

## Traffic Impact Assessment: A Case of Proposed Hypermarket in Skudai Town of Malaysia

Anil Minhans<sup>a\*</sup>, Nazir Huzairy Zaki<sup>b</sup>, Rakesh Belwal<sup>c</sup>

<sup>a</sup>Senior Lecturer, Faculty of Civil Engineering, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia

<sup>b</sup>Postgraduate Student, Faculty of Civil Engineering, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia

<sup>c</sup>Associate Professor, Faculty of Business, Sohar University, Sohar, Sultanate of Oman

\*Corresponding author: anilminhans@utm.my

### Article history

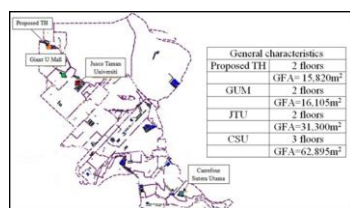
Received :10 May 2013

Received in revised form :

25 September 2013

Accepted :15 October 2013

### Graphical abstract



### Abstract

This paper deals with traffic impact assessment (TIA) of a proposed commercial development in the neighbourhoods of Skudai Town in the Johor Bahru region. We used three regimes: Trip Rate Analysis, Cross-Classification Analysis, and Regression Analysis to assess the future traffic expected to be caused by a development – a proposed Tesco hypermarket (TH) in Skudai. The obtained mean trip rates were critically examined for forecasting traffic. The results indicated no significant variances from the estimated mean entry trip rates as mentioned in the Trip Generation Manual, Highway Planning Unit (HPU) of Malaysia. The estimated mean trip rates were used to measure the performance of a critical intersection in the immediate vicinity the development. The critical Intersection was analyzed using SIDRA software to estimate the delay – a criterion for determining the level-of-service (LOS) provided to motorists. Traffic projections made for horizon year 2025 depicted a LOS ‘F’ with 2716.9s of average delay. Traffic improvements were also proposed to mitigate the impact of future development and traffic conditions. The study provided a framework for the estimation of trip rates for Malaysian conditions along with some guidelines for their adoption. These insights to TIA can assist developers or local authorities in decision making.

**Keywords:** Traffic impact assessment; cross-classification analysis; regression analysis; trip rates

© 2013 Penerbit UTM Press. All rights reserved.

### 1.0 INTRODUCTION

National Transformation Program (NTP) of Malaysia under its 9th Malaysian Plan intends to see Malaysia as a developed nation by the year 2020. This intent is reflected in the rampant urban developments which are currently unfolding in many states. The Skudai Town has attracted a fair share in these developments, given its locational advantage and vicinity to Singapore. The Town also contains an international university, Universiti Teknologi Malaysia, which imparts education to over 20,000 students and employs more than 4,000 academic and technical staff. Thus, as a university town, Skudai is expected to witness a higher rate of growth and developments in all sense, including the traffic and congestion on roads. Without a proper understanding of developmental impacts on the road network, the merit of such developments is defeated by unanticipated traffic congestion, noise and air pollution, high fuel consumption, and even accidents. Furthermore, new developments which intend to serve the economic and social cause can also reduce the accessibility and mobility of travellers by impacting the Level of Service (LOS) of the neighboring road network.

