

TRIP GENERATION ANALYSIS IN THE DEVATHANAM WARD OF TIRUCHIRAPPALLI CITY (TAMIL NADU)

Sivaprakash¹ Nisha Radhakrishnan²

¹Post Graduate student ²Assistant Professor

¹Transportation Engineering and Management ²Department of Civil Engineering

^{1,2} National Institute of Technology, Tiruchirappalli.

Abstract— Transportation planning involves a four step planning process in which trip generation plays a vital role. The most common method of analyzing trips generated is to utilize a travel demand model that considers socio economic factors based on anticipated land use, household and employment changes. This project estimates the trip generations and choice of transport modes in the study area. The current travel trends are analyzed by conducting Home Interview Survey in the study area. Numbers of trips made in the study area in terms of trip purpose, mode of travel, travel time were analyzed. Based on these data, statistical models were developed by considering population, employment, socio economic characteristics. For the present population and employment, the travel characteristics are estimated from the travel demand model.

Key words: Travel Demand, Home Interview, Trip Purpose, Travel time, Travel pattern.

I. INTRODUCTION

The demand for transportation in the urban centers is linked to the residential location choices that people make in relation to places to work, shopping, entertainment, schools and other important activities. Increasing demand for transportation is an inevitable outcome of urban growth. Increasing urbanization, population growth and rising incomes are the primary causes of rapid growth of travel demand in Indian cities. During the last decade, motor vehicle ownership in several metropolitan cities (those with over 1 million population) has been growing at nearly 10% per annum.

Travel demand occur as a result of thousands of individual travelers making individual decisions on how, where and when to travel. Such decisions are affected by many factors such as family situations, characteristics of person and choice (destination, route and mode) for the trip. The trip generation, trip distribution and modal split will provide the necessary tools for policy planning, alternate systems planning and project planning.

This project provides an analysis for the travel trend in the study area. Also this provides a modelling approach for analyzing travel demand in the study area.

II. NEED FOR THE STUDY

Travel demand forecasting is the process of estimating future travel demand and assigning it to an existing or future transportation network using a transportation model. In order to study the present scenario of travel trends, it is necessary to analyses the trip generation as a first stage of planning process. Trip generation data will assist the town planners in developing Public transport systems, and

integrating it with other modes of transport in the study area. Number of trips generated also give an idea about the traffic situation prevalent in the study area thereby suitable steps may be taken to improve the traffic movements during peak hours.

III. SCOPE OF THE STUDY

The scope of the study is to determine the reliability of currently accepted traffic forecasting methods and to develop new models to analyze the trips generated on the basis of various socio economic data which will help the planners to understand the travel behavior and needs of the people to improve the overall transport connectivity in the study area.

IV. OBJECTIVES OF THE STUDY

- 1) To analyze the trips generated from the study area by developing statistical models
- 2) To study the current travel trends in the study area
- 3) To develop statistical models for the trips produced in various purposes
- 4) To study the choice of mode selection in the households of the study area
- 5) To understand how demographic changes in the study area will affect the travel demand

