

NEIGHBOURHOOD DESIGN AND VMT: IS MALAYSIA PLANNING TO ACHIEVE THE SPIRIT OF NEW URBANISM?

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Abstract

Urban population currently represents sixty eight percents of the total population of Malaysia, doubling its value of thirty three percents in 1970. By the year 2020, when Malaysia plans to achieve industrialised-nation status, about two thirds of the population will be in urban areas living in mass-produced housing schemes first constructed in the 1970s. Although travel modes have changed significantly in Malaysia along with the changes in the physical design of these housing areas, very little is known about how the changes influence household vehicle-mile-travelled or VMT. The effects of neighbourhood design on VMT are an important aspect to consider in our effort to reduce greenhouse gas emission. Thus, this paper presents the findings of a study carried out in the City of Johor Bahru, within the designated economic growth area of Iskandar Malaysia, to understand how the change in neighbourhood designs over the decades due to policies and lifestyles influences VMT. Fifty two residential neighbourhoods representing several decades from 1970s to the 2000s were selected and travel diaries of their randomly selected households were recorded. While the results obtained confirm the prevalent theory on the relationship between neighborhood design and VMT, unfortunately for the study area the average VMT has been increasing with the newly-designed neighborhoods. Increasing wealth and mobility apparently has seen increasing demand for neighborhood designs that are not as compact as the traditional ones and not as 'mixed uses' either. While the rest of the world is going for 'new urbanism', Malaysia which embraced its form of 'new urbanism' called 'mixed development' since 1970s is doing the opposite. As population of Johor Bahru is rapidly growing due to its location in the economic growth area of Iskandar Malaysia, serious rethinking of the current development policies is in order.

Keywords: Vehicle Miles Travelled (VMT), Sustainable Neighborhood, Neighbourhood Design

1. Introduction

Urban population currently represents sixty eight percents of the total population of Malaysia, doubling its value of thirty three percents in 1970. By the year 2020, when Malaysia plans to achieve industrialized-nation status, about two thirds of the population will be in urban areas living in mass-produced housing schemes first constructed in the 1970s. Over the decades, due to the economic and population growth as well as rapid urban development has been resulting in a tremendous increase of private vehicle ownership in Malaysia. Inadequate public transport availability and services worsen the situation. According to Malaysian Road and Transport Department (2011), the total numbers of privately-owned vehicles (POV) in Malaysia have reached 19,144,262 units. Among the units in 2011, Johor State with a population of 3.5 millions holds the second largest POV rate among the states in Malaysia with a total of 2,649,657 units. This POV rate is set to further increase as the population of

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Johor is estimated to increase to 5 millions in 2025, with the biggest share of the increment will take place in the Iskandar Malaysia region.

Higher POV will increase the total number of travel trips which lead to higher vehicle-mile-travelled (VMT), thus resulting in traffic congestion and increased air pollution. Transportation, together with electricity and heat generation; manufacturing and construction; and residential have been identified as four main sectors that contributed to the greenhouse gas emission in Malaysia. However, research on VMT in Malaysia was barely heard off. Back in 2003 and 2007, it was used once as an indicator to measure road safety performance and as an indicator for international traffic safety comparison purposes. The parameter provides additional information about crash risk in terms of exposure for certain groups of road users. For instance, drivers who travel long distances are more at risk to be involved in an accident than those who make shorter trips (MIROS, 2011).

Therefore, it is the main objective of this study to investigate how changing designs of neighbourhoods in Iskandar Malaysia over the decades have influenced household VMT. The changing designs are described in terms of quantifiable characteristics including neighbourhood size, location of commercial zone, density, land use diversity, etc. The effects of neighbourhood design on VMT are an important aspect to consider in our effort to reduce greenhouse gas emission.

2. Residential development in Johor Bahru

After the 1997 monetary crisis, together with announcement of several physical and national plans, urbanisation of Malaysian cities intensified which saw a surge in the number of new housing projects or neighbourhoods that sprawled into rural area. Urban sprawling hit many cities in Malaysia, including Johor Bahru (Majid, 2011). Historically, residential development has been constantly happening in Johor Bahru since the 1980s (Table 1). Housing areas or neighbourhoods of many sizes were being developed each year with each new one was moving away from the city centre, encroaching into the rural area. This rapid urbanisation resulted in higher dependency on automobile as the preferred mode of travelling. Most of these developments are offered as mixed-used development where a diversity of land uses present ranging from residential to commercial and also industrial facilities in some cases. This is especially so for big development but some small ones offer only residential units, relying on the neighbouring developments for other facilities. Recent trend however has seen more and more exclusively-zoned developments offering only residential and recreational land uses which are not entirely a good idea if the city is trying to reduce household VMT.