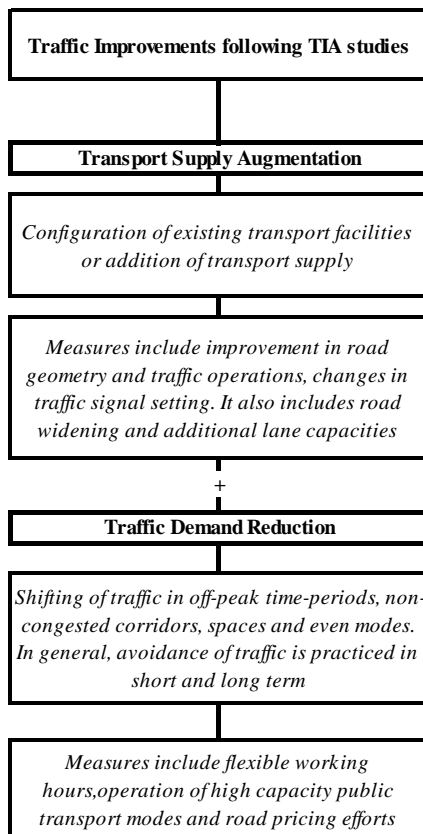
TIA is a process of determining the traffic impact on a road network when a new development takes place and of suggesting improvement alternatives based on the result. Figure 1 show the transport supply augmentation measures and traffic demand reduction measures that may follow TIA studies. This is done by forecasting the amount of traffic for a future year (i.e., the horizon year) based upon the population growth and additional traffic generated by the new development. Traffic engineers usually refer to guidelines of TIA and use trip generation rates from previously established procedures such as manuals developed by the Highway Planning Unit (HPU)<sup>1</sup> in Malaysia or Institute of Transportation Engineers (ITE)<sup>2</sup> in the United States. Sometimes, experience from the past projects is also used in estimating trip rates for the upcoming projects. The trip generation studies done by the HPU are still in their early stages, with limited number of survey sites, especially for less common type of land uses. At the same time, ITE manual does not reflect Malaysian travel pattern. Both the manuals provide trip rates that are insensitive to population density, travel patterns, economic growth, accessibility etc. Thus, these trip rates calculation procedures are prone to biases or errors which can result in either an overestimation or an underestimation. Therefore, these

inherent flaws in the trip rate estimation procedures reflect a potential gap and justify the need for this study.

Hence, local TIA studies in the Skudai Town are important to understand the traffic conditions in the future as well as the accuracy of mean trip rates. Furthermore, the percentage of commercial developments in Skudai Town is rapidly increasing for the past 5 years which has resulted in the rapid growth of traffic volume annually, compare to the years before. So, any trip rate study done here in the past 10 or more years may not be valid now. This study, therefore, can provide valuable information pertaining to traffic issues in Skudai Town and identical urban areas.

The aim of this study is to determine the traffic impact from new commercial development perspective in the neighbourhoods of Skudai Town. To achieve this aim, the following objectives are underlined:

- To estimate the mean trip rates per 100m<sup>2</sup> of gross floor area (GFA) of Hypermarket under commercial land use;
- To test and validate the adoption of mean trip rates per 100 m<sup>2</sup> while comparing three test regimes: Trip Rate Analysis, Cross Classification Analysis, and Regression Analysis;
- To quantify the impact in terms of level-of –service pertaining the development related traffic growth in the commercial area on the neighboring road network, particularly for the horizon year 2025; and
- To propose appropriate transport improvement measures for the existing road network within Skudai.



**Figure 1** Description of traffic improvement methods and measures following TIA studies

## 2.0 PREVIOUS STUDIES

Mean trip rates are determined by doing trip generation analysis. Trip generation is the first and the most important step in the four step process for forecasting the travel demand.<sup>3</sup> The objective of a trip generation model is to forecast the number of trips that begins or ends in each of the zones within a study area.<sup>4</sup> Trip Rate Analysis (TRA), Cross-Classification Analysis (CCA), and Regression Analysis (RA) are widely used to determine the mean trip rates for a new development. Trip Rate Analysis uses traffic volumes (incoming and outgoing) in a study area which are divided by a variable (representing characteristics of the study area, e.g., total of parking spaces, gross leasable area, gross floor area, occupancy rate, and number of employees) to obtain the trip attraction rate.<sup>5</sup> Even though this method of measuring mean trip rates represents the current conditions but this method do not take into account the relationship between mean trip rate and the variables.

Cross-Classification Analysis is a widely accepted method because the variables can be altered according to suitability and availability of data. According to Stopher and Meyburg (1978),<sup>6</sup> there are two ways to do the Cross-Classification Analysis which are for the trip production (in which the trip rate obtained will show the number of trips produced at that particular place) and the trip attraction (in which the trip rate obtained will show the number of trips attracted to that particular place). A typical Cross-Classification table shows the number of trips produced per household with characteristics such as car ownership, household size, average income and/ or other variables which seem to fit. Each element of the table is multiplied by the number of households in the same category, and the product is summed up for all categories in the table to obtain the number of total trips generated in the traffic analysis zone.<sup>7</sup> This method was considered a good alternative compared to other methods because it takes into account the important variables which contribute to the number of trips. But the limitation of this method is that there is no method to determine whether the independent variables are truly independent and also that there are no statistical test to support the end results. For Regression Analysis, the number of trips is assumed to be linear to the variables used. The variables used can be combination of few independent variables to produce a multiple regression or one independent variable to produce a single regression. All the variables can be checked for the dependency of each other by using a statistical analysis to ensure a good fit of the data. The problem with this method is that trip is dynamic in nature which means it changes every time and again irrespective of any variables, which makes the trips non-linear

