Review on Techniques for Mode choice analysis of Urban Residents

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Abstract: Transportation planning plays a significant role in the state, region and community's vision for urban development in future. The population in the growing city throughout world is continuously increasing. The highly populated city in the world is Chongqing in China with population of 30,165,500 at first rank [13]. The private vehicle ownership as number of two-wheeler and four-wheeler increasing rapidly [8]. Use of public transport is quite less and ignored in comparison to private transport facilities [14]. Mode choice behaviour of urban inhabitants plays an influencing role in transportation planning decisions. Choice of a particular mode affect the general efficiency of travel in the city. To conduct different activities urban residents makes trip by choosing various mode of travel. The various purposes of trip are Business, Service, Education, Work, Social, Recreation and Religious. Mode choice analysis is the third step after trip generation and trip distribution of the classical four-stage transportation planning process. Mode choice can be expressed in percentage, fraction or ratio. For mode choice modelling different techniques are available in the literature. As per percentage distribution among captive transit rider and choice rider there is possibility of mode choice shift of travel. Selection and Probability of each trip mode of travel is different for every urban resident. Socio-economic parameters and travel characteristics are important factors for selection of different modes of travel.

Keywords: **Mode choice, Population, Public transportation, Transportation planning, Vehicle ownership.**

I. INTRODUCTION

Transportation plays a significant role in country's economy. Mode choice analysis is the method of arriving at a choice about which mode to use under a set of circumstances. Travel characteristics and use of specific mode of travel of any area are important for transportation planning. Increase in population of developing countries like India number of captive transit rider and choice transit riders are also increasing. The cities; Mumbai, Delhi, Bangalore, Hyderabad and Ahmedabad are the top five cities with high population in India [7]. The use of private transportation mode public transport user is very less. More use of private vehicles increases the problems of traffic, congestion, vehicle parking, delay, air pollution, noise pollution and increase in travel time. Efficiency of road space reduces due to a greater number of private vehicle users. Use of public transport facilities can increase the efficiency of road and also solve the problems of traffic congestion and vehicle parking. To minimize various problems of urban area, mode shift from private vehicle to personal vehicle for transportation planning is required. For Transportation planning it is necessary to find out number of users with specific mode of travel.

Vehicle ownership rate for various countries is as shown in Table 1. It is by region, vehicles per 1000 people. The country with the highest motorization rank in the world from 1999 to 2016 [19].

Table 1 Motorization rates comparison by region and selected countries

Rank	Country/Region	1999	2006	2016
1	United States	790.1	840.7	831.9
2	Canada	560.0	599.6	686.3
3	Pacific	513.9	524.7	634.9
4	Western Europe	528.8	593.7	606.0
5	Eastern Europe	370.0	254.4	362.1

(Source: Motorization rates comparison by region and selected countries)

Number of two-wheeler and four-wheeler users are increasing rapidly in comparison to public transport in India [17]. In Ahmedabad Gujarat, total 25.9% of two-wheeler and 3.9% four-wheeler users are there [16]. More number of people uses private mode of transport than public transport in Ahmedabad. Ahmedabad having two bus transit system for public transportation namely Bus Rapid Transit System (BRTS) and Ahmedabad Municipal Transportation System (AMTS). Top ten cities with best public transportation in the world are Berlin, Shanghai, London, Madrid, Paris, Seoul, New York, Singapore, Tokyo and Hong Kong [20]. In India Mumbai, Delhi, Indore, Kolkata, Chennai and Bengaluru are best in Public transportation respectively [21].

Table 2 Transportation mode share of Ahmedabad city

Mode	Percentage mode share
Walk	37.2
Bicycle	9.0
Auto-rickshaw	6.1

BRTS	10.3
AMTS	1.1
Cars	3.9
Two-wheeler	25.9
Others (School bus, Staff buses, GSRTC, Rail)	6.3

(Source: Detailed Project Report for Ahmedabad Metro Rail Project)

Fig. 1 shows the comparison of different mode of travel in India starting from 1951 to 2015. Chart shows the number of two-wheeler are increasing with time [2].

