

THE UNIVERSITY OF MORATUWA
**USE OF ELECTRICITY CONSUMPTION FOR TRAFFIC
MODELING OF A SUBURBAN AREA**

BY
TISSA U. LIYANAGE

THIS THESIS WAS SUBMITTED TO THE DEPARTMENT OF CIVIL ENGINEERING
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SUPERVISED BY
PROFESSOR AMAL S. KUMARAGE

DEPARTMENT OF CIVIL ENGINEERING
UNIVERSITY OF MORATUWA
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THE UNIVERSITY OF MORATUWA
FACULTY OF ENGINEERING

The undersigned certify that they have read, and recommended to the faculty of Engineering of University of Moratuwa, Sri Lanka for acceptance, a thesis entitled, “Use of Electricity Consumption for Traffic Modeling of a Suburban Area” submitted by Tissa U. Liyanage in partial fulfillment of the degree of Doctor of Philosophy.

Chairman
Dr. I.M.S. Sathyaprasad
Senior Lecturer,
Department of Civil Engineering
University of Peradeniya



University of Moratuwa, Sri Lanka.
Electronics & Communications
www.ub.mrt.ac.lk

Professor Amal S. Kumarage
Head,
Department of Transport and Logistics Management
University of Moratuwa

Professor J.M.S.J. Bandara
Head,
Transportation Engineering Division
Department of Civil Engineering
University of Moratuwa

Dr. T. Sivakumar
Senior Lecturer
Department of Transport and Logistics Management
University of Moratuwa

Date: _____

Abstract

The history of urban travel demand studies spreads over a period of more than fifty years. Most of them are recorded from developed countries, with just a handful from developing countries. The scarcity of reliable and up-to-date socio-economic data to the required formats, and fewer possibilities of acquiring electronic data bases are the most apparent reasons for this situation. Often, data bases from more than one type of non-related data sources are required to run a complete travel demand forecasting model. This has restrained the calibration and forecasting of travel demand models in developing countries.

In particular, little attention has been given to forecasting travel in small and medium communities except for a few instances from developed countries. The primary reason for this is that, forecasting travel for small communities is not considered important, when statewide or national level travel forecasting models have not been developed, and specially due to the limited financial and technical capacities in the respective agencies. National level travel surveys are however not adequately sensitive to small and medium urban centres as they do not represent local travel behaviour adequately. But the need for travel demand forecasting in small communities is great with respect to infrastructure development planning. Many researches have shown that there is a strong relationship between trip generation and the combined income of a household. But it is very difficult to collect the income data in developing countries, and no proper and reliable data sources are available. In this context, more readily available electricity consumption data, for both households and for non-households can be used as a cost effective approach for ascertaining travel demand, given that such data can be easily measured either in terms of disaggregate household or aggregate area level, at a much lesser cost.

There are a number of advantages to use electricity consumption as an explanatory variable for travel forecasting. The electronically available disaggregated data sets can be easily used in many forms at the data preparation stage. This helps to use the data in aggregate or disaggregate forecasting according to the user requirements. The monthly updated data can be aggregated into any form of small zones by sorting them with addresses. The spatial location of the user can be geo-referenced and located with these addresses. Therefore, the use of GIS for travel modeling is possible. Since the electricity

is accessible to many users in urban areas, variations of the land use changes can be assessed in time with updated data.

Generalized functional forms for trip generation, mode selection, and trip distribution in suburban areas using electricity consumption as the main explanatory variable are suggested herein. The trip generation forecasting is explained by electricity consumption at household level with the hypothesis that household electricity consumption behaving as a surrogate variable for the combined income of that household. This model fit has been strengthened by introducing some of the socio-economic variables as well. Mode split models have also been calibrated using household electricity consumption, and functional forms for each mode and are presented separately. Both the trip generation and the mode selection by non-electricity users have been incorporated with category analysis techniques. The concept of traffic attraction to a destination zone based on its economic strength has been used here relating to the non-household electricity consumption level as a surrogate variable for the economic strength of that zone. The assignment of traffic in local road network is suggested with available commercial software popular for small areas to have a complete series of traffic forecasting models.