Traffic and Transport improvements that follow aftermath of TIA studies are generally based on the provision of transport supply and reduction of traffic demand. The additional transport supplies include changes in the configuration of transport facilities to maximize supplies or addition of new supplies to mitigate the impact of new development traffic. On the traffic demand side, it includes the shifting traffic in modes, times and spaces. When the predicted traffic volume for the horizon year exceeds the capacity of the existing road, transport improvement need to be made in order to sustain the new amount of traffic. Common supply side measures include road widening, traffic signal settings, etc. Similarly, demand side measures include operation of mass transport to encourage the public transport and road pricing effort to discourage the use of private vehicles.

## 3.0 METHODOLOGY

The study methodology is summarised in the flowchart in Figure 2. Primary data was collected by conducting surveys in the Skudai

Town to assess future traffic conditions and the mean trip rates. This study mainly focused on a prospective commercial development - a Tesco Hypermarket (TH) - due to be operational in year 2015. This new commercial development of the Tesco Hypermarket (TH)<sup>8</sup> comprising of 15,820m<sup>2</sup> of GFA was identified as an opportunity. TH was in a process of obtaining development certificate and was due to be opened in year 2015.

Three trip generation methods namely Trip Rate Analysis (TRA), Cross-Classification Analysis (CCA) and Regression Analysis (RA) were used to determine the entry mean trip rate. The obtained mean trip rates were used to assess the performance, based on LOS and the average delay, of an existing critical intersection in the vicinity of the proposed TH for the horizon year 2025. A

transport improvement was proposed based on the performance figures. Secondary data were also collected from Majlis Perbandaran Johor Baru Tengah (MPJBT)<sup>9</sup> on land use, socio-economic variables, and trip behaviour. Current and proposed land use developments data were indicative of the type, scale and intensity of all the land uses.

More specifically, three existing commercial developments depicting similar land use and socio-economic characteristics in the area were identified; these were Giant U Mall (GUM) in Pulau Utama, Jusco Taman Universiti (JTU) in Taman Universiti and Carrefour Sutera Utama (CSU) in Taman Sutera Utama. Figure 3 shows the location of proposed TH, GUM, JTU and CSU and their general characteristics, i.e., number of floors and GFA.

