Development of Mode Choice Models: A Case Study of West Zone of Ahmedabad City

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Abstract - *Ahmedabad city is considered one of the most densely populated cities of Gujarat. The despicable transportation planning process prompts inadequacy in embracing the reasonable transport strategies to mitigate the transportation problems coming about because of urbanization and fast increment of populace. The mode choice model is probably the most important element in transportation planning and policy making. This directly affects the level of transport demand, travel patterns and its effect on environment. This research aims to examine and to build up the model by the investigation of different trips which is finished by concentrate the present transport arrangement of Ahmedabad and to build up a mode choice model for work trips in west zone of Ahmedabad city that can be utilized to simulate the behaviour of individuals towards motorized and non motorized modes. To accomplish the objectives, a mathematical model is needed that is capable of modelling and forecasting the travelling mode choice behaviour in the multi modal environment. The multinomial mode choice model is produced utilizing the SPSS programming where method of travel is considered as reliant and travel time and travel cost are considered as autonomous variable. The developed model demonstrates that still 61% work trips utilizes 2 wheeler that implies that if the efforts are made for the improvisation of the existing facilities and if the travel time is reduced up to some level in accordance with the travel cost, it could encourage the people to use public transport instead of using 2 wheelers.*

Key Words: **Mode choice, transportation planning, mode choice modelling, travel behaviour, travel Demand, multinomial logit model.**

1. INTRODUCTION

Transport is an important part of India's economy but it is poor as compared to the other countries. Public transport is the basic mode of transport for the most of the people of the India. India's public transport is among the most heavily used in the world.Motor vehicle population in India is low by international standards, with only 24.85 million cars on the nation's roads as of 2013[1] and the number of two wheelers like motorcycle and scooter is considerably higher at 132.55 million[2]. In total, about 21 percent households have two wheelers whereas only 4.7 per cent of households in India have cars/jeeps/vans as per 2011 Census. [3][4]Bicycles, or cycles have ownership rates ranging from around 30% to 70% at the state level. However, recent developments suggest that bicycle riding is fast becoming popular in the metro cities of India[4][5].

Before doing transportation planning of any city, it is necessary to know the choice of mode that is used by the people of any particular area. Public transport modes make use of road space more efficiently than private transport, whereas public transport is having more flexibility and it is more convenient. So modal split analysis helps to decide the mode of travel as bus, car, auto, railway, etc. In modal split analysis the total number of trips is expressed such as fraction, ratio, or percentage.

1.2 Aim

The main of this study is to develop a mode choice model for work trips in west zone of Ahmedabad city that can be used to simulate the behaviour of individuals towards motorized and non motorized modes.

1.3 Research Objectives

1) To identify the travel behaviour of people and to study the existing transportation pattern in study area.
2) To study the factors affecting mode choice and various types of mode choice models.
3) To develop the most suitable model for work trips in study area.
4) To compare the developed model with existing model.

1.4 Scope of Study

1) The scope of this study will be limited for work trips in only west zone of Ahmedabad city. The same will not be applicable to the rest of the zones of Ahmedabad city.
2) The review is to concentrate on mode shift from individual vehicle to mass transport mode by identifying and understanding the factors likely to encourage the shift by developing models for mode selection.

1.5 Need of Study

1) To incorporate the designing of transport systems, by making use and understanding the travel behaviour of the residents of the study area, and thus it develops a system that can accommodate the travel demands for future.