Table 1. Development of Neighbourhoods in Johor Bahru over the years.

Year	No. of Neighbourhoods	Individual Size (acres)
Pre 1980s	7	From 35 to 251 acres
1980s	99	From 4 to 2000 acres
1990s	96	From 4 to 4800 acres
2000s	100	From 3 to 3200 acres

3. Neighbourhood Designs and Household VMT

Considerable amount of research has been carried out at varying depth trying to understand how built environment influences travel behaviour. Travel research by Cervero and

Kockelman (1997) has identified “three Ds” that influence travel demand and behaviour. They are density, diversity and design. Meanwhile, Ewing & Cervero (2001) and Ewing et al. (2009), next identified another “two Ds” which are destination accessibility and distance to transit.

Density refers to the variables of interest per unit area. The area can be gross or net, and the variable of interest can be population, dwelling units, employment, building floor area, etc. Ewing (1997) concludes that “doubling urban densities results in a 25-30% reduction in VMT or a slightly smaller reduction when the effects of other variables are controlled”. By other means, doubling urban density refer to compact neighbourhood. Compact neighbourhoods can degenerate vehicle trips and encourage non-motorized travel in several ways (Cervero & Kockelman, 1997). Furthermore, Cervero and Kockelman mention that by bringing origins and destinations closer together, the opportunity for resident to leave their car at home and walking or cycling to a destination will increase. In addition, compact neighbourhoods tend to have less parking, better quality transit services, wider mixes of land uses, and larger shares of low-income households, all factors that reduce car usage. In Johor, high density development can reach maximum of 60 units per acre (for apartments). However, high demand on landed houses, which particularly comprise of 8 to 40 units per acres, makes compact development not a development choice.

A simulation study by Kulash et al., (1990) and McNally and Ryan (1993) found that a connected or grid street design reduces VMT as well as slower average travel speeds. These support Calthorpe (1993)’s conclusions about the transportation benefits of neotraditional design, which connected street patterns reduces the distance of trip (with assumption trip frequencies are fixed). Research by Cervero and Kockelman (1997), found that neighbourhood with good design especially street pattern design and diversity will encourage people to commute by non-motorized modes. Their research result suggest “ a neighbourhood with all rectangular or square blocks could be expected to average nine more daily personal VMT per household than one with no quadrilateral blocks”. This is because rectangular or quadrilateral blocks (grid-like street pattern) will encourage walking since the interconnectivity between destination is higher. From the research, number of intersection (more intersection) helps fewer personal VMT per household.

Higher density is expected to reduce the need to travel long distances, thus lower the VMT. However, argument against this hypothesis by some scholar had made the literature on this hypothesis became ambiguous. Steiner (1994), in her review of literature on the link between residential density and travel distances conclude that resident of high density areas will travel shorter compared to resident of lower density areas. Differ with Steiner, Levinson and Kumar (1997), on the basis of their study across cities in the US with more than 1 million inhabitants, state the opposite. In their paper, they suggest that metropolitan residential density is principally a surrogate for city size. Large settlements offer more services and facilities, which could reduce travel distances and favour the use of slower transport modes and public transport. On the other hand, the dispersion of urban land use over a large area may lead to longer distances, which lead residents to use their cars. In addition, research conducted by Banister (1997) showed that average trip distances were shorter in larger settlement than in smaller settlement. This is because, inadequate or few public transport facilities require the resident to use their own car to get to the services and facilities that were also not provided in a smaller settlement. In Malaysia, neighbourhood size varied according to the land owner who developed the area. Thus, it may also associate with the changes of VMT in Iskandar Malaysia.

Using cross sectional data, Handy & Clifton (2001) and Bagley & Mokhtarian (2002) observed association between travel behaviour and neighbourhood characteristic are largely explained by the self selection of residents with certain attitudes into certain kinds of neighbourhoods. Residents will basically have their own preferences in choosing a neighbourhood. Those who are exposed with environmental friendly and low carbon programme may end up choosing a neighbourhood that promotes sustainable development (i.e. neighbourhood that provides special track for walking and cycling). Dieleman et al. (2002) who examined the issue with use of the Netherlands National Travel Survey, confirmed that both personal attributes and the characteristics of residential environments are determinants of travel mode choice and trip distance. However, home buyer with preferences to live near to their workplace, might not take neighbourhood design factors into consideration in buying a house.

