Southeast Asia. *Journal of Contemporary Asia*, vol.44, issue 4, pp.664-687.

Grabar, Henry. (2012). Why Has Scandinavia's Biggest Development Project Abandoned its Master Plan? *City Lab*. 30 August. Retrieved from https://www.citylab.com/design/2012/08/why-has-scandinavias-biggest-development-project-abandoned-its-master-plan/3120/

He, Sylvia Y. (2020). Regional impact of rail network accessibility on residential property price: Modelling spatial heterogeneous capitalisation effects in Hong Kong. *Transportation Research Part A*, vol. 135, pp.244-263.

Hendrigan, Cole. 2020. *A Future of Polycentric Cities: How Urban Life, Land Supply, Smart Technologies and Sustainable Transport Are Reshaping Cities*. Palgrave Macmillan.

Ho, Pui-Yin. (2018). *Making Hong Kong: A History of Its Urban Development*. Edward Elgar Publishing Lid.

Hong Kong Housing Authority. (2020). *Number of Applications and Average Waiting Time for Public Rental Housing*. Revised on 8 May. Retrieved from https://www.housingauthority.gov.hk/en/about-us/publications-and-statistics/prh-applications-average-waiting-time/index.html

Katz, Bruce & Noring, Luise. (2017). The Copenhagen City and Port Development Corporation: A Model for Regenerating Cities. Brookings Institute. Retrieved from https://www.brookings.edu/research/copenhagen-port-development/

Katz, Bruce & Nowak, Jeremy. (2018). How a dying city transformed into one of the wealthiest in the world. *The New Localism*. 12 January. Retrieved from https://www.thenewlocalism.com/research/how-a-dying-city-transformed-into-one-of-the-wealthiest-in-the-world/

Kaur, Sharen. (2020). Phase 2 of Penang Sentral to go full swing next year. *New Straits Times*. 18 February. Retrieved from https://www.nst.com.my/property/2020/02/566630/phase-2-penang-sentral-go-full-swing-next-year

Keegan, Matthew. (2019). How public transport actually turns a profit in Hong Kong. *The Guardian*. 19 March. Retrieved from https://www.theguardian.com/cities/2019/mar/19/how-public-transport-actually-turns-a-profit-in-hong-kong

Kerajaan Negeri Pulau Pinang. (2018). *Environmental Impact Assessment Study for the Proposed Pan Island Link 1 (PIL1) Highway Project, Penang*. Kerajaan Negeri Pulau Pinang.

Khoo, Teng Chye & Guo, Remy. (2017). Making Singapore a Liveable and Sustainable City: Our Urban Systems Approach. In Heng Chye Kiang (Ed.), *50 Years of Urban Planning in Singapore*, pp.81-100. World Scientific Publishing Co. Pte. Ltd.

Kidokoro, Tetsuo. (2019). *Transit-Oriented Development Policies and Station Area Development in Asian Cities*. Asian Development Bank. Retrieved from https://www.adb.org/publications/transit-oriented-development-policies-asian-cities

Knowles, Richard D.; Ferbrache, Fiona; Nikitas, Alexandros. (2020). Transport's historical, contemporary and future role in shaping urban development: Re-evaluating transit oriented development. *Cities*, vol.99, pp.1-11.

Knowles, Richard D. (2012). Transit Oriented Development in Copenhagen, Denmark: from the Finger Plan to Ørestad. *Journal of Transport Geography*, vol. 22, pp.251-261.

Land Transport Authority of Singapore. (1996). *White Paper: A World Class Land Transport System*. Retrieved from https://eresources.nlb.gov.sg/printheritage/detail/30748689-8215-4197-8d63-17d8bf1aac89.aspx

Lansbury, Russell D.; Chung-Sok Suh; and Seung-Ho Kwon. (2007). *The Global Korean Motor Industry: The Hyundai Motor Company's global strategy*. Routledge.