The up-to-date electricity consumption data in electronic format could be obtained from the Lanka Electricity Company Ltd (LECO) or Ceylon Electricity Board (CEB) free of charge or at a nominal fee. Therefore, this approach will give a very economical use of a model that has been calibrated in a state-of-the art method to suit the local traffic environment. The simple and cost effective approach will be especially helpful for the local authorities for infrastructure development and planning.

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To
my wife, Nalini
daughter, Helli



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and
our Parents.

Table of Contents

Abstract	iii
Acknowledgements	v
List of Tables	xi
List of Figures	xii
List of Abbreviations	xiv
CHAPTER 01: INTRODUCTION	1
1.1. General	1
1.2. Objective and Scope.....	3
1.2.1. Passenger Transport Modelling.....	3
1.2.2. Urban Transport Modelling and Present Challenges	4
1.2.3. Use of Electricity Consumption	6
1.3. Methodology	7
1.4. Classification of Suburban Area	7
1.4.1. Suburban Land Use in Sri Lanka	9
1.4.1.1. Geographic	9
1.4.1.2. Demographic	10
1.5. Sub Urban Economy and Activities.....	11
1.6. Colombo Metropolitan Region: A Case Study	13
1.6.1. Maharagama Divisional Secretariat Division	14
1.6.2. Moratuwa Divisional Secretariat Division.....	15
1.7. Data Collection	16
1.8. Analysis.....	17
1.9. Outline of Thesis.....	19
CHAPTER 02: LITERATURE REVIEW	20
2.1. Introduction.....	20
2.2. Electricity Consumption and Users in Sri Lanka.....	22
2.3. Limitations of Urban Transportation Demand Analysis.....	24
2.4. Some Basic Concepts of Urban Transport Demand Analysis	25
2.5. Model Development in General.....	27
2.6. Approaches to Urban Travel Demand Modelling	29
2.6.1. Direct Approach.....	29
2.6.2. Sequential Approach.....	32
2.7. Non Motorized Travel in Regional Travel Modelling	33
2.7.1 Assumptions Related to Non-Motorized Models.....	34
2.8. Model Development with Sequential Approach	35

2.8.1.	Trip Generation Modelling	36
2.8.2.	Trip Attraction Model	44
2.8.3.	Mode Choice Models	44
2.8.4.	Trip Distribution Models	49
2.8.5.	Trip Assignment Models.....	56
2.9.	Time Series Models	61
2.10.	Transferability of Travel Demand Models.....	62
2.11.	Statistical Methods in Model Calibration	62
2.12.	Evaluation Methods for the Performance of the Model.....	63
2.13.	Summary of Literature Review	66
CHAPTER 03: DATA COLLECTION AND PROCESSING.....		68
3.1.	General	68
3.1.1.	Types of Data	68
3.1.2.	Data Collection and Management.....	69
3.1.3.	Technical Approach for Data Collection	69
3.2.	Household Survey	71
3.2.1.	Data Collection Method	72
3.2.2.	Accuracy and the Selection of Sample Size.....	72
3.2.3.	Economic Factors.....	75
3.2.4.	Activity Data of the Population.....	76
3.2.5.	Travel Data.....	76
3.3.	Collection of Secondary Data	77
3.3.1.	Census Data.....	77
3.3.2.	Electricity Consumption Data.....	77
3.3.2.1.	Household and Non-Household Electricity Consumption	79
3.3.2.1.1.	Distribution of Household Electricity Consumption	79
3.3.2.1.2.	Distribution of Non-Household Electricity Consumption	82
3.4.	Limitation of Data Handling	84
3.5.	Summary	85
CHAPTER 04: BACKGROUND DATA AND PRELIMINARY ANALYSIS		86
4.1.	Introduction.....	86
4.2.	Suburban Transport System	86
4.2.1.	Bus Passenger Transport.....	87
4.2.2.	Private Motorized Transport	88
4.2.3.	Non Motorized Transport.....	88
4.2.4.	Rail Transport	89
4.3.	Approach for Trip Generation.....	90

