TRAFFIC IMPACT ASSESSMENT OF NEW COMMERCIAL DEVELOPMENT IN THE NEIGHBOURHOODS OF SKUDAI TOWN

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Dedicated to my beloved mama, Hasnah Binti Abdul Rahim
and ayah, Zaki Bin Ahmad Ghazi

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ABSTRACT

Urban areas in Malaysia including Johor Bahru are witnessing a rampant commercial development. The purpose of development can easily be defeated by unanticipated traffic congestion and other negative impacts. This paper deals with traffic impact assessment (TIA) of proposed commercial development in the neighbourhoods of Skudai Town. In traffic impact studies, estimation of mean trip rate is a central component for TIA and adoption of inaccurate trip rates can result into underestimation or overestimation of development traffic, both with undesirable impacts. This paper analyses three regimes of Trip Rate Analysis, Cross-Classification Analysis and Regression Analysis techniques to determine the future development traffic for a proposed Tesco hypermarket (TH) within Skudai Town. Furthermore, the obtained mean trip rates for critically examined for their adoption and forecasting traffic for base year 2015 and horizon year 2025. The results indicated significant variances in the estimated entry mean trip rates when compared with the entry trip rates from Trip Generation Manual (TGM) Malaysia. These estimated mean trip rates were then tested to measure the performance of critical intersection in the immediate vicinity of proposed Tesco Hypermarket for the opening year 2015. Critical Intersection is analysed using SIDRA software to estimate delay, a criterion for determining the level of service (LOS) provided to motorists. The traffic projections made for horizon year 2025 were further analysed, depicting a LOS F with 2716.9s of average delay. Furthermore, traffic improvements were proposed to mitigate the impact of future development traffic. In this regard, the study provided a framework for the estimation of trip rates for local Malaysian conditions and their adoption guidelines. These offer indispensible assistance to TIA that can assist developers or local authorities in decision making.

ABSTRAK

Kawasan Bandar di Malaysia termasuk Johor Bahru sedang menyaksikan pembangunan komersial yang pesat. Matlamat pembangunan boleh dikalahkan dengan kesesakkan lalu lintas dan impak negatif lain yang tidak dijangka. Kajian ini membincangkan tentang taksiran impak trafik (TIA) oleh cadangan pembangunan komersial di dalam kawasan kejiranan Bandar Skudai. Di dalam kajian impak trafik, pengiraan kadar perjalanan adalah perkara asas untuk TIA dan penggunaan kadar perjalanan yang tidak tepat boleh menghasilkan kadar yang terlalu tinggi atau rendah yang mana kedua-duanya mempunyai impak yang tidak diingini. Kajian ini menganalisa tiga rejim iaitu Analisa Kadar Perjalanan, Analisa Klasifikasi Menyilang dan Analisa Regresi untuk mengetahui trafik di masa hadapan disebabkan oleh pembangunan Pasaraya Besar Tesco (TH). Purata kadar perjalanan yang diperoleh diuji secara kritikal untuk pengunaan dan ramalan trafik untuk tahun dasar 2015 dan tahun ufuk 2025. Hasil kajian menunjukkan terdapat perbezaan ketara di antara kadar perjalanan masuk yang di kira dengan kadar perjalanan masuk daripada Manual Generasi Kadar (TGM) Malaysia. Kadar perjalanan yang di kira diuji untuk mengira prestasi simpang kritikal di dalam kawasan persekitaran cadangan TH untuk tahun pembukaan 2015. Persimpangan kritikal itu dianalisa mengunakan perisian SIDRA untuk mengira kelewatan iaitu kriteria untuk mengetahui Tahap Servis (LOS) untuk pengguna jalanraya. Analisa diteruskan dengan unjuran trafik untuk tahun ufuk 2025 yang menunjukkan LOS F dengan purata kelewatan 2716.9s. Tambahan lagi, penambahbaikkan trafik telah dicadangkan untuk mengatasi impak trafik akibat pembangunan di masa hadapan. Dalam hal ini, kajian ini memberi rangka kerja dan juga garis panduan pengunaan untuk pengiraan kadar perjalanan untuk situasi Malaysia. Ini memberi bantuan yang amat penting kepada TIA yang boleh membantu pemaju dan pihak berkuasa tempatan di dalam membuat keputusan.