V. METHODOLOGY

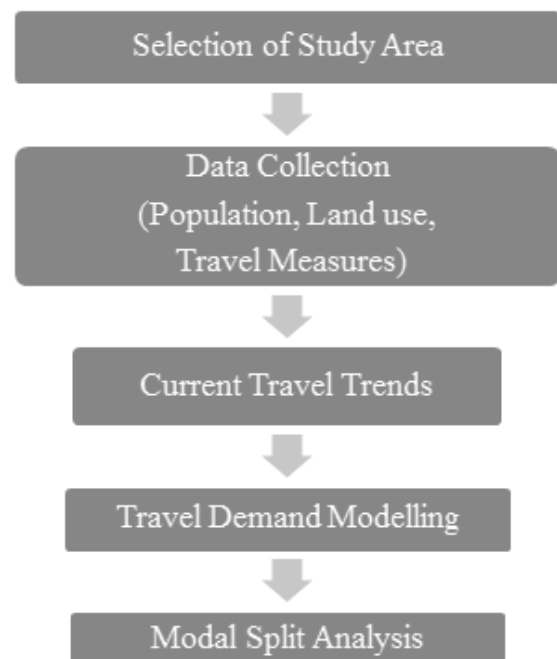


Fig. 1: Methodology

VI. STUDY AREA

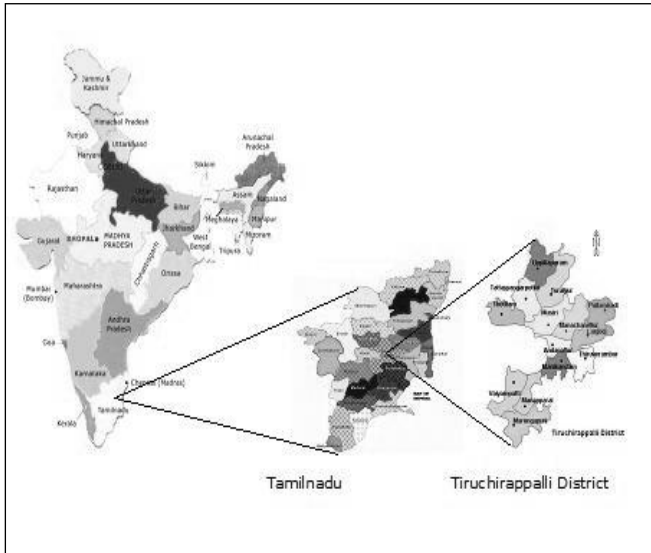


Fig. 2: Study Area

VII. LANDUSE CLASSIFICATION

Tiruchirappalli city in Tamil Nadu has sixty wards. The ward wise updated land use maps of Tiruchirappalli city was developed by using Remote Sensing and GIS techniques with the help of high resolution satellite image due to the unavailability of updated land use maps. In this study, the IRS – 1D PAN image (in 1998) and IRS – P6 LISS IV (in 2006) were used to generate the ward wise land use map. The steps for the ward wise AOI of Trichy city generated with the help of Arc GIS 9.2 and ERDAS Imagine 9.1. The different land use themes were identified by suitable visual interpretation and image classification procedure. Ground truth survey is also done to improve the accuracy of the land use classification. For this study, 6 sets of land use classes are considered. The land use maps are given in Figure 4 and 5.

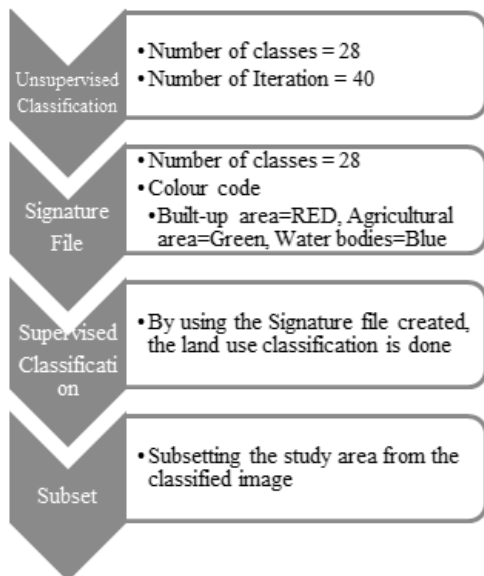


Fig. 3: Classification

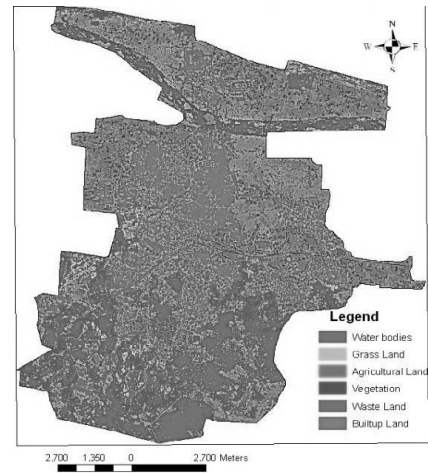


Fig. 4: Classified 1998 IRS image of Tiruchirappalli District

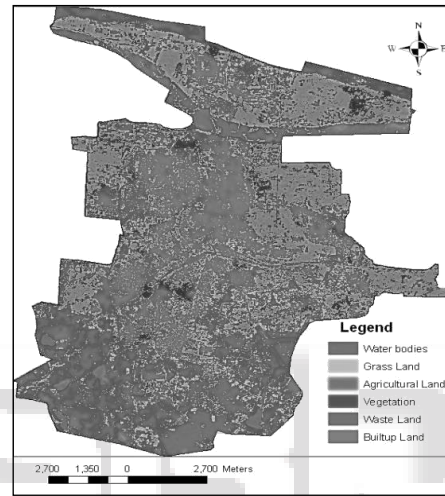


Fig. 5: Classified 2006 IRS image of Tiruchirappalli District

VIII. SELECTED STUDY AREA

Devathanam, the ward number 7 is coming under Ariyamangalam zone. This ward situated off NH-67. It is situated at a distance of 6km from the Chathram bus stand. The population and number of households in 2001 (*Website – 4*) and 2011 are given in the table

Sr. No	Description	Year	
1	Ward No.		07
2	Area in km ²		5.29
3	Population	2001	11263
4	Number of HH		2596
5	Density		2129
6	Population	2011	15340
7	Number of HH		4318
8	Density		2900

Table 1: Population and number of Household

Increase in Population Density is 36% over 10years and the increase in number of households 1722.