4.3.1.	Factors Affecting Suburban Trip Generation.....	91
4.4.	Approach to Trip Distribution Modeling.....	94
4.4.1.	Non-Household Electricity Consumers.....	95
4.4.1.1.	Bulk Consumers.....	96
4.4.1.2.	Retail Consumers.....	96
4.5.	Approach to Mode Split Models.....	97
4.6.	Preliminary Analysis of Travel Data from Household Surveys.....	99
4.6.1.	Effect of Population Activities.....	103
4.6.2.	Effect of Distance to City Centre.....	104
4.7.	Summary.....	105
CHAPTER 05: CALIBRATION AND VALIDATION OF TRAVEL FORECASTING MODELS FOR SUBURBAN AREAS.....		107
5.1.	Introduction.....	107
5.2.	Calibration of Trip Generation Model.....	107
5.2.1.	Some Basic Models.....	107
5.2.2.	Approach for Selection of the Best Model.....	110
5.2.3.	Final Trip Generation Model.....	112
5.2.4.	Validation of Trip Generation Model.....	115
5.2.5.	Summary & Conclusion.....	116
5.3.	Calibration of Trip Distribution Model.....	117
5.3.1.	Selection of TAZs for OD Matrix.....	119
5.3.2.	Distribution of Trips.....	119
5.3.3.	Calibration process.....	121
5.3.4.	Statistical Examination of Residuals.....	123
5.3.5.	Validation of Trip Distribution Model.....	125
5.3.6.	Summary and Conclusion.....	126
5.4.	Calibration of Mode Split Models.....	126
5.4.1.	Private motorized mode split models.....	128
5.4.2.	Public transport mode split models.....	131
5.4.3.	Non-motorized mode split models.....	134
5.4.4.	Validation of Mode Split Models.....	138
5.4.5.	Summary and Conclusion.....	143
5.5.	Traffic Assignment to the Local Road Network.....	144
5.5.1.	Introduction.....	144
5.5.2.	Trip Assignment Model Approaches.....	145
5.5.2.1.	Statewide Traffic Assignment Models.....	145
5.5.2.2.	Small Area Traffic Assignment Models.....	146
5.6.	Time Series Analysis of Electricity Data.....	146

5.7.	Limitation of the Model Usage	152
5.8.	General Summary	152
CHAPTER 06: DEVELOPMENT OF THE COMPUTER PROGRAMME AND THE MODEL APPLICATION		153
6.1.	Development of the Computer Software.....	153
6.1.1.	Data Inputs Forms.....	153
6.1.2.	Results Output.....	155
6.2.	The Computer Programme.....	156
6.3.	Trip Generation and Mode Split Estimates Using STEP	157
6.4.	Trip Distribution Estimates Using STEP	158
6.5.	Summary	160
CHAPTER 07: CONCLUSION AND RECOMMENDATIONS		161
7.1.	General	161
7.2.	Research Conclusion.....	162
7.3.	Recommendation and Future Research.....	164
REFERENCES.....		166
ANNEXURES.....		172
Annex I: Statistic Test for Parent and Sample Populations of Domestic Electricity Consumption.....		173
Annex II: Observed O-D Trips in Maharagama DSD		174
Annex III: Estimated Trips against Observed Trips by Different Modes		175
Annex IV: Difference between Observed Total Trips and Estimated Sum of Trips by Mode Split Models.....		176
Annex V: Input Data Set for Travel Estimates at Moratuwa DSD		177
APPENDICES		178
Appendix I: Data Collection Survey Form for Households Surveys.....		179
Appendix II: Development of STEP Program		180