New urbanism and transit-oriented development are some of urban design philosophies that have gained popularity in recent years as ways of shaping travel demand and lower the VMT. These urban design philosophies shared three common transportation objectives, which are to reduce the number of motorized trips, to increase non motorized trip (by foot or bicycle) and to reduce travel distances and increase vehicle occupancy levels (i.e. encourage shorter trips and more travel by transit, and ride-sharing) (Cervero & Kockelman, 1997). The New Urbanism principles synthesize a whole range of spatial patterns that are not only good urban design, but also fit in well with many other important planning goals including growth management, environmental protection and urban revitalization (Ellis, 2002). It promotes the creation and restoration of diverse, walkable, compact, vibrant, mixed-use communities composed of the same components as conventional development, but assembled in a more integrated fashion, in the form of complete communities (<http://www.newurbanism.org/>).

4. Materials and Method

4.1 Study area

The study area comprised of 52 neighbourhoods located within Iskandar Malaysia with irregular spatial shapes and has different land areas between 10 acre (minimum) and 3000 acre (maximum) (Figure 1). The average land area of neighbourhoods is about 1000 acres. Spatial data, including distance and area were obtained from Iskandar Region Development Authority, IRDA.

4.2 Data Collection

To understand the changing of VMT in Iskandar Malaysia, we conducted a survey of resident in fifty two selected neighbourhood located inner and outer from Johor Bahru City Centre. The selection of these neighbourhoods was mainly based on the time-periods during which they were developed (from 1960 till present).

The survey was conducted by means of distribution of travel diary and questionnaire among a school's students, with assumption that these students come from the neighbourhoods that their schools are in. Travel diary is a crucial method in order to obtain respondent vehicle miles travel data (see Cervero & Kockelman, 1997; Ewing & Cervero, 2001; Ewing et al, 2009). In this research, school student was asked to record their father or family vehicle odometer reading for one week. In addition, household data and travel data was obtained

using a questionnaire that was distributed together with the travel diary. The questionnaire consists of two sections, which are Household Demographic Data in section A, while section B gathers the Household Travel Information which includes: work trip, non-work trip, provision of public transportation, neighbourhood self-selection, travel frequency and travel attitude. Different with travel diary, in order to collect fair data, school students were asked to pass the questionnaire to their parent to be filled.

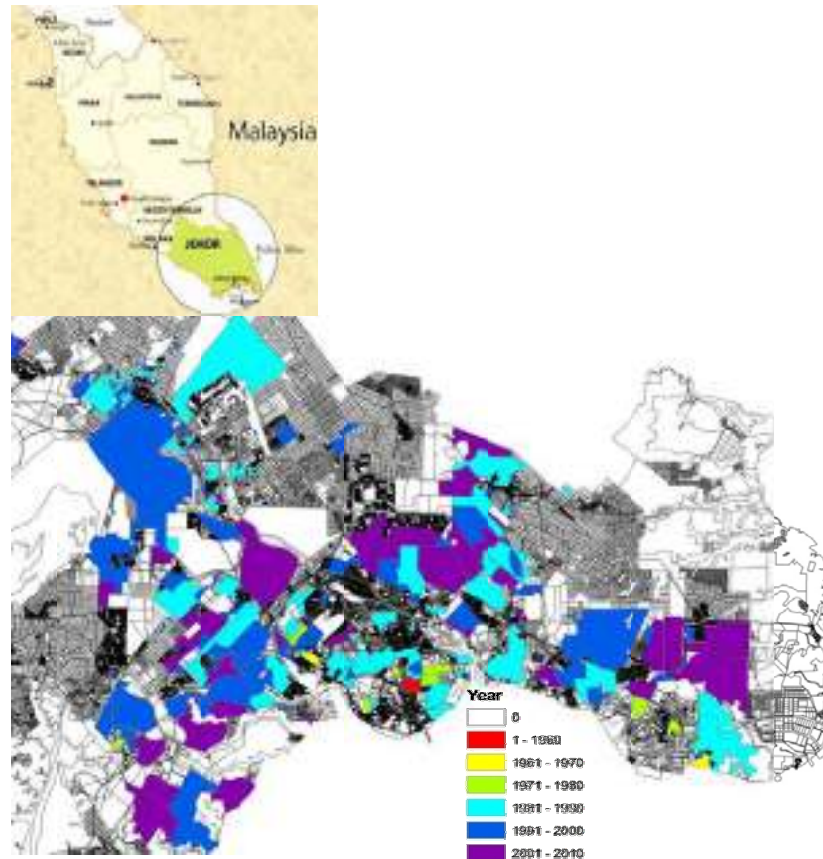


Figure 1. Residential neighbourhoods of Iskandar Malaysia by year of development.

