TRIP GENERATION RATE OF FAST-FOOD RESTAURANTS IN JOHOR BAHRU AREA

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This project report is dedicated to my beloved father, **Abdulameer** and my **mother**, for their endless support and encouragement.

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ABSTRACT

This study is an attempt to give some insights on the trip generation rates of fast-food restaurants located in Johor Bahru area and the parameters affecting the trip generation rate for the selected land use type. In Malaysia, trip generation has often been treated lightly, and inadequate research works have been carried out. Although the Malaysia Trip Generation Manual (2010) is a concise and easy to use reference, the models for fast-food restaurants do not consider some of the features of fast-food restaurants similar to those provided in the Institute of Transportation Engineers' (ITE) methodology. This study considered three (03) parameters to establish a relationship with the trip generation rates of the selected land use type. Statistically significant parameters have been determined which were a) gross floor area of the restaurant b) number of parking space c) number of seats, then prediction models for trip generation rates and equation have been developed. The average vehicle trip rates developed in this study also were compared with those reported in ITE Trip Generation Manual 9th edition (2012) and Malaysia Trip Generation Manual 1st edition (2010). The comparison showed that the rates found in this study were lower than those reported in ITE Manual and higher than the rates mentioned in Malaysia Trip Generation Manual.

ABSTRAK

Kajian ini adalah suatu usaha untuk memberi sebahagian gambaran ke atas kadar penjanaan perjalanan daripada restoran makanan segera yang terdapat di sekitar Johor Bahru dan parameter parameter yang mempengaruhi kadar penjanaan perjalanan untuk jenis tanah terpilih. Di Malaysia, penjanaan perjalanan selalunya di anggap remeh dan terlalu sedikit kajian yang di jalankan. Walaupun Manual Penjanaan Perjalanan (2010) adalah ringkas dan mudah untuk di gunakan sebagai panduan, model model restoran makanan segera tidak mengambilkira sebahagian dari ciri ciri restoran makanan segera seperti yang di gariskan dalam metodologi oleh Institusi Jurutera Pengangkutan (ITE). Kajian ini mempertimbangkan tiga (3) parameter untuk membangunkan perkaitan di Antara kadar generasi trip daripada jenis jalan yang terpilih. Secara Statistically parameter parameter pilihan telah di tentukan , dimana a) restoran gross luas lantai b) number of parking space c) jumlah tempat duduk, kemudian jangkaan model model untuk kadar gerasi trip dan persamaan telah di bangunkan. Kadar average pengangkutan jalan di bangunkan dari kajian ini juga di bandingkan dengan laporan yang di perolehi dari ITE Trip Generation Manual 9th edition (2012) and Malaysia Trip Generation Manual 1st edition (2010). Perbandingan mendapati kadar kadar yang ddi perolehi dari kajian ini adalah lebih rendah daripada nilai nilai yang di laporkan dalam Manual ITE dan lebih tinggi daripada yang di Malaysia Trip Generation Manual.

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LIST OF ABBREVIATIONS/SYMBOLS

GFA	Gross Floor Area
P.S	Number of Parking Space
McD	Mcdonals's Resturants
KFC	KFC Restaurants
ITE	Instatute of Transportation Engineering
B.K	Burger King Restaurants
S.D	Standard deviation
S.E	Standard Error
R^2	Power of Regression
r	Coeffecient of Linear Correlation
TSF	Thousand Square Feet
M^2	Meter Square

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CHAPTER 1

INTRODUCTION

1.1 Background

Nowadays, the transportation planning issues faced by most Asian cities include rapid urbanization and motorization which is leading to sharp increase in travel demand whereas, the supply has largely remained unmatched with demand. During the last two decades, these cities have experienced tremendously rapid growth. As a result of this growth, traffic volumes over certain corridors have begun to exceed capacity during peak hours, causing unacceptable levels of congestion. To control the traffic-related problems caused by the dramatic increase in population and automobile ownership and by the unplanned conversion of land-use activity types, many studies has been conducted of a projects that would generate substantial trips to conduct transportation impact studies. To conduct such studies, transportation planners and traffic engineers require estimates of the anticipated traffic volumes attracted to or produced by land uses.

Trip generation rate plays a role in many phases of transportation planning related activities. It is the first phase in the travel demand forecasting process. It involves the estimation of the total number of trips entering or leaving a particular area of any specific type of land use. Trip generation rates depend on a number of factors including land use, population, socio-economic activities in an area. It forms the basis for other analyses like trip distribution, modal split and traffic assignment.

This study is an attempt to throw lights on the trip generation rates of a specific land use type i.e. fast-food restaurants located in the Johor Bahru area and the parameters affecting the trip generation rate for the selected land use type. Although many studies have been conducted in various countries to determine the trip rates for land uses, the most comprehensive document available to transportation officials to date is the Institute of Transportation Engineers' (ITE) Trip Generation. The main problem with using the trip generation rates mentioned in the ITE publication for different land uses is that the values reflect the conditions that exist in the United States. To get a better estimate of the trips generated by a particular land use, trip rates that reflect local conditions must be developed.

The Institute of Transportation Engineers (ITE) is an international body of transport professionals based in Washington, DC, USA, that publishes and updates the information regarding the trip generation for various types of land uses in USA. The Trip Generation Manual (9th Edition), 2012 that included 172 land use types. The Highway Planning Unit of the Ministry of Works Malaysia published the "Trip Generation Manual Malaysia 2010" that provides trip generation information on 61 different land use types in Malaysia. This is the guide book for estimating trip generation rate for any specific type of land use in Malaysia. The "fast-food restaurants" is one of the land-use types included in the manual. However, the manual considers only one parameter related to the trip generation rates (i.e. Gross Floor Area). This study focused on the above land-use type considering multiple parameters in the analyses. The significance of other parameters was also assessed through the study. The study sites are located within the Johor Bahru area, the capital of Johor state the second-largest city in Malaysia that will represent the local environment. This study considered three (03) parameters to establish a relationship of the trip generation rates of the selected land use type. Those are a) gross floor area of the restaurant b) number of parking space of the restaurant c) number of seats in the restaurant. Statistically significant parameters have been determined, and prediction models for trip generation rates have been developed.