IX. TRAVEL BEHAVIOUR STUDY

Home Interview Survey is the one of the most reliable type of surveys for collection of origin and destination data. The survey is essentially intended to yield data on the travel pattern of the residents of the household and the general characteristics of the household influencing trip-making. It is impractical and unnecessary to interview all the residents of the study area. The sample size for the Home Interview Survey is taken as 10% of the total number of residents in the study area. The total number of households in the study area is 4318.

A. Trip Purpose Distribution

The data showed 51% work based trips followed by 30% school trips were produced in the study area as shown in figure 6.

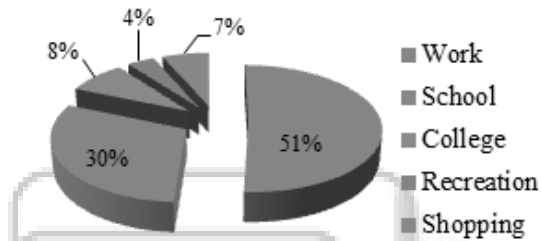


Fig. 6: Trip Purpose

B. Travel Mode Distribution

32% people preferred two-wheeler as the mode of travel followed by 30% giving preference to Bus travel. Rest 38% was shared by other modes of travel as shown in figure 7.

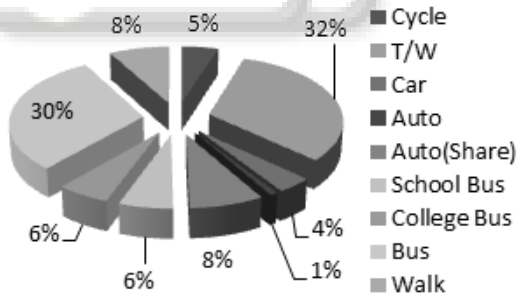


Fig. 7: Model of Travel

C. Type of organization

The type of organization that was surveyed in two categories namely Government and Private. The distribution of the organization is shown graphically in figure 8. It is observed that 91% of the organizations are private and 9% are government.

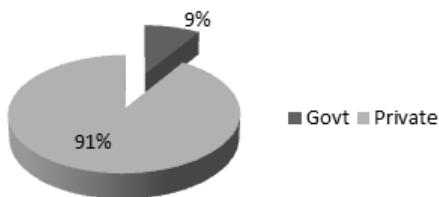


Fig. 8: type of organization

D. Gender Classification

The distribution of employees by gender is shown in the figure 9. It is observed that 84% of them are male and 16% of them are female are working in the commercial areas considered. Out of the surveyed employees, 79% are male and 21% are female.

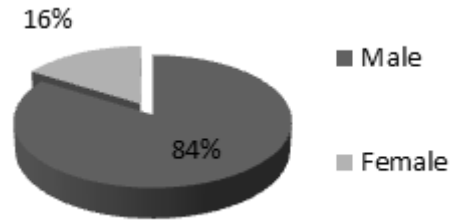


Fig. 9: Total Employees

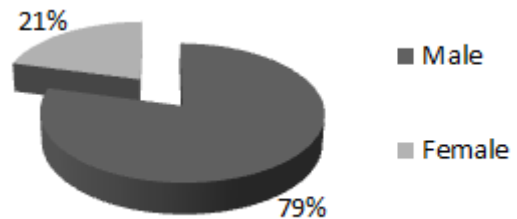


Fig. 10: Surveyed Employee

E. Temporal Distribution of modes of vehicles

During morning peak hour, for most of the trips two-wheelers were preferred followed by bus while walking was preferred for most of the evening travel trips.