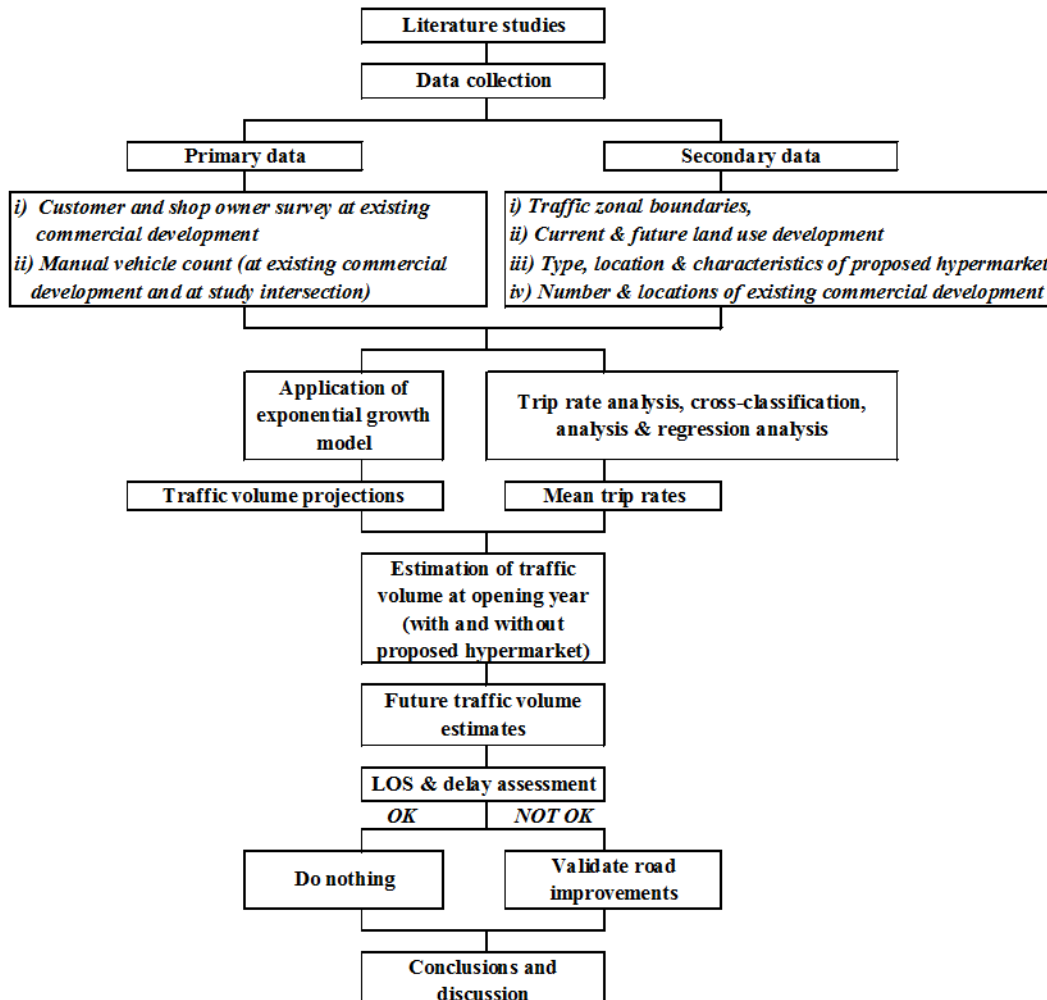


Figure 2 Methodology of study

#### 4.0 FIELD STUDIES

A critical intersection in the vicinity of the proposed TH was selected as the test site to analyse the performance with additional development traffic. It was identified as 4-arm signalised intersection connecting Lebuhraya Skudai-Pontian to Jalan Teratai and Persisiran Pulau Perdana situated approximately 385m away from the proposed TH location (Figure 4). Lebuhraya Skudai-Pontian is a major road with two lanes each in both the directions, separated by a median. It connects Pontian in the west and Skudai in the east and has average peak hour traffic of 2900

Passenger Car Unit per hour (PCU/hr). Both Jalan Teratai and Persisiran Pulau Perdana are minor roads heading to residential and commercial areas where one-lane is dedicated in both directions for Jalan Teratai and 2 lanes each in both directions for Persisiran Pulau Perdana, with a median for both the roads. Figure 4 shows the location and the geometric layout of this intersection. Procedures adopted for data collection were as follows:

- Customer survey was conducted in a form of O-D questionnaire with sample size of total 384 samples based from the total population of Skudai with 95% confidence level, 5% standard error and 50/50

probability for 1 day each at GUM, JТУ and CSU. Trip maker’s attributes and trip attributes were obtained by collecting information related to gender, age, marital status, occupation, household size, employment status, car ownership, income, origin, trip duration, travel mode, vehicle occupancy, trip purpose and frequency of trip in a typical week.

- Shop owner survey for all shops was conducted at GUM, JТУ and CSU seeking information on type of shops, GFA, average number of employees employed during peak hour and the average sales obtained in a typical month.
- Manual vehicle counts were conducted at every entry and exit points of GUM, JТУ and CSU for 1 day each during typical weekday and weekend for AM peak (11AM-1PM) and for PM peak (5PM-7PM). The type and vehicle occupancy were recorded at every 15 minutes interval.
- The highest hourly data was considered as peak hour rate for each location and the traffic volumes were converted into PCU factor based on Trip Generation Manual (2010).

