

TRIP DISTRIBUTION ANALYSIS: A CASE STUDY OF VADODARA CITY

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Abstract

Trip distribution analysis involves determination of the pattern of trip interchanges between various zones. The main objective of this paper is to distribute the present trips within study area by TransCAD. Also to present an overview of the second stage of travel demand modeling i.e. trip distribution by gravity model. The previous papers have been reviewed whereby gravity model have been developed and in which various functions for different trip purposes have been calibrated.

Keywords- Trip Distribution; TransCAD; Gravity Model; Trip Purpose; Deterrence Functions

I. INTRODUCTION

Urbanization is an index of transformation from traditional rural economies to modern industrial one. It is taking place at a faster rate in India. The process of urbanization increases both the number and size of town and cities. With this, there is a requirement for a good transport networks. Due to this, there is many transport activity like traffic fatalities and injuries, congestion, pollution etc. occurs.

With increase in population, Vadodara started facing problems of traffic, parking, pedestrian's safety, congestion in the city. The solution may include,

- Land use and city planning controls
- Transportation studies are to be carried out and plans for new roads and reorganization of existing network are to be formulated
- Traffic restraint measures like restriction in parking & road charges etc.

Construction of new facility needs long time of span and generally this type of improvement is included in long range plans. So the society demands increasing care and professional competence in the planning and operation of all transportation system.

Urban transportation planning can be defined as a systematic planning of traffic and transport characteristics with the goals of producing safe, efficient and convenient transport system which can meet current as well as future needs of community. It is a science that arises in providing transportation facilities in an urban area and to prepare a systematic basis for planning such facilities.

Urban Transportation Planning Process (UTPP) is a multistage process which includes transportation models such as trip generation, trip distribution, mode choice and trip assignment. In transportation planning, it is of utmost importance to have an accurate model for forecasting the

distribution of trips between origin and destination zones, as these trips are used as input into the process of assigning trips across the network.

II. GRAVITY MODEL

This model originally generated from an analogy with Newton's gravitational law, which states that the attractive force between any two bodies is directly related to their masses and inversely related to the distance between them. Similarly, in the gravity model, the number of trips between two zones is directly related to activities in the two zones, and inversely related to the separation between the zones as a function of the travel time.

$$T_{ij} = K_{ij} * O_i * D_j * F(d_{ij}) \quad \text{Eq. (1)}$$

Where,

T_{ij} = Future number of trips from zone-i to zone-j

K_{ij} = constant value (initial value = 1)

O_i = total number of trips end originated in zone-i

D_j = total number of trips end destined to zone-j

$F(d_{ij})$ = the generalized function of the travel cost, which is called deterrence function because it represents the disincentive to travel as distance (time) or cost increases.

The versions of this function are:

1) Exponential Function,

$$F(d_{ij}) = e_{ij}^{-bd_{ij}} \quad \text{Eq. (2)}$$

2) Power Function,

$$F(d_{ij}) = d_{ij}^{-b} \quad \text{Eq. (3)}$$

3) Combination Function,

$$F(d_{ij}) = d_{ij}^{-b} * e_{ij}^{-bd_{ij}} \quad \text{Eq. (4)}$$

Where, b value depends on the trip purpose and is shown in Table 1:

Table 1 Value of b

Work	0.5-2.0
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Shopping	1.5-2.0
Recreational	2.0-2.5
Other Purpose	2.0-2.5

* Modi K. B. "Transportation Planning Models: A Review", NCRTE (2011)

III. LITERATURE REVIEW

(1) Study done by Abdel et al in Alexandria (2014) serves as a framework for calibrating a gravity model for the purpose of analyzing the travel behaviour for different purposes... The proposed model demonstrates the different patterns of trip distribution per purpose. It also shows a considerable shift toward non-compulsory trip purposes in the city of Alexandria. Also, the value for dispersion parameter ranges between 0.12-0.14.

(2) Study done by Jin & Yang (2014) shows that LBSN (Location based social networking) has increased in popularity and sophistication, emerging as a new travel demand data source. Users of LBSN provide location-sensitive data interactively via mobile devices, including smartphones and tablets. This data has the potential to provide origin-destination estimates. The proposed methodology is calibrated and comparatively evaluated against the OD matrix generated by gravity model based method as well as a reference matrix from the local metropolitan planning organization. The results of this method illustrate significant improvement in reducing the OD estimation errors caused by the sampling bias from the gravity model based method.

(3) Study done by Guler in Turkey (2014) aims to calculate the transportation demand of the Marmaray corridor. The model was used to estimate freight and passenger transportation between Istanbul and other Turkish provinces. The estimated results were used to calculate the required train numbers on a daily basis through the Marmaray corridor and some suggestions were put forward to increase the capacity of this corridor.

(4) Study done by Zala K in (2013) describe the calibration of a gravity model for various trip purposes like business, service and home and also for the same, the value for the deterrence functions ranges between 1 to 3 depending upon travel factors.

IV. NEED OF STUDY

With increase in population, numbers of motor vehicles are also increase day by day. Though it gives comfort to road user, have generate certain problems like congestion, lack of safety, degeneration of environment. The situation already becomes unmanageable in many cities.

In order to understand the nature of this problems and formulate proposals for the same and efficient movement of people and goods from one place to another place, transportation planning is important.