1.2 Problem Statement

Although the Malaysia Trip Generation Manual (2010) is a concise and easy to use reference, the models for fast-food restaurants do not consider some of the features of fast-food restaurants, such as the number of the parking spaces, and the number of seats in the fast-food restaurants that can have significant influence on the Trip generation rate of the fast-food restaurants. As a result, the Trip generation rate estimated cannot be made specific to fast-food restaurants. On the other hands, The Malaysia Trip Generation Manual (2010) offers the Trip generation rate for one type of parameter (GFA). As well as, there is no explanation or sufficient description for that parameter. It is difficult to consider all the factors influencing the Trip generation rate of fast-food restaurants especially factors like land use characteristics of the surrounding area. However other factors like the physical features of the fast-food restaurants that are easy to measure, and analyst should be incorporated into the estimation of the trip generation rate. The above-mentioned points form the basis for undertaking this study.

It is difficult to consider all the factors influencing the Trip generation rate of fast-food restaurants especially factors like land use characteristics of the surrounding area. However other factors like the physical features of the fast-food restaurants that are easy to measure and analyse should be incorporated in the estimation of the Trip generation rate. The above-mentioned points form the basis for undertaking this study.

1.3 Aim and Objectives

The aim of this study is to determine the average P.M peak hour trip generation rate/equation to estimate trip generation rate for the fast food restaurants in Johor Bahru area. The objectives of the study are the following:

i. To determine fast-food restaurant trip generation rate /equation of the selected sites in Johor Bahru Area.

ii. To identify statistically significant parameters those affect the trip generation rates.

iii. To develop mathematical relationships between the significant parameter(s) and the trip generation rate of the selected land-use type.

1.4 Study outcome

This research is intended to provide empirical trip generation data for use in transportation planning and traffic engineering studies for urban areas throughout Johor Bahru city. This study also provides the foundation for subsequent research to be conducted, local agencies, and/or private organizations to further build a comprehensive urban trip generation database of fast-food restaurants.

The most applicable outcome of this study is the production of quantitative information on travel characteristics of urban land uses like fast-food restaurants that can be used in traffic impact studies. This research is intended to establish a standardized data collection and analysis methodology, which will result in consistent information gathering in the future

1.5 Research Organization

The subsequent chapters of this research are organized as follows

Chapter 2 - Defines trip attraction, discusses current trip attraction usage, and presents sources of trip attraction data and relevant trip attraction research.

Chapter 3 - contains concept of trip rate analysis method and study data. Data collection and survey are explained in detail. Data of trip attraction are gathered to be analyzed. Discusses the different data collection methods considered for this study and their challenges. This chapter provides an overview of the sites surveyed in the "initial pilot" study (used to test the chosen survey methodology), and presents an evaluation of the study sites and their surrounding context.

Chapter 4 the empirical results are presented and analyzed. Trip attraction for the Johor Bahru area is presented in a form of tables and figures. The Trip Attraction Rate (Trip Attraction Rate) using regression Analysis Method is represented and applied.

Chapter 5 - Discusses the findings of the surveyed sites in brief.

REFERENCES

Alan J. Horowitz, (2006). Statewide Travel Forecasting Models. Transportation Research Board, U.S.

Al-Zahrani, A., & Hasan, T. (2008). Trip generation at fast food restaurants in Saudi Arabia. ITE Journal, 78(2), 24-29.

Greene, C., & Kannan, V. (2011). A Trip Generation Study of Coffee/Donut Shops in Western New York. ITE Journal, 81(6).

Hunt, L., Broadstock, D. et al. (2010), Modelling car trip generations for UK residential developments using data from TRICS, Transportation Planning And Technology 33(8): 671-678

Khattak, A. J. and Rodriguez, D. (2005), Travel behavior in neo-traditional neighborhood developments: A case study in USA, Transportation Research Part A-Policy and Practice 39(6): 481-500

Mathew T. V. and Krishna Rao K. V. (2007). Introduction to Transportation Engineering. NRTEL

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.

Meyer, M. D. and Miller E. J. (2001). Urban Transportation Planning: A Decision-Oriented Approach, 2nd Edition. McGraw Hill, New York.

Mousavi, A., Bunker, J. M., & Lee, B. (2012). A new approach for trip Generation estimation for use in traffic impact assessments. In *25th ARRB Conference Proceedings*. ARRB Group Ltd.

Ortuzar, Juan de Dios, and Luis G. Willumsen. Modelling Transport. Chichester, West Sussex, and England Wiley. 1990.

Papacostas, C. S. and Prevedouros, P. D. (2001) Transportation Engineering and Planning, Prentice Hall Inc.

Paquette, R. J., Ashford, N. J. et al. (1982).,Transportation engineering; planning and design, New York, Ronald Press Co.

Pettersson, P. and Schmocker, J. D. (2010), Active ageing in developing countries? – trip generation and tour complexity of older people in Metro Manila , Journal of Transport Geography 18(5): 613-623

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.

Washington, S. (2000), Iteratively Specified Tree-Based Regression: Theory and Trip Generation Example, Journal of Transportation Engineering 126(6)

WONSON, M. (1989). Trip Characteristics of Fast-Food Restaurants. ITE JOURNAL-INSTITUTE OF TRANSPORTATION ENGINEERS, 59(2), 43-45.