List of Tables

Table 1.1: Variation of Urban Factor by DSD in Colombo District.....	10
Table 1.2: Household Electricity Consumers at DSD Level in Colombo District.....	12
Table 2.1: Cross-Classification Trip Rate Table by (OMPO, 1982).....	38
Table 2.2: Average Daily Person-Trips by Household for Madison, (1962).....	39
Table 2.3: Classification of household based on physical and utility type	42
Table 2.4: Household grouping based on their economic strength and ECU level	42
Table 2.5: Electricity consumption and trip generation rates.	43
Table 2.6: Electricity consumption of household and average vehicle ownership	48
Table 2.7: Relationship between household electricity consumption and trip length	56
Table 3.1: Total households by Physical and Utility Type and Sample Distribution achieved	75
Table 3.2: Population with Different Activities from Study Areas	76
Table 3.3: Descriptive Statistics of Domestic Electricity Consumption and Distribution	82
Table 3.4: Descriptive Statistics of Non-Household Electricity Consumption and Distribution	84
Table 4.1. Comparison of Modal Share by Trip Length of Passenger Transportation	87
Table 4.2: Daily Observed Trip Generation Frequencies	99
Table 4.3: Observed Daily Trip Generation Frequencies by Mode	100
Table 4.4: Vehicle Ownership Rates in Suburban Area	101
Table 4.5: Effect of Vehicle Ownership on Trip Generation & Electricity Consumption	102
Table 4.6: Activity Based Trip Generation in Suburban Areas	104
Table 5.1: Initial Statistic Significant Test for all Variables.....	109
Table 5.2: Development of the Best Model from Basic Models.....	110
Table 5.3: Statistical output from SPSS for Model M4	115
Table 5.4: Percentage (%) of Trips Based on Trip Purpose.....	119
Table 5.5: Observed and Estimated Total Trip Ends at Different Regions from Both Surveys.....	126
Table 5.6: Parameters for Mode Split Models	136
Table 5.7 : Statistics of model fit if calibrated using electricity consumption alone	138
Table 5.8: Mode Based Trip Rates by Non Electricity Users.....	144
Table 6.1: Trip Generation and Mode Split Results for Moratuwa DSD	157
Table 6.2: Trip Distribution Estimates for Moratuwa DSD Area.....	159
Table 6.3: Trip Ends to Major Zones.....	160

List of Figures

Figure 1.1: Population Density by Divisional Secretariat Divisions in Colombo District.	11
Figure 1.2: Distribution of DSD in CMR	14
Figure 1.3: Two Study Areas in Colombo Suburbs	16
Figure 1.4: Flow Diagram of the Research Activities.....	18
Figure 2.1: ECU Vs Income for the US in 1997	24
Figure 2.2: The Basic Hypothesis of Urban Travel Demand.....	27
Figure 2.3: Model Development as an Iterative Process.....	28
Figure 2.4: Trip Generation Vs Age by Gender.....	44
Figure 2.5: Car Ownership and Trip Rates against Household Electricity Consumption Units	49
Figure 2.6: Regression fit of observed OD trips Vs Estimated OD trips	55
Figure 3.1 : LECO Served Area in the CMR.....	78
Figure 3.2: Domestic Electricity Consumption Frequency Distribution of Parent and Sample Populations in the Maharagama Study Area.....	80
Figure 3.3: Domestic Electricity Consumption Frequency Distribution of Parent and Sample Populations in the Moratuwa Study Area.....	81
Figure 3.4: Non-household Electricity Consumption Frequency Distribution of Retail and Bulk Consumers in Western Province	83
Figure 4.1: Average Household Electricity Consumption Vs Trip Rates by Major Mode Types	98
Figure 5.1 : Behaviour of independent variables in the model.	114
Figure 5.2: Validation with Observed Trips Vs Estimated Trips using Model M4 at Moratuwa DSD.	116
Figure 5.3: Observed Trip Distribution by Length in the Study Area	120
Figure 5.4: Linear Regression Fit between Observed Trips and Estimated Trips of O-D Pairs.....	122
Figure 5.5: Observed Trips and Residuals	124
Figure 5.6: Regression Standard Residuals of Observed Trips.....	124
Figure 5.7: Observed O-D Pairs Against Estimated OD Pairs.....	125
Figure 5.8: Model Behaviour of Mode Selection with Average Household Electricity Consumption	137
Figure 5.9: Observed Against Estimated Car Trips	138
Figure 5.10: Observed Against Estimated Van trips.....	139
Figure 5.11: Observed Against Estimated Motor Bicycle trips	139