5. Analysis and Discussion

Table 2 displays briefly the demographic characteristic of the respondents. From the survey, 69.44% respondent own at least one car, and 21.69% respondent own two cars. Respondent with more than two cars hold the lowest percent of car ownership with only 3.8%.

Table 2. Descriptive statistic travel data of neighbourhood by years

Building Decade of Neighbourhood	No. of Neighbourhood	Travel Distance (KM)	Household income (RM)	Household member	Car Ownership per house	License ownership per house
		Mean	Mean	Mean	Mean	Mean
Pre1980s	3	48.88	2722.22	4.44	0.8	1.67
1980s	15	66.19	3469.58	5.31	1.21	2.13
1990s	20	66.88	3210.47	5.41	1.18	2.33
2000s	15	57.84	4154.16	5.71	2.37	2.0

The results of the VMT survey indicate that average daily travel per household increases against age of the neighbourhoods (Figure 2). Recently-approved neighbourhoods, i.e. new designs, tend to generate higher VMT compared to old ones. On average, daily travels range from 50 km/day for neighbourhoods built in the 1980s to about 100 km/day for those built in the 2000s.

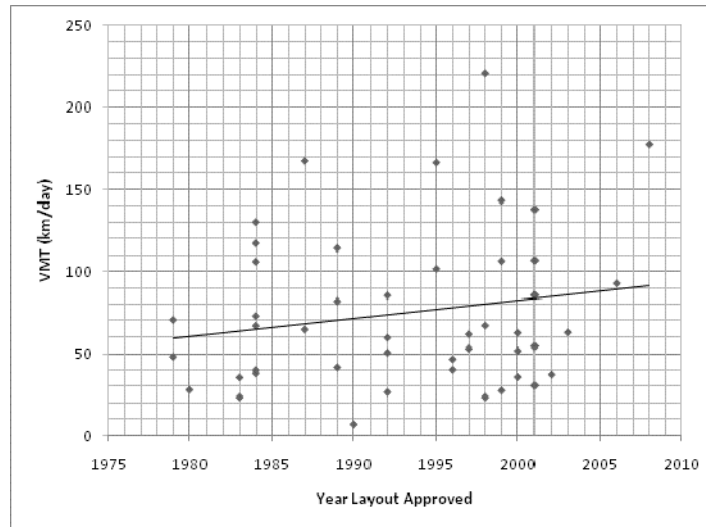


Figure 2: Higher VMT (km/day) are generated in recently approved neighbourhoods.

The values obtained have been controlled against the average household age and also against distance of neighbourhoods from the Central Business District (CBD) where most jobs are located. In this study, the distance of neighbourhoods to the CBD does not influence the total VMT generated by residents in respected neighbourhoods (Figure 3). This finding is opposite to that of Nasri (2012) which reported that neighbourhood distance to CBD is positively linked to VMT. Nasri (2012) concludes that longer distance from the CBD results in longer travel distance to reach various destinations. This, however, is only true if all those destinations are located in the CBD. In our case, only sixteen percents of the respondents work in the CBD. Besides, non-work travels are kept close to the respective neighbourhood and away from the CBD with all the services available nearby such as shopping malls, hypermarkets, linked shops and even offices above these shops. Thus, majority of the people no longer need to travel all the way to Johor Bahru City Centre to do their shopping or for work.

One factor that has been identified to have contributed to the increase of VMTs in those neighbourhoods is the diversity index. A study by Kassim (2012) has highlighted a progressive decrease of land use diversity in neighbourhoods in Iskandar Malaysia, including the neighbourhoods in this study. For plot of diversity index against age of neighbourhood, please refer to Kassim (2012). Figure 4 plots the VMTs obtained from this study against the diversity index from Kassim (2012) study for the neighbourhoods shared by both studies. The plot indicates that VMT increases as neighbourhood land use diversity decreases. Residents

of low land-use diversity neighbourhood will need to travel far in order to get to the facilities or services that are not provided within their neighbourhoods.