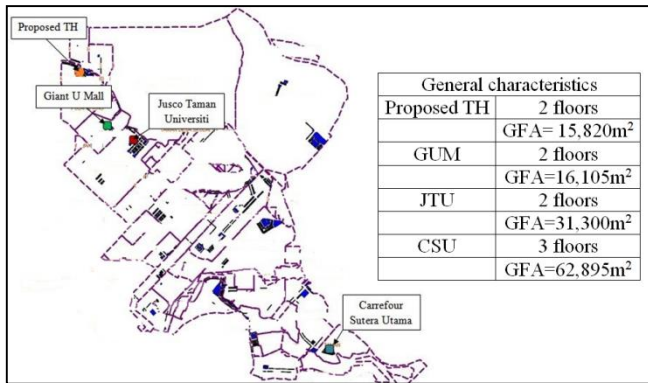


Figure 3 Location of proposed TH, GUM, JТУ and CSU and the general characteristics (not to scale)

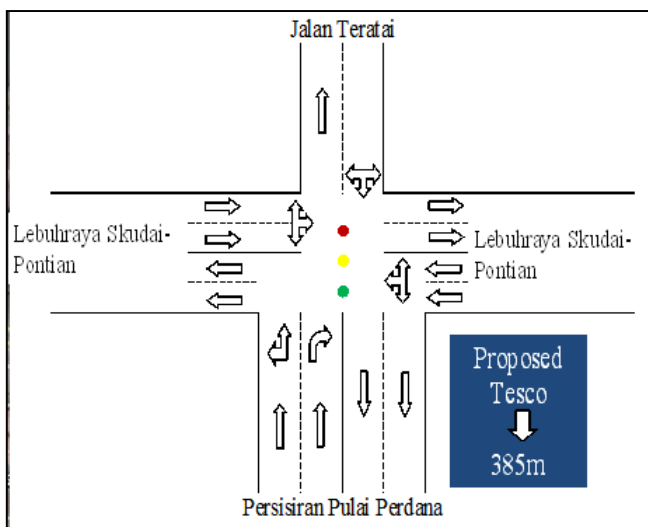


Figure 4 Geometric layout of critical intersection near proposed TH

## 5.0 RESULTS AND ANALYSIS

### 5.1 Mean Trip Rate Estimation

Firstly, mean trip rates were estimated using Trip Rate Analysis technique. The following two equations were used to determine the mean trip rate. Table 1 show the results of entry mean trip rate per 100m<sup>2</sup> GFA using Trip Rate Analysis.

$$Triprate/100m^2\ GFA = \frac{Peak\ hour\ traffic\ volume\ (PCU/hr)}{Total\ GFA\ (m^2)} \times 100m^2$$

Table 1 Trip rates in PCU trips per hour per 100m<sup>2</sup> GFA and standard deviation using TRA

Hypermarket	Weekday		Weekend	
	AM peak	PM peak	AM peak	PM peak
GUM	2.29	2.27	2.27	2.65
JТУ	1.14	1.43	1.35	1.68
CSU	0.91	1.46	2.02	1.80
Mean trip rate	1.45	1.72	1.88	2.04
Standard deviation	0.7393	0.4766	0.4757	0.5288

Secondly, mean trip rate was estimated using Cross-Classification Analysis technique. The estimation used peak hour person trips, GFA and number of employees as variables. Table 2 shows the entry mean trip rate obtained using Cross-Classification Analysis for GUM, JТУ and CSU respectively. The step-wise procedure followed is explained below.

1. Total peak hour person trip were obtained from occupancy rates while manual vehicle count at GUM, JТУ and CSU were conducted by observation.
2. Arrival rate to individual shops were taken from the customer survey data as average daily person trip and from the total average daily person trip; and the percentages of average daily person trips into each shop were determined.
3. The peak hour person trips for each shop were determined by multiplying the total peak hour person trips and the percentage of average daily person trip of each shop; underlying assumptions were made that the same percentage of trips attracted to each shop as average daily and peak hour trips.
4. The GFA of shops were grouped into small (<200m<sup>2</sup>), medium (200m<sup>2</sup>-500m<sup>2</sup>) and large (>500m<sup>2</sup>) and number of employees were grouped into categories of 1, 2, 3, and 4+ employees.
5. The conversion factor (CF) was obtained by dividing the peak hour PCU trip by total peak hour person trip.
6. The following model equations were used to calculate mean trip rate:

$$D_{gh} = (A_g) \times (B_{gh}) \times (C_{gh})$$

$$P_T = \sum_g \sum_h D_{gh} \text{ and}$$

$$Triprate\ per\ 100m^2\ GFA = (P_T \times C_F) / H \times 100m^2$$

where,

$A_g$  = Percentage of shops with GFA category  $g$  either small, medium or large,  
 $B_{gh}$  = Percentage of shops in GFA category  $g$  with number of employees category  $h$  ( $h = 1, 2, 3$  or  $4+$ ) per shop,  
 $C_{gh}$  = Average number of person trips per hour attracted to the shop at GFA category  $g$  and number of employees category  $h$ ,  
 $D_{gh}$  = Number of person trips per hour attracted to the shops with GFA category  $g$  and number of employees category  $h$ ,  
 $P_T$  = Total number of person trips per hour,  
 $C_F$  = Conversion factor from person trip to PCU trip,  
 $H$  = Total average GFA for every GFA category  $g$  with number of employees category  $h$ .

**Table 2** Trip rates in PCU trips per hour per 100m<sup>2</sup> GFA and standard deviation using CCA

Hypermarket	Weekday		Weekend	
	AM peak	PM peak	AM peak	PM peak
GUM	1.42	1.42	1.37	1.65
JTU	0.68	0.86	0.81	1.01
CSU	0.38	0.62	0.85	0.76
Mean trip rate	0.83	0.97	1.01	1.14
Standard deviation	0.5352	0.4105	0.3124	0.4590

Thirdly, mean trip rate was estimated using Regression Analysis technique. For this purpose, graphs were plotted using the peak hour traffic volume obtained from manual vehicle counts for each GUM, JTU and CSU as the y-axis and the GFA for each GUM, JTU and CSU as x-axis to obtain the linear trip equation and  $R^2$  values. The slopes of the linear lines were taken as the mean trip rate per 100m<sup>2</sup> GFA. Table 3 shows the entry mean trip rate obtained using Regression Analysis for JTU and CSU respectively.

**Table 3** Trip rates in PCU trips per hour per 100m<sup>2</sup> GFA and standard deviation using RA

Hypermarket	Weekday		Weekend	
	AM peak	PM peak	AM peak	PM peak
GUM*	-	-	-	-
JTU	3.56	4.48	4.22	5.26
CSU	1.38	2.22	3.07	2.75
Mean trip rate	2.47	3.35	3.64	4.00
Standard deviation	1.54	1.60	0.81	1.77

\*The data for GUM was found inconsistent and was not included in the analysis

Finally, the mean trip rates arrived after the use of three methods were compared with the one suggested by the HPU Malaysian Manual. Table 4 gives summarized account of the entry trip rates estimated using all the three methods and lays them side by side with the trip rates referred in the HPU manual. The Paired T test between the results of individual estimation methods with the one given by the HPU manual did not reveal any significant difference between a particular estimation method and the manual directed data. However, the test results indicate the lowest mean difference for the Cross-Classification method of estimation and the mean trips rates produced by this method of estimations were used for the rest of the analysis.

**Table 4** Entry mean trip rate per 100m<sup>2</sup> GFA using TRA, CCA, RA and the HPU manual

Mean trip rate source	TRA	CCA	RA	HPU Manual	
Weekday	AM peak	1.45	0.83	2.47	2.50
	PM peak	1.72	0.97	3.35	2.99
Weekend	AM peak	1.88	1.01	3.64	1.07
	PM peak	2.04	1.14	4.00	1.28

## 5.2 Traffic Impact Assessment in Base Year Traffic Volume

The performances of the critical intersection in the vicinity of the proposed TH were analysed using SIDRA software. The results are shown in Table 5. It was found that the worst performance in terms of average delay, queue distance and LOS occurred during weekday PM peak and therefore the traffic impact assessments were made based from this traffic volume which represented worst case scenario.