Figure 5.12: Observed Against Estimated Bus trips	140
Figure 5.13: Observed Against Estimated Train Trips	141
Figure 5.14: Observed Against Estimated Three Wheeler Trips	141
Figure 5.15: Observed Against Estimated Bicycle Trips.....	142
Figure 5.16: Observed Against Estimated Walk Trips	143
Figure 5.17: Average Monthly Household Electricity Consumption Since 1970.....	147
Figure 5.18: Average Monthly Household Electricity Consumption Against Total Consumption	147
Figure 5.19: Total Annual Household Electricity Consumption against GDP	148
Figure 5.20: Average Household Electricity Consumption Against GDP	148
Figure 5.21: Per Capita Electricity Consumption (All Types) Against GDP	149
Figure 5.22: Per Capita Electricity Consumption (All Types) Against GDP	149
Figure 5.23: Distribution of Household Electricity Consumption in Different Areas	150
Figure 5.24: Distribution of Household Electricity Consumption with Distance from Colombo.....	151
Figure 6.1: Suburban Travel Estimation Programme (STEP) Software	153
Figure 6.2: Data Inputs from Origin Zones.....	154
Figure 6.3: Data inputs from Destination Zones.....	155
Figure 6.4: Trip Generation Results Output.....	155
Figure 6.5: Mode Split Results Output	156
Figure 6.6: Trip Distribution Matrix Results Output	156

List of Abbreviations

ADT – Average Daily Traffic
ATM – Automated Teller Machines
CBC - Cluster Bus Company
CBD - Central Business District
CD – Compact Disc
CEB - Ceylon Electricity Board
CMC – Colombo Municipal Council
CMR - Colombo Metropolitan Region
CoV - Coefficient of Variation
CTB – Ceylon Transport Board
DCS - Department of Census and Statistics
DOT – Department of Transportation
DSD – Divisional Secretariat Divisions
ECU – Electricity Consumption Unit
FHWA – Federal Highway Authority
GDP – Gross Domestic Product
GIS – Geographic Information System
GND – Gramaseva Niladhari Division
GWhrs – Giga Watt Hours
HC - Hourly Capacity
ITE - Institute of Transportation Engineers
kWh – Kilo Watt Hour
LECO - Lanka Electricity Company (Private) Limited
LSE - Least Square Estimation
MC – Municipal Council
MWhrs – Mega Watt Hours
NCHRP – National Highway Cooperative Research Program
NhEcu – Non- Household Electricity Consumption
NTC - National Transport Commission
OD – Origin and Destination
PEF - Pedestrian Environment Factor
POA - Private Omnibus Association

PS – Pradeshiya Sabha
RDA – Road Development Authority
RMV – Registrar of Motor Vehicles
RTB - Regional Transport Board
SLCTB - Sri Lanka Cluster Bus Company
SLR – Sri Lanka Railway
SMITE - Spreadsheet Model for Induced Travel Estimation
STEP - Suburban Travel Estimation Program
TAZ - Traffic Analysis Zone
TC – Town Council
U.S. – United States
UC – Urban Council
UDA – Urban Development Authority
UK – United Kingdom



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