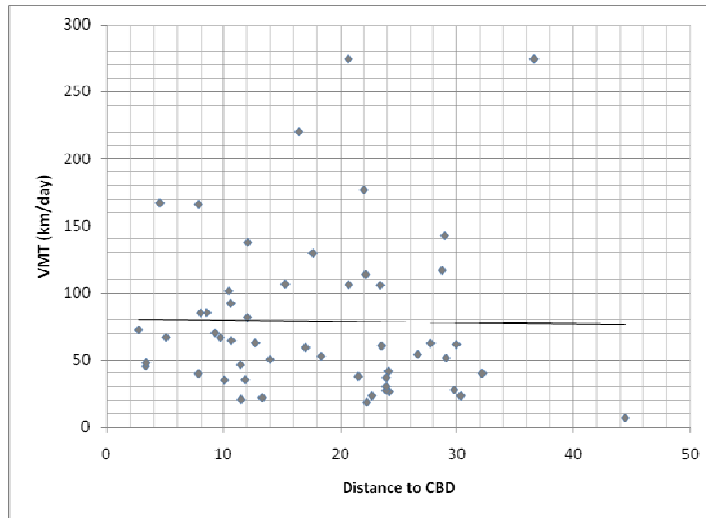


Figure 3: Distance from CBD has no effects on household VMT (km/day) for the study area.

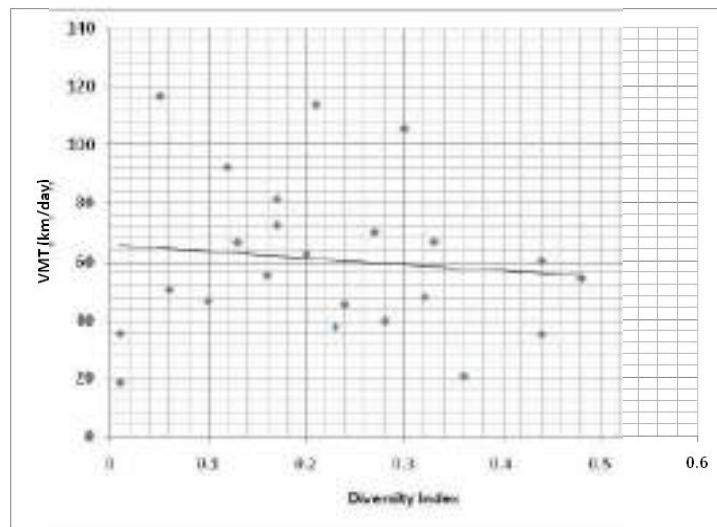


Figure 4: VMT (km/day) increases in neighbourhoods with low land use diversity.

Size of the neighbourhood and the location of the commercial area within a neighbourhood also influence VMT per household. Analysis of travel diary against these two variables indicates that VMT is directly proportional to neighbourhood size but inversely proportional to the centrality of commercial area location (Figures 5 & 6). Centrality of commercial area location is crudely represented by the distance between the centroids of each neighbourhood area and its commercial area.

Currently Malaysia has no restrictions on where the commercial area should be located within a neighbourhood development. There are neighbourhoods with commercial area located at the centre which is alright but there are also commercial areas located at the

entrance or along the side of a neighbourhood development for various other reasons. There are some, due to their larger size, with more than one commercial area that are scattered over the neighbourhood. Locating facilities and services, i.e. commercial area, at the front and at the back of the neighbourhood, far from the residential area, forces residents to travel by car and over a longer distance. This situation is as explained by Levinson and Kumar (1997) that dispersion of urban land uses over a large area may lead to longer distances, which lead residents to use their cars.