2) To be identified that can be put into practice in order to attract a substantial number of car users to adopt public transport to fulfil their travelling needs.
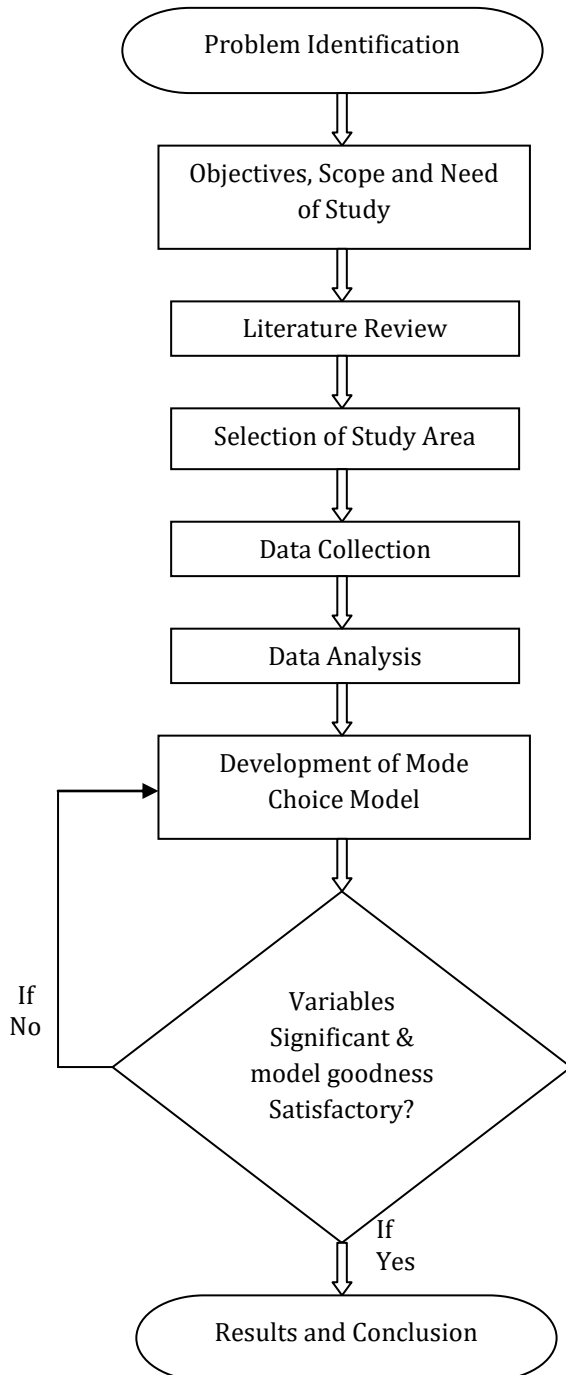
2. RESEARCH METHODOLOGY

Fig-1: Research Methodology

3. STUDY AREA PROFILE

As explained earlier Ahmedabad city is one of the biggest cities in Gujarat as well as in India. It is also 4th fastest developing city of world as per Forbes magazine 2010. Ahmedabad city is mainly divided in six different zones which are 1) Central Zone 2) East Zone 3) South Zone 4) North Zone 5) West Zone 6) New West Zone. There are mainly two public transport systems exists in Ahmedabad which are Ahmedabad municipal transport service (AMTS) and Bus rapid transit system (BRTS). The mass transit metro system, MEGA for the cities of Ahmedabad and Gandhinagar is under construction since March 2015.The North South and East West corridors are expected to complete by 2019. [8] Here the table is shown for the ward wise population data.

Table –1: Zone wise Population Data of Ahmedabad City[7]

Zone	Area(Sq.km)	Population
Central Zone	16.60	6,26,196
East Zone	78.52	8,92,986
North Zone	41.54	8,15,050
South Zone	92.05	7,10,218
West Zone	56.53	7,32,336
New West Zone	178.76	7,28,751

Table –2: Population data of different wards in West zone of Ahmedabad City[7]

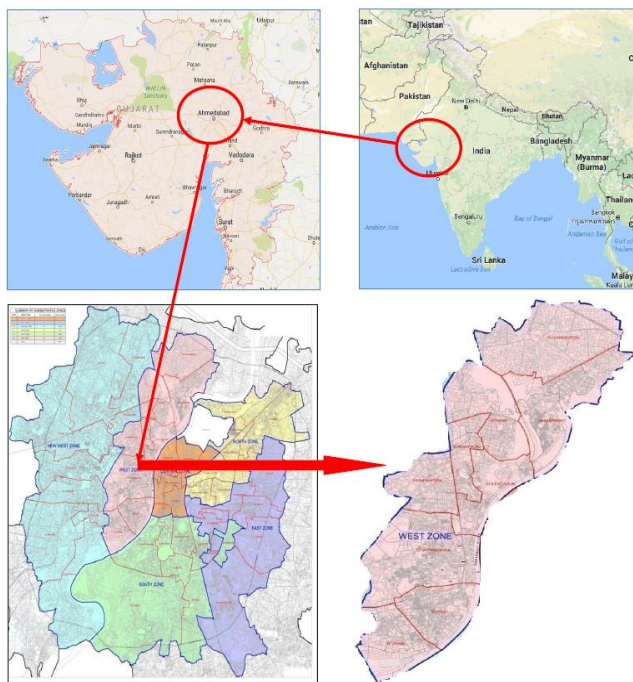| Ward No.	Ward Name	Area(Sq. km)	Total population	Total Number of Households
3	Chandkheda-motera	16.00	70,261	20,436
4	Sabarmati	5.34	66,583	14,362
9	Naranpura	3.21	75,783	20,829
6	Wadaj	5.56	68,313	16,290
10	Navrangpura	3.33	76,954	20,829
26	Ambavadi	6.33	76,358	16,979
5	Ranip	6.3	71,447	24960
31	Paldi	4.55	76,912	18,855
41	Vasna	5.05	77,418	27,754