**Table 5** Base year intersection performance

Day and time	Total traffic vol. (PCU/hr)	v/c	Average Delay (s)	Queue Distance (m)	LOS	
Week day	AM peak	2662	0.936	40.3	142.2	D
	PM peak	2967	0.947	50.1	198.9	D
Week -end	AM peak	1255	0.755	21.7	47.4	C
	PM peak	2458	0.866	31.5	96.9	C

## 5.3 Projected Traffic Volume at Opening Year 2015

The following equations were used to determine the traffic volume at opening year 2015 with 5% growth factor ( $r$ ) as obtained from RTVM11 assuming 50/50 entry/exit proportion and directional split. Table 6 shows the performance of the critical intersection at opening year 2015.

$$U_{2015(a)} = 2967(1+r)^3$$

Table 6 shows the performance of the critical intersection at opening year 2015.

$$U_{2015(b)} = \left( \frac{\text{Total GFA}}{100} \right) \times \text{Mean Trip Rate}$$

$$U_{2015(\text{total})} = U_{2015(a)} + U_{2015(b)}$$

where,

$r$  = given growth rate



**Table 6** Intersection performance at opening year 2015

Trip Rate source	Total traffic volume (PCU/hr)	v/c	Average Delay (s)	Queue Distance (m)	LOS
	<b>Without proposed TH</b>				
	<b>3435</b>	<b>1.035</b>	<b>116.5</b>	<b>431.7</b>	<b>F</b>
<b>With proposed TH</b>					
TRA	3706	1.111	196.6	607.3	F
CCA	3589	1.068	159	520.1	F
RA	3629	1.111	170.8	570.0	F
HPU Manual	3911	1.151	263.2	764.3	F

#### 5.4 Projected Traffic Volume in Horizon Year 2025

Mean trip rate from Cross-Classification was used and the projected traffic volume in horizon year 2025 was determined as 5846 PCU/hr and using this traffic volume, the intersection was again analysed using SIDRA with v/c ratio of 1.740, average delay of 1092.1s and LOS F were the output.

#### 5.5 Transport Improvement

Due to the fact the LOS in horizon year 2025 exceeded the desirable LOS, a proposed improvement was made which is to build a flyover for through traffic in the major road with performance of v/c ratio of 0.897, average delay of 12.1s, queue length of 280.7 and with LOS B.

#### 6.0 CONCLUSIONS

Trip generation manual can be viewed as a source for trip rates applicable to all Malaysian condition. However, the trips generated based on the manual are either underestimated or overestimated, both signifying implications on the future development traffic. Three regimes were tested for ensuring the adoption of trip rates against the benchmarked HPU manual, all regimes did not produce significant differences for the given study area which are GUM, JTU and CSU within Skudai Town. However, the benchmark (i.e., the HPU Malaysian Manual) considers only 7 data points of Malls all across Malaysia. This makes us believe that the rates mentioned in the manual might be conservative or might not reflect the true world conditions. Additionally, "it is a well-known fact that traffic generation is affected by a variety of socio-economic variables."<sup>10</sup> The inclusion of socio-economic, demographic and land use data can be used as important variables for trip rates estimation. The result of this study therefore indicates the appropriateness of regression method based estimation for trip rate analysis that can take a range of plausible variable in estimating a better model for prediction. As this study faced some constraints in the data revealed by the respondents, a due consideration to the major determinants of traffic and a careful collection of data can help in developing better models. This would help in restoring the LOS while permitting newer constructions or development projects. It is evident from other analysis that facing new developments, the status of LOS is going down in Skudai. Projections for the base year 2015 indicate that the critical intersection under study produced the performance of LOS 'F' depicting a delay of 159s. The situation therefore demands more attention and immediate intervention of the concerned authorities. At the same time, the projections for the LOS in the horizon year 2025 assuming a do-nothing scenario produced an excessive average delay 1092 s. In

this regard, this study proposes a framework for the estimation of trip rates including local conditions described by the trip attributes, land use and socio-economic attribute of travellers. These are quintessential variables for the estimation of trips for Malaysian conditions. We would like to mark these areas to be probed better by future researchers. The developments on one front are to be matched by similar developments in the area of the traffic and town planning. For example, in our case, to mitigate the congestion due to development traffic in addition to traffic growth for opening and horizon year (2015 and 2025), if we consider to build a flyover for through traffic for major road (Lebuhraya Skudai-Pontian), it assures a LOS B (average delay 12.1s) for the horizon year 2025 signifying a free flow traffic with minimum disturbance.