Lee, Jonathan. (3 October 2017). Vehicle registrations in Malaysia hit 28.2 million units. *Paul Tan*. Retrieved from https://paultan.org/2017/10/03/vehicle-registrations-in-malaysia-hit-28-2-million-units/

Lee, L. Y & Cheah, Y. K. (2014). Willingness-To-Pay for Monorail Services: Case Study in Penang, Malaysia. *Pertanika Journal of Social Sciences & Humanities*, vol.22 (1). Retrieved from http://www.pertanika.upm.edu.my/Pertanika%20PAPERS/JSSH%20Vol.%2022%20(1)%20Mar.%202014/11%20Page%20165-180%20(JSSH%200592-2012).pdf

Leong, Lincoln. (2016). The 'Rail plus Property' model: Hong Kong's successful self-financing formula. *McKinsey & Company*. 2 June. Retrieved from https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/the-rail-plus-property-model

Loo, Becky, P.Y.; Bryson, John R.; Meng Song; Harris, Catherine. (2018). Risking multi-billion decisions on underground railways: Land value capture, differential rent and financialization in London and Hong Kong. *Tunnelling and Underground Space Technology*, vol. 81, pp.403-412. Retrieved from https://www.sciencedirect.com/science/article/pii/S0886779818300944#b0245

Mah, Ernest Herh Sun. (2018). Are We Happy with Our Buses or Are We Not? *Penang Monthly*. October. Retrieved from https://penangmonthly.com/article.aspx?pageid=15279&name=are_we_happy_with_our_buses_or_are_we_not?

Majoor, Stan. (2008). Progressive planning ideals in a neo-liberal context: The case of Ørestad Copenhagen. *International Planning Studies,* vol.13, issue 2, pp.101–17.

Majoor, Stan. (2014). Ørestad: Copenhagen's radical new town project in transition. *Planning Theory & Practice*, vol.15, issue 3, pp.432-438.

Majoor, Stan. (2015). Urban Megaprojects in Crisis? Ørestad Copenhagen Revisited. *European Planning Studies*, vol. 23, issue 12, pp.2497-2515.

Malaysian Resources Corporation Berhad. (2018). *Media Release: Penang Sentral Opens To Public*. 15 November. Retrieved from https://www.mrcb.com.my/wp-content/uploads/2020/03/MRCB-Media-Release_Penang-Sentral-Soft-Opening-2018-Final-15-Nov-2018.pdf

Ministry of Transport of Malaysia. (2019). *Transport Statistics Malaysia*. Retrieved from http://www.mot.gov.my/en/resources/yearly-statistic

MTR Corporation. (2020). *Annual Report 2019*. MTR Corporation Ltd. Retrieved from https://www.mtr.com.hk/en/corporate/investor/2019frpt.html

Newman, Peter; Matan, Anne; McIntosh, James. (2015). Urban Transport and Sustainable Development. In Michael Redclift and Delyse Springett (Eds.), *Routledge International Handbook of Sustainable Development* (pp.337-350). Routledge.

Niu, Shaofei; Hu, Ang; Shen, Zhongwei; Siu, Stephen Yu Lau & Xiaoyu Gan. (2019). Study on land use characteristics of rail transit TOD sites in new towns—taking Singapore as an example. *Journal of Asian Architecture and Building Engineering*, vol. 18, pp.16-27. Retrieved from https://www.researchgate.net/publication/332784354_Study_on_land_use_characteristics_of_rail_transit_TOD_sites_in_new_towns-taking_Singapore_as_an_example

Noring, Luise. (2019). Public asset corporation: A new vehicle for urban regeneration and infrastructure finance. *Cities*, vol.88, pp.125-135.

NST Business. (2018). Soft opening of MRCB's Penang Sentral on Nov 22. *New Straits Times*. 16 November. Retrieved from https://www.nst.com.my/business/2018/11/431711/soft-opening-mrcbs-penang-sentral-nov-22

Padeiro, Miguel ; Louro, Ana & da Costa, Nuno Marques. (2019). Transit-oriented development and gentrification: A systematic review. *Transport Reviews*, vol.39, issue 6, pp.733-754. Retrieved from https://www.tandfonline.com/doi/full/10.1080/01441647.2019.1649316

Pejabat Setiausaha Kerajaan Negeri Pulau Pinang. (2013). *The 'Recommended Transport Master Plan Strategy'*. Penang State Government.

Penang Institute. (2015). *Penang transportation by the numbers*. Retrieved from https://penangmonthly.com/article.aspx?pageid=2446&name=penang_transportation_by_the_numbers

Penang Property Talk. (2019). First draft of Transit Oriented Development (TOD) guidelines to be ready by Q1 2020. *Penang Property Talk*. 21 November. Retrieved from https://www.penangpropertytalk.com/2019/11/first-draft-of-transit-oriented-development-tod-guidelines-to-be-ready-by-q1-2020/

Pulido, Daniel; Darido, Georges; Munoz-Raskin, Ramon; Moody, Joanna. (2018). *The Urban Rail Development Handbook*. World Bank Group.