Fig-2: Study Area

The district has a population density of 983 inhabitants per square kilometer(2,550/sq. mi)[6]

Table –3: Demographic of Ahmedabad City[6]

Name of City	No. of Households	Density	Sex Ratio	Growth Rate
Ahmedabad (West Zone)	251073	983	923	14.57

4. DATA COLLECTION

The targeted individuals for the information collection were the workers, students, aged persons, house wives, businessmen. Among the all it mainly focuses on the workers, students. In 900 household surveys, there were in total 2018 respondents. The information collected was from various households in the different election wards. It includes both the data, the members which were at home, and the data of the rest of the family members were given by the household which were present at home.

Table –4: Number of Samples Data in West Zone

West Zone		
Area	No. of Household	Percentage (%)
Navrangpura	300	33 %
Vasna	370	41 %
Paldi	230	26 %

5. DATA ANALYSIS

5.1 Existing Use of Public Transport

The city bus and auto - rickshaws are the existing public transports for Ahmedabad City. The use of bus and auto-rickshaws for work, education and other trips are shown in Figure 5.15 the chart reflects that use of public transport for other trips have high percentage followed by educational trips, where as for work trips the use of public transport are less.
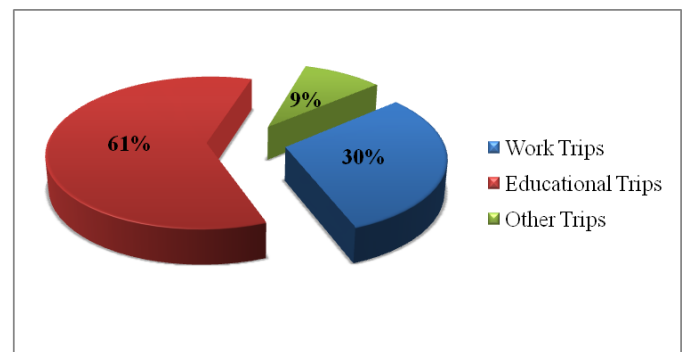

Fig-3: Existing use of Public Transport

5.2 Mode Share for Work Trips

The mode share observations for the three major income groups LIG, MIG and HIG are as shown in Figure 5.16, where in the maximum number of work trips are found to be commuted by two-wheeler for MIG and HIG and it is highest by Auto-rickshaw mode for LIG. The share of non-motorized modes such as walking and bicycle are very less. Very poor share is in city bus service.
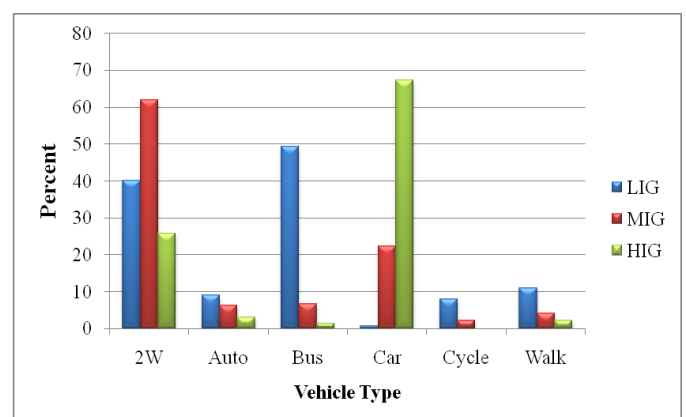