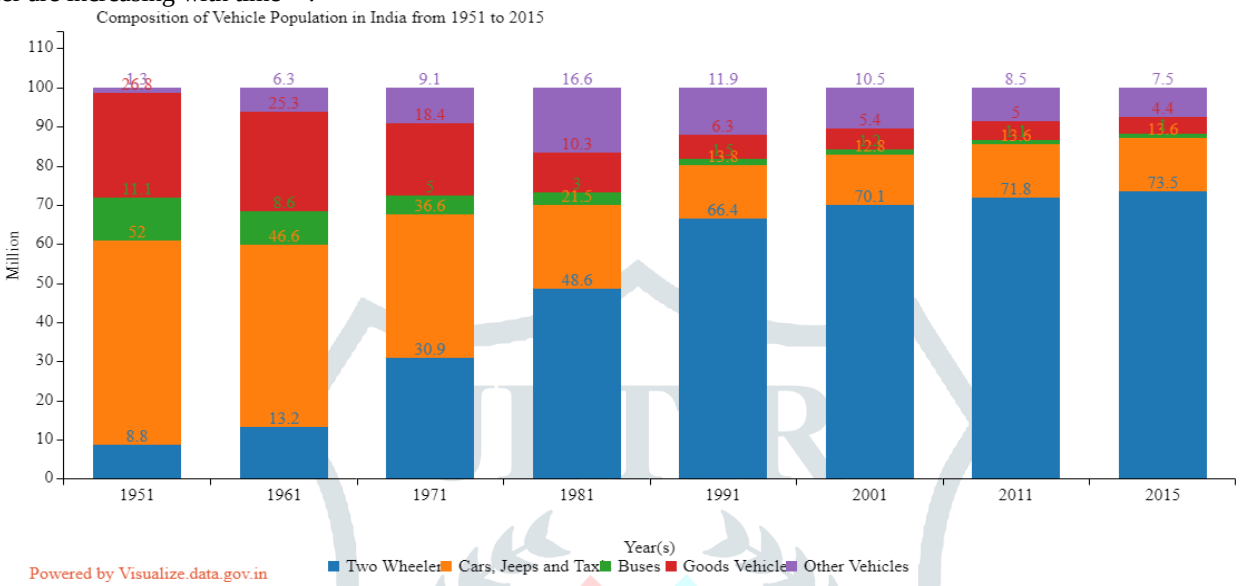

Fig. 1 Comparison of different mode of travel in India

Use of mode choice analysis; it is easy to find out number of trips generated by specific mode of travel. Number of trips can be expressed as fraction, percentage or ratio. Ahmedabad is amongst those cities which has a greater number of private transport users. Public transportation facilities can reduce different problems of urban area. This study aims at analyze the behaviour of urban residents for selection of public and private transportation which is necessary for transportation planning.

II. LITERATURE REVIEW

Fanglei Jin et al. (2017) [3]; The main study of this paper includes the case study of Suzhou city china and mode choice behaviour of citizens derived using Multinomial logit model. Under the rapid development of public transportation, a case study was processed to study the citizens mode choice behaviour. A stated preference survey was carried out to analyzed the mode choice pattern of citizen under different scenarios and MNL model were developed. The conclusion shows that in-vehicle time, non-in-vehicle time, cost and number of transfers has affect majorly on mode choice pattern of citizen. Middle and young aged people favour public transportation and people with higher income uses car and taxi as a mode of travel. Some of the policy implications also suggested for increasing the use of public transportation mode.

Arnab Jana and Varun Varghesea (2017) [1]; The paper analyze choice of model for inter-regional travel for India. This paper considers the four type of trips namely Social trips, Pilgrimage trips, Health trips and Shopping trips. The information was collected on native tourism from home interview survey in 2008 to 2009 in India. Sample size for the survey were 1,53,308 households and data collected from 8,109 samples from village and 4,719 samples from urban areas. For the analysis of the data binary logit model were developed from collected data and mode of travel considered were on feet, Bus, Trains, Air travel, own private transportation and Rental transportation. The individual data were segregated from urban area and rural area and the trips were separated into same day and overnight trips. Binary logit model analyzed the Socio-economic parameters, Trip characteristics, Time of year, Purpose of trip and Type of stay were influencing factors which derived from the model. Results shows that trips within district and urban areas made by Bus and trips outside the district made by the trains. In rural areas rental transportation mostly used for Health trips. Pilgrimage trips made by walk and as distance increases private and public transportation also increases.

Jayesh Juremalani and Krupesh A. Chauhan (2017) [6]; Comparison between different mode choice models for work trip has been carried out using data mining process. Personal characteristics and trip characteristics which were taken as independent variable and have been considered for development and analysis of different models. Study considers the development of three models namely MNL, Boost tree and SVM models. Among all of these models Boost tree model found to be superior model than all other models because it has higher accuracy.

Minal et al. (2016) [11]; Study mainly aims on development of mode choice model for behaviour of commuters in Delhi using Random Forest (RF) decision tree (DT) model and Multinomial Logit (MNL) model. For this purpose, household survey was carried out and 5000 sample were collected from Delhi. In this study major mode of transportation considered were Two wheelers, Private car, Bus, Metro, Auto Rickshaw and Bicycle. For mode choice analysis purpose WEKA6.3.9 software has been used. The results

show that Random forest-based decision tree model have the higher prediction accuracy of 98.96% and Logit model have accuracy of 77.31% which shows that RFDT model has higher accuracy and superiority.

Wencong Wang et al. (2015) [18]; Authors were analyses the factors affecting on the mode choice of travel for urban residents, and use of Revealed Preference data and Stated Preference data for development of a multinomial logit model. The study provides a theoretical background for use of traffic policy to improve the structure of a public transportation system and improvement needed for more use of public transportation. Mode choice analysis carried out after implementation of BRT service. Based on the data of personal characteristics and trip characteristics MNL model was developed and utility of each mode of travel has derived. The result shows that different factors have different influencing degree on mode choice. Females were more likely to use BRT and also ticket price and speed of BRT affect most for selection of mode of travel.