Shahid, Sundas. (2018). Ørestad: What does the future hold? *Inside Scandinavian Business*. 26 April. Retrieved from https://www.insidescandinavianbusiness.com/article.php?id=104

Silva, Cristian. (2019). Auckland's Urban Sprawl, Policy Ambiguities and the Peri-Urbanisation to Pukekohe. *Urban Science*, vol.3, issue 1. Retrieved from https://www.mdpi.com/2413-8851/3/1/1/xml

Singh, Mohinder. (2017). Transportation: Mobility, Accessibility, and Connectivity. In Heng Chye Kiang (Ed.), *50 Years of Urban Planning in Singapore*. World Scientific Publishing, pp.127-151.

Sun, Sheng Han. (2012). Reshaping land transport in Singapore: a policy perspective. In Helena Bender (Ed.), *Reshaping Environments: An interdisciplinary approach to sustainability in a complex world*, pp.45-64. Cambridge University Press.

Suzuki, Hiroaki; Murakami, Jin; Tamayose, Beth Chiyo; Hong, Yuhung. (2015). *Financing transit-oriented development with land values: Adapting land value capture in developing countries*. World Bank Group. Retrieved from http://documents.worldbank.org/curated/en/468551468165570019/Financing-transit-oriented-development-with-land-values-adapting-land-value-capture-in-developing-countries

Tai, Ian. (2019). Is It The Right Time To Invest In MTR Corporation Ltd? *Value Invest Asia*. 16 August. Retrieved from https://valueinvestasia.com/is-it-the-right-time-to-invest-in-mtr-corporation-ltd/

Tan, Christopher. (2015). Analysing train breakdowns, line by line. *The Straits Times*. 26 March. Retrieved from https://www.straitstimes.com/opinion/analysing-train-breakdowns-line-by-line

Tan, Christopher. (2017). Lessons from past mistakes can help SMRT stay on track. *The Straits Times*. 5 July. Retrieved from https://www.straitstimes.com/singapore/transport/lessons-from-past-mistakes-can-help-smrt-stay-on-track

Terpstra, Jane Tong; Terpstra, Robert & Lim, Ngat-Chin. (2013). Proton: Its Rise, Fall, and Future Prospects. *Asian Case Research Journal*. Retrieved from https://www.researchgate.net/publication/263907043_Proton_Its_Rise_Fall_and_Future_Prospects

The Institution of Civil Engineers. (1990). *Rail mass transit for developing countries: Proceedings of the conference organized by the Institution of Civil Engineers, and held in London on 9-10 October 1989*. Thomas Telford Ltd.

Transport and Housing Bureau of Hong Kong. (2017). *Public Transport Strategy Study*. Retrieved from https://www.td.gov.hk/filemanager/en/publication/ptss_final_report_eng.pdf

Urban Redevelopment Authority of Singapore. *Past Concept Plans*. Retrieved from https://www.ura.gov.sg/Corporate/Planning/Concept-Plan/Past-Concept-Plans

Wad, Peter, & Govindaraju, V. G. R. C. (2011). Automotive Industry in Malaysia: An Assessment of its Development. *International Journal of Automotive Technology and Management*, vol.11, issue 2, pp.152-171.

Wong, Maggie Hiufu. (2015). Hong Kong's MTR: Taking a ride on the world's most envied metro system. *CNN*. 31 March. Retrieved from http://edition.cnn.com/travel/article/hong-kong-mtr-success-story/index.html

World Bank. (2015). *Malaysia Economic Monitor: Transforming Urban Transport*. Retrieved from http://documents.worldbank.org/curated/en/509991467998814353/Malaysia-economic-monitor-transforming-urban-transport

Yang, Perry Pei-Ju & Lew, Seng How. (2009). An Asian Model of TOD: The Planning Integration in Singapore. In Curtis, Carey; Renne, John L.; Bertolini, Luca (Eds.), *Transit Oriented Development: Making it Happen*. Ashgate, pp.91-106.

Yeoh, Tricia. (2019). *Reviving the Spirit of Federalism: Decentralisation Policy Options for a New Malaysia*. Retrieved from http://www.ideas.org.my/policy-ideas-no-59-reviving-the-spirit-of-federalism-decentralisation-policy-options-for-a-new-malaysia/

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