Fig-4: Mode Share for Work Trips

5.3 Average trip length by different modes

Here is the figure is shown for the average trip length by using the various modes of transport. From the total number of trips, the bifurcation is done to know that how many trips are using bus, car, and two wheeler.
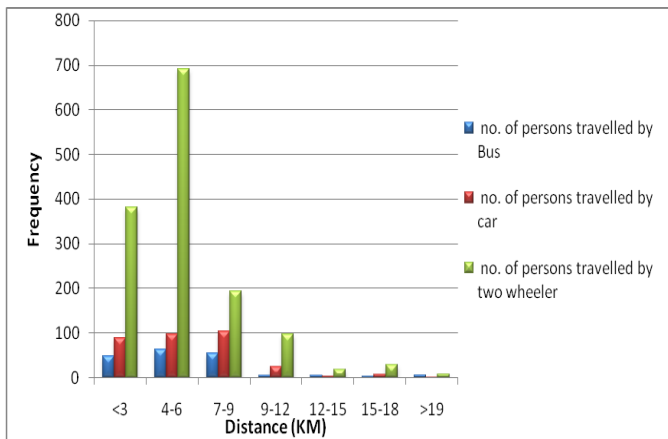
Fig-5: Average trip length by different mode

5.4 Average trip length by cost of different mode

The figure underneath shows the cost of total trip by different modes. As it is the simple principle that when the trip length gets increased, the cost will be also increase due to the consumption of the fuel. For the long trip more fuel will be consumed so the cost will also get increased and if the trip length is small the cost will be low.
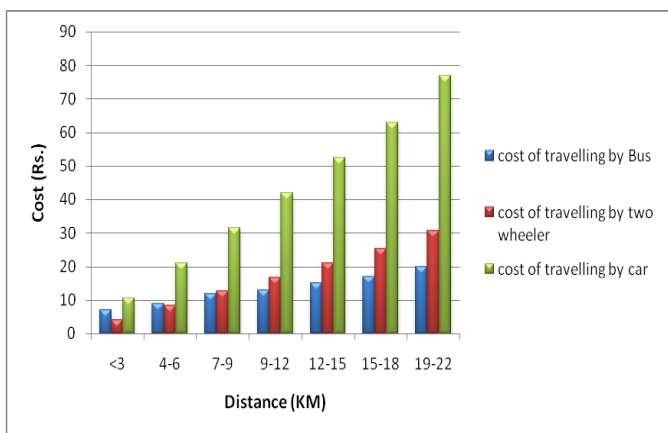

Fig-6: Average trip length by cost of different mode

6. DEVELOPMENT OF MODE CHOICE MODEL

From the various models available such as Nested model, Probit model, general extreme value models, the multinomial logistic model is selected here for the development of mode choice. Numbers of different modes are available here for the development of model such as bus, car, auto, etc., so it is the only reason behind the selection of the multinomial logistic model and also in past it is seen that multinomial logistic model proves to be more useful and effective when there are number of modes are available for the development of model. Here from the available data and after doing the analysis of the same, multinomial logistic model is developed

for the Navrangpura, Paldi and Vasna wards which belong to west zone in the Ahmedabad city.

Table –5: Multinomial Logit model for Work Trips

Model	TT + TC
A	2833.522
β_1	3301.714
β_2	3805.588
ρ^2	0.640

6.1 Model Equation for Work Trips

After making the final decision on the choice of model, the next step involved the different parameters that should be considered while developing the model. Below is the equation is shown for the development of model.

$$y = \alpha + \beta_1 x_1 + \beta_2 x_2$$
$$y = 2833.522 + 3301.714\, x_1 + 3805.588\, x_2$$

Where,

y = Mode of travel

x_1 = Travel time

x_2 = Travel cost

As shown in the equation, in case of multinomial logistic model dependent and independent variables are always required for the development of model, here mode of travel is chosen as dependent variable and travel time and travel cost are selected from the different independent variables for work trips because it has a great significance behind the choice of any mode. The values are also shown here for the development of multinomial models.

7. CONCLUSIONS

1) Based on the descriptive analysis of the collected data the travel time, travel cost, gender, age, monthly income, and frequency are considered the most important factors that affects the mode choice of trip commuters.

2) SPSS software is used for the developing the model, in which mode of travel is considered as dependent variables and travel cost and travel time are independent variables, goodness of fit measures are very carefully considered here and the model is developed in further it should also to be kept in mind that the model is developed for the work trips in the Navrangpura, Vasna and Paldi wards in west zone of Ahmedabad city.

4) Before, the development of model, it has been known that total 69 % of the working trips are developed using two wheelers which is really a big number, after inputting all the collected data, and after developing the model, it has been found that still there are 61 % working trips are uses two wheelers, this is may be because we have considered travel time and travel cost as the independent variables here and the affordance to any specific travel depends on the travel cost which always affects the selection of mode but if travel

cost is affordable but if the travel time which includes the waiting time and changing time, if it is more than the normal time particularly as compared to the 2 wheelers people will not use the public transport that is why the ratio of 2 wheelers is still very high.

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