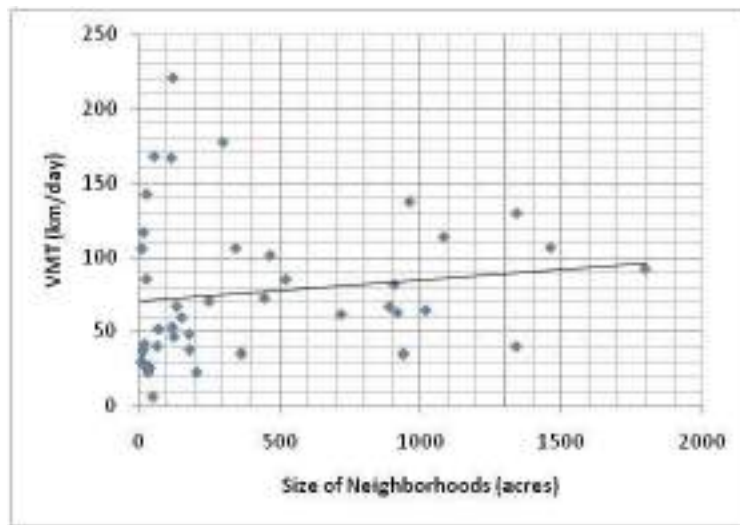
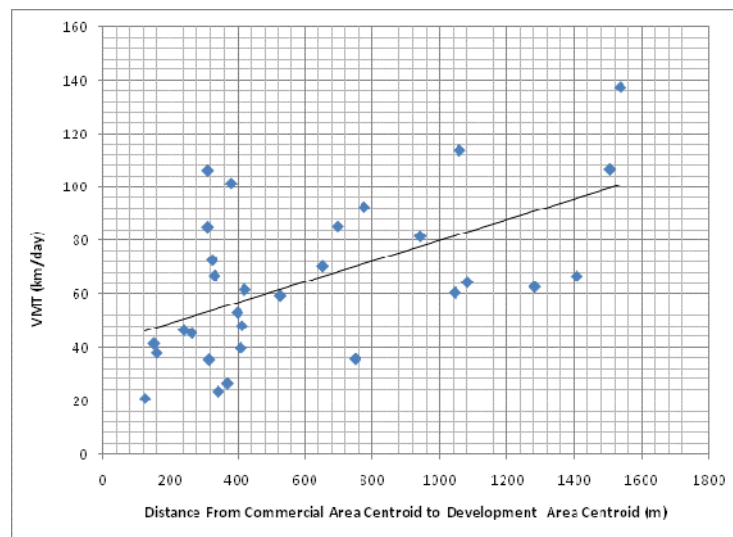


Figure 5. Vehicle Miles Travelled by Neighbourhood Size



neighbourhood. Smaller neighbourhood size will lead to higher neighbourhood density but with lower land use diversity. As a result, the VMT will not decrease even though the neighbourhood density is higher since the residents have to travel far to get to the facilities and services needed.

Finally, the last factor identified to influence VMT is neighbourhood intersection density. Theoretically, higher intersection density lowers VMT in the neighbourhood (Cervero and Kockelman, 1997) and grid-like street pattern encourages walking since the interconnectivity between destinations is higher. The neighbourhoods in Iskandar Malaysia have, over the years, gone through a lot of changes with the street pattern from grid to cul-de-sac, loops as well as curvilinear, thus resulting in lower intersection density and finally lower connectivity index (Rusman, 2012). VMT analysis done in this study shows that VMT increases with the decrease in connectivity index which happens to keep decreasing as more recent neighbourhoods are shying away from the grid pattern into more aesthetic curvilinear pattern or more private cul-de-sac-dominated pattern.

6. Conclusion

The most important finding from the study in terms of effort to minimize greenhouse gas emission is that household VMT in Iskandar Malaysia is on the increase. More recent designs of neighbourhood seem to contribute negatively towards this, i.e. higher household VMT coming out from neighbourhoods developed the last couple of years than decades before.

Among the factors that contribute towards the increase in VMT are changes in lifestyles and preferences in housing that help shape the current neighbourhood designs. Neighbourhoods now are becoming bigger with less density and, unfortunately, less diversity of land uses. Those high density neighbourhoods are normally small ones exclusively zoned for housing, forcing the residents to travel beyond the neighbourhoods for amenities and facilities. Preference for curvilinear design rather than the higher connectivity grid design also increases household VMT.

While many cities are talking about reduction of VMT through better and compact designs, unfortunately for Iskandar Malaysia the average VMT has been increasing with the newly-designed neighborhoods. Increasing wealth and mobility apparently has seen increasing demand for neighborhood designs that are not as compact as the traditional ones and not as 'mixed uses' either. Thus, Malaysia in general and Iskandar Malaysia in particular are taking its mixed development concept, which has been initiated since the late 1970s, further away from the New Urbanism concept while the rest of the world are embracing New Urbanism. This is cause for alarm as Iskandar Malaysia is targeting to increase its population from the current 1.5 million to 3.0 millions in 2025.

7. Acknowledgement

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