Minal and Ch. Ravi Sekhar (2014) [12]; This paper focused on review of mode choice study and analyzed as a transportation planning process. Disaggregate model found to be most useful and accurate model and specifically Multinomial logit model gives the specific and accurate result in this study. The conclusion of the study derives the different influencing factors like trip characteristics, comfort, convenience and characteristics of mode which affect most to the traveler. In this study comparison of use of different model given and accordingly disaggregate model has given more empathizes for mode choice modelling. Also, hybrid fuzzy model gives the most accurate results with compare to any other individual models.

G R Amrutha Lekshmi et al. (2014) [4]; This paper considers trip-based method and tour-based modelling were the approaches used aimed at travel demand modelling. Thiruvananthapuram, capital of Kerala was considered as study area and data of socio-economic and travel characteristics were collected by home interview survey method. Utility functions were developed for each mode of travel and analysis shows that variables such as vehicle ownership, age, income, cost of travel and time of day were identified as influencing variables. based on all variables MNL model was developed using SPSS software package tool. Result shows that socio-economic and travel characteristics have higher influence on selection of travel mode. The developed model can be used to forecast the types of activity outlines and creating the mode preference of the residents.

R Ashalatha et.al. (2013) [15]; In this paper author has analyzed statistical mode choice models such as multinomial logit model. The study used multinomial logistic regression for analysis of mode choice behaviour of travelers in Thiruvananthapuram city. Data of Socio-economic and trip characteristic were collected. Total 739 samples were collected and based on that data analysis were carried out. In survey they have collected data like age, gender, income, trip purpose, trip length, travel time and travel cost. Then MNL model developed and influencing factor on trip were determined. This paper concludes that lower age group uses bus whereas performance to car is higher among higher age group. Male commuters given preference to a car and female commuters gives preference to bus as a mode of travel. As income increases the use of bus as transportation mode decreasing and a greater number of car users were shown. Also, as increase in travel time and shifting from one bus to another bus in the case of public transport affect most and a greater number of commuters use the car as transportation mode. The person who have their own two-wheeler and four-wheeler uses two-wheeler for reaching at a working place rather to use public transport. Shifting of a greater number of people from public transport to private transport reduce the efficiency of road transport so, final suggestion was given that improvement and different schemes need in public transport facilities for higher use of it.

Huanhuan et al. (2012) [5]; This paper analyzed the use of Binary logit model for selecting a car and bus only two mode of travel and encourage the people to stop driving cars and start riding bus in the city of Jinan. Individual and travel attributes were considered for study like occupation, gender, age, monthly income and trip distance, trip purpose, departure time, travel cost, travel hours. Jinan resident travel survey data were used to establish impact factors on travel behaviour and use of mode of travel. Travel and spatial distribution characteristics of resident travel were analyzed. Binary logit model between bus and a car were developed and influencing factors were derived. This analysis found that age and gender impact choice of bus travel. Use of bus and car were depend upon persons income. People with higher income prefer to use car as mode of travel. Travel time and travel fare major influencing factor to choose the mode of travel. As increase in trip time and trip fare a greater number of people uses car than bus. Suggestion were given that reduction in travel time and travel cost attract the greater number of people to use public transport as a bus.

Miaomiao ZHOU and Jian LU (2011) [10]; This paper analyzed the factors influencing the trip mode choice of urban residents. This study was conducted for effective operation of traffic control and demand management policies. The prediction model was developed separately based on multinomial logit model (MNL) and probabilistic neural network (PNN). Using these two model probabilities of each mode of travel were determined and final mode choice was estimated. The result shows that probabilistic neural network gives the results with higher accuracy and MNL model gives better results for some extent. Estimation of error was observed less in probabilistic neural network model.

Liya YAO et al. (2010) [9]; The main study of this paper compares the two mode of transport subway and bus in the city of Beijing. Effect of fare on traffic structure was studied and mode split analysis was done. Effect of traveler trip information, personal attributes, and traffic mode level of service on mode split studied. Different variables were determined and based on that disaggregate model MNL model were developed. Utility function for both mode of travel was determined. Traveler select the mode which has higher utility. Influencing factors on subway and buses were analyzed and results show that cost, trip time, gender, age, income, occupation and trip purpose have remarkable influences on trip mode selection.

III. CONCLUSION

As per the literature review majorly two characteristics of analysis are observed; Socio-economic and trip characteristics are there and for that different categories of analysis available in which classification can be done by gender, vehicle ownership, travel purpose, travel time, travel distance and travel cost which are affecting on selection of mode choice. Concluding observations of the literature review there are different techniques available for mode choice analysis like Multinomial logit model (MNL), Binary logit model

(BL), Artificial neural network (ANN) and Nested logit model (NLM). Mostly preferable method for mode choice analysis is MNL method because MNL model can be useful for developing a model between more than two choice alternatives. BL model is useful for development of model between two alternatives only. ANN models useful for behavioural analysis and minimizing the error which indicates the deviation between input and output. It gives slightly higher accuracy than MNL model. NL model accommodates the similarity between different nests of alternatives in mode choice modeling. Literature review are aiming at to understand the mode choice behavior of urban residents, influencing factors and finding out the percentage of mode choice preferred by individuals.

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