#### 7.0 DISCUSSION

Developments in the urban areas of Malaysia are vulnerable to unanticipated traffic congestion and other negative impacts. This paper conducted a traffic impact assessment in the neighbourhoods of Skudai Town in the Johor Bahru region using three estimation mean trip rate regimes. A variety of methods - customer survey, shop owner survey, observation method, and references to secondary data were employed in the study. Although the study mainly focussed on a prospective commercial development - a Tesco Hypermarket (TH) - due to be operational in year 2015, the study gave pertinent insight to all such cite which might be affected by the additional development traffic. Comparisons of traffic estimates using the three different regimes: Trip Rate Analysis, Cross-Classification Analysis, and Regression Analysis with those suggested by the HPU Manual although did not reveal any significant difference. However, it was observed that inaccurate mechanisms to assess the trip rates can result into either underestimation or overestimation of traffic, particularly when the trip rates can be affected by a variety of socio-economic variables. The result therefore indicated the appropriateness of the regression-based estimations for trip rate analysis. The study also highlighted the importance of traffic assessments at different times and the ways and measures to deal with them. It was found that the worst performance in terms of average delay, queue distance and LOS occurred during weekday PM peak. The study suggested that the traffic impact assessments to be made based on the peak traffic volume which represents the worst case scenario. Mean trip rate from Cross-Classification method was used and the projected traffic volume in horizon year 2025 was estimated as 5846 PCU/hr at the intersection revealing further (using SIDRA software) a v/c ratio of 1.740, average delay of 1092.1s and LOS F. As the LOS in horizon year 2025 failed to meet the desirable LOS, suggestion to build a flyover was made containing the traffic in the major road to an average delay of 12.1s, queue length of 280.7 and with LOS B.

#### Acknowledgement

The Author (Principal Investigator) does hereby acknowledge Ministry of Higher Education (MOHE) and Universiti Teknologi Malaysia (UTM) for providing funding for this research project (Vote Number 07J06) and Research Management Center (RMC) for logistical assistance throughout the duration of this project.

## References

- [1] Highway Planning Unit. 2010. *Trip Generation Manual 2010*. 1st ed. Malaysia: Highway Planning Unit.
- [2] Institute of Transportation Engineers. 1991. *Trip Generation*. 5th ed. Washington D.C.: Institute of Transportation Engineers.
- [3] Black, J. 1981. *Urban Transport Planning: Theory and Practice*. John Hopkins University Press.
- [4] Papacostas, C. S. and P. D. Prevedouros. 2008. *Transportation Engineering and Planning*. 3rd ed. New Delhi: Prentice Hall.
- [5] Uddin, M. M., M. R. Hasan, I. Ahmed, P. Das, M. A. Uddin, and T. Hasan, T. 2012. A Comprehensive Study on Trip Attraction Rates of Shopping Centers in Dhanmondi Area. *International Journal of Civil & Environmental Engineering*. 12.
- [6] Stopher, P. R. and A. H. Meyburg. 1975. *Urban Transportation Modelling and Planning*. 1st ed. Lexington, Massachusetts: Lexington Books, D.C Heath & Company.
- [7] Rhee, J. 2003. Improvement of Trip Generation Forecast with Category Analysis in Seoul Metropolitan Area. *Proceedings of the Eastern Asia Society for Transport Studies*. 4.
- [8] Tesco PLC. 2012. *Tesco PLC Annual Review and Summary Financial Statement 2012*. Tesco PLC: United Kingdom.
- [9] Majlis Perbandaran Johor Baru Tengah. 2010. *Local District Plan Johor Bahru 2020*. Malaysia: Majlis Perbandaran Johor Baru Tengah.
- [10] Mohamed, S. S. and K. Hokao. 2000. Estimation of Generated Traffic by New Developments: Current Practice and Possible Improvements based on Bangkok Experience. Victoria Transport Policy Institute. Referred from [www.vtpi.org](http://www.vtpi.org).