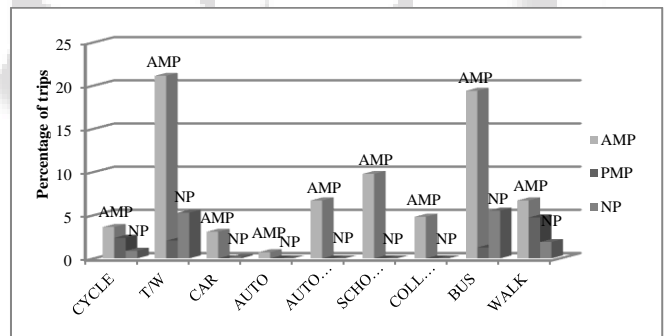


Fig. 11: Mode of Travel

F. Distribution of trips by purpose and travel distance

25% and 15% of the total trips accounted for work and school based trips respectively within a distance of 4 to 8km. Rest of the major trips were made within 4km as shown in figure 12.

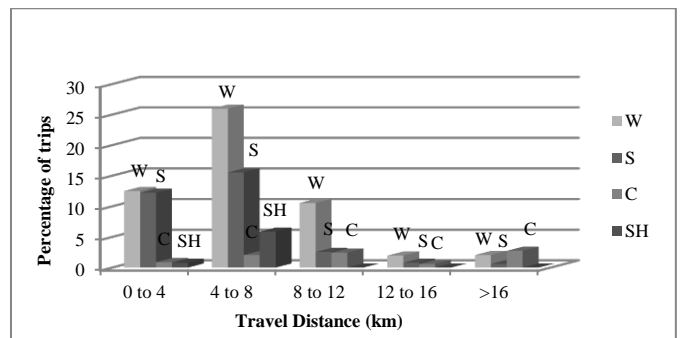


Fig. 12: Distribution of Trips for and Travel Distance

X. TRAVEL DEMAND MODELLING

A. Trip Production Analysis

In order to determine the dependence of trip rate on various trip production parameters, statistical models were developed. Trip production model estimate the number of home based trips to and from the study area where the trip makers resides. Linear regression models were developed to predict the trip rate of each household. For this purpose, the trips reported in the data were assumed to be journeys. Therefore for single journey the number of trips was taken as 2. All trips were found to be home-based. For the household trip rate model, 370 household samples were used, of these 75% were used to develop the model and remaining 25% were used for the validation of the developed model.

Purpose Code	Constant	Household size	Income	Distance	R ²	Actual trip rate	Observed trip rate
Work	1.405	0.573	0.174	-	0.80	3.72	3.88
Educa	0.705	0.342	0.098	-	0.72	2.24	2.20
Shopp	0.055	0.004	0.14	-	0.78	0.65	0.77
Recre	-1.494	0.495	0.235	-	0.69	1.43	1.34

Table. 2: Validation of the models with actual trip rate

B. Trip Attraction Analysis

Trip attraction model estimate the number of home based trips to and from the study area at the non-home end of the trips. In order to analyze trip attractions, the number of trips attracted to certain activities is related to a measure of the amount of that activity. In the commercial areas trips model, number of employees were taken as independent variable. Total trip rate was used as the dependent variable. For the trip attraction model, 65 commercial area samples were used, of these 75% were used to develop the model and remaining 25% were used for the validation of the developed model.

The trip attraction model was developed from the samples collected by conducting interview survey. Hence model has been developed as follows:

$$T = 2.991 + (2.118 * Emp)$$

$$R^2 = 0.951$$

Where, T = Household Trip rate, Emp = Number of employees in the company

C. MODAL SPLIT ANALYSIS

Modal split can be defined as the proportionate division of the total number of person trips between different modes of travel. It is the prediction of choice probabilities as functions of observed characteristics. Multinomial logic model was used to calculate the probability of occurrence of each particular mode of travel.

1) Utility Function

Based on the characteristics of the decision maker, the household variables in the mode choice models used are income, age of the traveller, number of vehicles in the households. The utility function for the work trips and education trips are found to be:

Work Trips:

$$U_w = 1.731 + (0.148 * VO) + (0.033 * Age) + (0.009 * Inc)$$

Education Trips:

$$U_e = 0.962 + (0.102 * VO) + (0.012 * Age) + (0.101 * Inc)$$

Where, VO – number of vehicles owned by the household,

Inc – Average Income of the household (Rs. in thousands)

2) Probability of mode choice

The Probability of occurrence of each mode of transport is given by

$$P = \frac{e^{U_i}}{\sum e^{U_x}}$$

Where, U_i = Utility value for the particular mode I, U_x = Utility value for all the modes considered