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LIST OF ABBREVIATIONS

Symbol	Descriptions
LOS	Level of Service
TIA	Traffic Impact Assessment
GFA	Gross Floor Area
HCM	Highway Capacity Manual
HPU	Highway Planning Unit Malaysia
ITE	Institute Transportation Engineers
O-D	Origin-Destination
IDR	Iskandar Development Region
TAZ	Traffic Analysis Zone
HB	Home Based
NHB	Non-Home Based
TH	Tesco Hypermarket
GUM	Giant U Mall
JTU	Jusco Taman Universiti
CSU	Carrefour Sutera Utama

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Policy makers in Malaysia under the current 9th Malaysian Plan intend to develop Malaysia into a developed nation by the year 2020 based from the National Transformation Program (NTP). This is revealed in rampant urban development in many states of Malaysia especially southern state of Johor. Given the location value of Skudai Town due to its close proximity to Singapore, the development is even large both in scale and intensity. Skudai Town also contain an international university, Universiti Teknologi Malaysia which imparts education to over 20,000 students and employs more than 4,000 academic and technical staff. In this regard, Skudai Town may well be regarded as university town.

But, without a proper understanding of development impacts on the road network, the intent of the developments which are to bring economic and social purposes could be easily defeated by unanticipated traffic congestion and other negative impacts. It is well known that new development will generate new traffic volume on the existing road network and if the existing road network are unable to cater for the new amount of traffic volume, traffic congestion will occur which will

lead to poor economic return due to delay in travel time, air pollution and high fuel consumption during congestion and even accidents.

New development can also decrease the accessibility and mobility of travelers if not planned properly. In other words, the extra traffic generated from the new development will have an adverse impact on the Level of Service (LOS) of the road network. Therefore, it is essential to conduct a traffic impact assessment (TIA) during planning stage of the new development to determine the amount of traffic that will be generated from the new development and to determine if the existing road network is capable to sustain the combination of old and new development traffic. If the existing road network is unable to accommodate the new traffic, ways of mitigation can be planned based on the results obtained from TIA such as modifying the road geometrics, adding of an additional lane, providing roundabout or configuring traffic signal among others that seems appropriate.

Skudai Town is rapidly growing with many new mixed land use development such as new malls, shop houses, residential areas, factories and many more. Only few years ago that Skudai Town was under developed with only few residents and commercial areas on top of already established Universiti Teknologi Malaysia (UTM). Due to the rapid growth, TIA study for Skudai Town is necessary to be conducted for estimating the appropriateness of the application of Malaysian trip rates.

1.2 Problem Statement

TIA is very important during the planning stage of any new development to avoid congestion and other negative impacts that may arise. The problem in this country is that the standard and procedures in producing and evaluating of TIA report

still has not been standardized or well developed (Wee Ka Siong, 2001). This will raised concern on validity of the estimation of traffic volume projection.

Because there are no proper standards to follow, traffic engineers or traffic planners usually refer to guidelines of TIA and use trip generation rates from previously established manuals such as Trip Generation Manual from Highway Planning Unit (HPU) in Malaysia or by Institute Transportation Engineers (ITE) in the United States. Experiences from past projects in determining trip rates are also used as analogy for estimating trip rates for upcoming projects.

Even though the trip rates stated in the HPU trip manual was based from study done all across Malaysia, but it was still at early stages with limited number of survey sites especially for less common types of land uses. On the other hand, the problem with the ITE manual is that it does not reflect well on the true conditions of typical Malaysian lifestyle and travel pattern as ITE was published based on various studies within the United States which are different to typical Malaysian way of life, climate, socio-economic considerations and so forth which makes the travel pattern different between these two countries.