V. OBJECTIVE

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- To study trip generation characteristics
- To collect origin-destination data by household survey
- To distribute observed trips within Vadodara City

VI. STUDY AREA

Vadodara has a population of almost 1.6 million people (as of census 2011). Vadodara is the third largest city in the Indian state of the Gujarat. It is the administrative headquarters of Vadodara District. It is located on the banks of the Vishwamitri River, southeast of Ahmedabad, 139 km from state capital, Gandhinagar. Both the railway line and national highway connecting Delhi and Mumbai pass through Vadodara. The two main institutions involved in planning and development in Vadodara are VMC and the VUDA.

Vadodara is also connected with Ahmedabad through Indian National Expressway 1, a stretch of 97 km Super Highway with exits at Anand, Nadiad, S.P.Ring Road and finally Ahmedabad. In near future, this Expressway will be extended southwards from Vadodara all the way up to Mumbai.

The study area was divided into 12 zones based on population data and ward data.

The zoning of Vadodara city in TransCAD software is shown in Fig 1:



Figure 1 Zoning of vadodara city

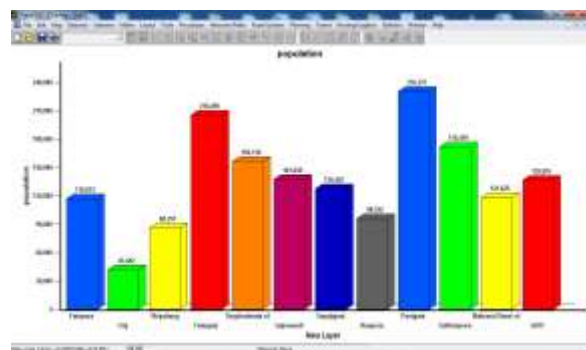


Figure 2 Population data of vadodara city

VII. METHODOLOGY

As the study area is Vadodara city, Zoning was done according to ward wise as per data collected from Vadodara Municipal Corporation. The map was imported in TransCAD. The household survey was conducted in the city and 808 samples were collected from all zones. This data was transformed in excel sheet. By using this sheet, O-D matrix and desire line diagram was made in TransCAD.

VIII. ANALYSIS & RESULT

From the survey of **808** House Holds, O – D matrix is prepared with the help of TransCAD as shown in Fig.3

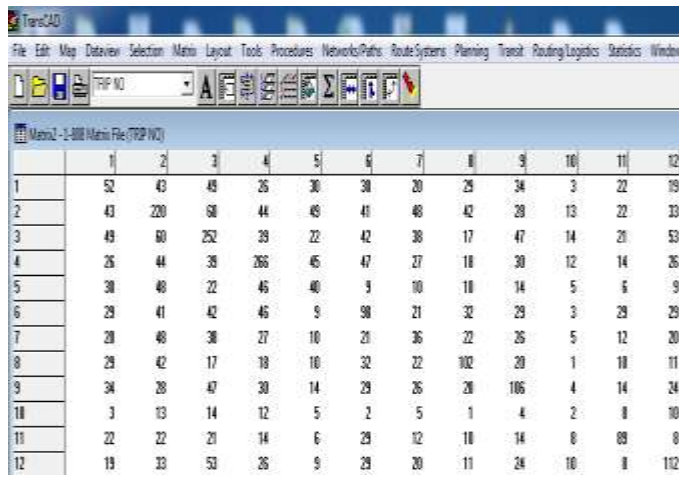


Figure 3 Observed origin & destination matrix

The desire line diagram for observed trips are prepared with the help of transCAD software using observed O – D Matrix and is given in Fig.4

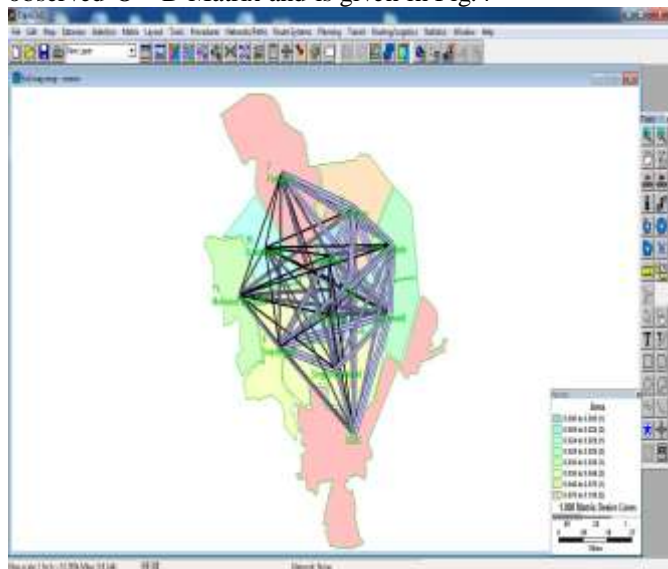


Figure 4 Desire line diagram for observed trips

IX. CONCLUSION

The generated trips from each zone are distributed to all other zones based on the choice of destination. The distribution of trips is based on attraction of zones so the various purpose wise trips are shown in below table 2:

Table 2 Number of trips observed as per purpose

Trip Purpose	No of Trips
Work	1167
Education	739
Shopping	315

Shopping trips includes recreational and other trips. Also desire line diagram can be used to find the dominant traffic direction in Vadodara city & by this we can provide various transportation systems or can improve the existing systems.

X. REFERENCES

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