Mode of travel	Frequency	Percent	Cumulative %	U _w	Exp(U _w)	Probability	% probability
Bus	144	24.4	24.4	3.929	50.848	0.265	26.5
Car	94	15.9	40.3	3.202	24.561	0.128	12.8
Auto	17	2.9	43.1	1.754	5.776	0.030	3.0
T/W	266	45.0	88.2	4.517	91.527	0.477	47.7
Cycle	30	5.1	93.2	2.357	10.553	0.055	5.5
Walking	40	6.8	100.0	2.154	8.615	0.045	4.5
Total	591	100			191.88	1	100

Table. 3: Probability of mode choice of individuals of work trips

From the table 3, it is clearly seen that the probability of selecting two-wheeler as the mode is higher which is followed by Public bus. The working people are giving preference to two-wheelers and public bus to travel from the home to work place.

Mode of travel	Frequency	Percent	Cumulative %	U _w	Exp(U _w)	Probability	% probability
Bus	123	27.1	27.1	3.119	22.603	0.296	29.6
Car	2	0.4	27.5	0.087	0.916	0.012	1.2
Auto	79	17.4	44.9	2.491	12.065	0.158	15.8
T/W	17	3.7	48.7	0.472	1.604	0.021	2.1
Cycle	60	13.2	61.9	2.199	9.011	0.118	11.8
Walking	27	5.9	67.8	1.299	3.665	0.048	4.8
School/ College Bus	146	32.2	100.0	3.278	26.497	0.347	34.7
Total	454	100			479.45	1	100

Table. 4: Probability of mode choice of individuals of educational trips

From the table 4, it can be seen that the students (school or college) in the study area prefer School bus or college buses as their first choice of travel, which is followed by public bus.

XI. SUMMARY

In order to find the travel demand at present scenario, Home Interview survey was conducted in the study area to determine the purpose of the trip, mode that is being used by the people, the distance and travel time for the trips generated. The current travel pattern was analyzed with all the trip determining factors. Based on these factors, statistical models have been developed for the study area and validated with the samples. The total number of trips for different purposes and mode were found for the study area from the statistical model developed.

XII. CONCLUSION

Total samples collected from the Household interviews were 370 and commercial areas were 65, with a sample size of 10%. Findings from the survey can be as concluded below:

- 1) About 55% of the total households surveyed were owned by the residents themselves, while rest was rented households.
- 2) The average household size was found to be 5, with a maximum household size of 13.
- 3) Monthly income data for residential areas showed that 36% people were having a monthly income of Rs5000 - Rs10000, against 57% people in commercial areas. A total of 32% people in residential areas were found to have a monthly income between Rs10000 -Rs20000 in comparison to 29% in commercial areas.
- 4) Two wheelers stood out as the most preferred mode of travel with 32% and 45% in residential and commercial areas respectively, while 30% and 38% people opted for public transport systems in residential and commercial areas.
- 5) Temporal distributions showed 86% morning peak hour trips are generated in residential areas whereas it accounted for 85% in commercial areas. The majority return trips in residential areas were made during evening peak hour accounting to 79% against 88% in commercial areas.
- 6) About 49% of the total trips generated were within 4 km – 8 km in residential localities whereas in commercial areas it was restricted within 2 – 4 km.
- 7) The survey data showed that 26% trips in residential areas are work based and are limited to a distance of 4km – 8km. College based trips accounted for 4% of the trips ranging in a distance from 8km – 12km, whereas about 15% were school based trips within 4km – 8km.
- 8) The statistical models so developed on the basis of these travel patterns in residential areas showed a total of 11608 work based trips followed by 7916 educational trips per day. 1637 shopping based trips and 1112 recreational trips were found to be generated in the study area per day.
- 9) The preferred mode by the individuals for the work trips were found to be 47.7% for two-wheelers followed by 26.5% Public bus and for the educational trips 34.7% for School or college bus and followed by 29.6% for public buses.

XIII. FUTURE WORK

- 1) The present study involved collecting vast exhaustive data for one ward of Tiruchirappalli city to analyse the trip pattern produced, but more works can be done in the future studies.
- 2) Due to large data being used for analysis, it is difficult to collect such a large data. Thus by reducing the sample size, the study can be conducted for all the wards of the city area. This data can then be used to formulate a base O-D matrix between different wards for the trips produced.
- 3) Changes in land use can be considered as an important trip affecting criteria and can be incorporated in future studies.

XIV. REFERENCES

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