Both manuals provide trip rate that are insensitive to population density, travel patterns, economic growth, accessibility etc. For example, the number of vehicle trips going into a shopping mall for a car dependent city will considerably higher than a city that depends on public transport even for the same shopping mall type and area. In other words, the number of trip generated by a certain type of land use depends on local conditions of the area. Thus, trip rates calculating procedures can be prone to biases or errors which can result in overestimation or underestimation of mean trip rates. These inherent flaws in the trip estimates provided the need of this study.

Another source was to calculate the trip rates by the developer themselves but the trip rates can also prone to biases or error which means the developer usually manipulated the procedures to estimates minimum trip rates to show that the proposed new development will not have major impacts on the current traffic volume just to obtain a planning certificate easily or the developer lacks sound knowledge of how to estimates the trip rates with limited errors.

When there is underestimation of trip rates, the outcome of TIA is rather minimal which shows that the new development will not generate much traffic in the future. That means the road network within the area will be design base on small traffic volume which may not be enough or adequate in the future. This can lead to serious congestion when the road is operating at capacity. This is also beneficial to the developer due to the low cost for the development because underestimation of trip rates requires less number of complex road networks.

By using unsuitable procedures to estimate the trip rates can also lead to overestimation. An overestimation of trip rates shows that the new development will create high traffic volume in the future. This means that the road network will be designed based on high traffic volume which will be higher in terms of investment cost and also the operating cost to construct the road network. There will also be using lot of land spaces. This can lead to the road network be underutilized and a wastage of spaces of land and money just to built unessential roads.

Hence, local TIA studies in Skudai Town were conducted to understand traffic conditions that may emerge in the future and 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 years before that which means any trip rates study done here in the past 10 or more years may not be valid now. Therefore, this study can provide valuable information pertaining traffic issues in Skudai Town and identical urban areas.

1.3 Objectives

In order to achieve the aim of the study, the main objectives had been identified as:

i. To estimate the mean trip rates per $100m^2$ of gross floor area (GFA) under commercial land use;
ii. To test and validate the adoption of mean trip rates per $100m^2$ while comparing three test regimes; Trip Rate Analysis, Cross Classification Analysis And Regression Analysis techniques;
iii. To quantify the impacts of additional development traffic from the proposed commercial area for the horizon year 2025 on the neighboring road network;
iv. To propose appropriate transport improvement measure for the existing road network within Skudai.

1.4 Scope of Study and Limitations

In order to achieve the objectives, the scope of study was confined only to commercial areas in the neighborhoods of Skudai Town. It involved collection of information on land uses, current and proposed commercial area establishment characteristics, traffic growth factor and current traffic volume in Skudai Town. This study used three test methods to determined the mean trip rate for a proposed commercial area namely Trip Rate Analysis, Cross-classification Analysis and Regression Analysis where only the entry volumes were counted due to limitations of time, man power and resources to count both the entry and exit traffic volume as the exit traffic volume was assume to be the same as entry traffic volume.

Another limitation, that type, scale and intensity of commercial activities in the preselected commercial markets for analysis are considered to be identical in nature. These commercial areas are presumed to generate trip rates which are deemed comparable. The projected traffic volumes at a critical intersection near the proposed commercial establishment were analyzed using SIDRA software to determine the performance of the intersection.

1.5 Significance of Study

As what already been mentioned, this study focused on TIA due to a new commercial area development in rapidly developing Skudai Town. This study which was based from existing commercial developments in the study area will give an expectation on how much trips will be generated by a new propose commercial developments in the area.

The trip rates estimation in this study will not be biased to any party, be it a developer or municipal authorities and will be adequate enough that it will not be too low nor too high that can lead to the new road network at capacity which can cause congestion or underuse which is a waste in term of cost and land spaces within the new development. The results could be used for future TIA studies from similar development of commercial areas in Skudai Town.

Also, this study signifies the appropriateness of the application of universal Malaysian trip rates and its impacts.

REFERENCES

Allen, D. L., Barret, M. L., Graves, R. C., Pigman, J. G., Abu-Lebdeh, G., Aultman-Hall, L., and Bowling, S. T. (2011). *Analysis of Traffic Growth Rates.* Kentucky Transportation Center. Lexington, Kentucky.

Chatterjee, A. and Venigalla, M. M. (1996). Travel Demand Forecasting for Urban Transportation Planning. *Compendium of technical papers: Institute of Transportation Engineers, 37, 217-281.* Institute Transport Engineers.

Garber, N. J. and Hoel, L. A. (2009). *Traffic and Highway Engineering.* (4th ed.). Cengage Learning: Canada.

Highway Planning Unit (2010). *Trip Generation Manual 2010*. (1st ed.). Malaysia: Highway Planning Unit.

Institute of Transportation Engineers (1991). *Trip Generation.* (5th ed.). Washington D.C.: Institute of Transportation Engineers.

Lay, M. G. (2009). *Handbook of Road Technology.* (4th ed.). New York: Spoon Press.

Majlis Perbandaran Johor Baru Tengah (2010). *Local District Plan Johor Bahru 2020.* Malaysia: Majlis Perbandaran Johor Baru Tengah.

McNally, M. G. (2000). "The four step model." *Handbook of Transport Modelling*, 1st Ed., D. A. Hensher and K. J. Button, eds., Elsevier Science, Kidlington, Oxford, U.K.

Minhans, A. (2008). *Traffic Management Strategies in Cases of Disasters.* Published Doctoral Dissertation, Institute for Traffic and Transport, Darmstadt University of Technology, TUD, Darmstadt, Germany.

Minhans, A. et. al. (2012). *Methodologies for Estimation of Traffic Impacts from Proposed Commercial Developments – A Case Study of Skudai Town, Johor, Malaysia.* Conference Proceedings UTM-IBIMA International Real Estate Conference 2012. Kuala Lumpur, Malaysia.

Minhans, A., Pillai, C. M. (2012). *Multi-Criteria Analysis for Effectiveness and Difficulties of Traffic Management in Disasters.* APSEC-ICCER, Conference Proceedings, Surabaya, Indonesia.

Papacostas, C. S. and Prevedouros, P. D. (2008). *Transportation Engineering and Planning.* (3rd ed.). New Delhi: Prentice Hall.

Rhee, J. (2003). *Improvement of Trip Generation Forecast with Category Analysis in Seoul Metropolitan Area.* Proceedings of the Eastern Asia Society for Transport Studies. Vol.4.

Siong, W. K. (2001). *Development of Traffic Impact Assessment (TIA) Criteria in Malaysia: Johor State as the Basic Model.* Doctor Philosophy, Universiti Teknologi Malaysia, Skudai.

Sosslau, A. B., Hassam, A. B., Carter, M. M. and Wickstrom, G. V. (1978). *NCHRRPe port 187: Quick-Response Urban Travel Estimation, Techniques and Transferable Parameters.* TRB. National Research Council, Washington.

Stopher, P. R. and Meyburg, A. H. (1975). *Urban Transportation Modelling and Planning*. (1st ed.). Lexington, Massachussets: Lexington Books, D.C Heath & Company.

Tesco PLC (2012). *Tesco PLC Annual Review and Summary Financial Statement 2012.* Tesco PLC: United Kingdom.

Uddin, M. M., Hasan, M. R., Ahmed, I., Das, P., Uddin, M. A. and Hasan, T. (2012). *A Comprehensive Study on Trip Attraction Rates of Shopping Centers in Dhanmondi Area.* International Journal of Civil & Environmental Engineering. Vol 12.