

MODE CHOICE ANALYSIS IN VADODARA

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Abstract : Commuters' travel behavior plays a crucial role in Transportation Planning. Mode choice is all about making a decision about using a particular mode based on priority and purposes. Mode choice varies because of various parameters such as standard of living, travel distance, travel time, travel cost, travel purpose, etc. The present study is all about the recognizing the factors affecting the mode choice decisions of commuters in Vadodara, a city of Gujarat, India.

Vadodara is divided into 19 electoral-wards. Household survey was conducted in the city surveying approximately 4200 households for the socio-economic, travel and mode-choice data. Origin-Destination (O-D) trip matrix for different modes were generated with the survey data. The main aim of this study is to look out for the factors that affects the commuters' mode choice decisions and analyze the data collected through household survey to understand the travel behavior of the commuters. Various factors such as age, gender, trip purpose, etc. plays a vital role in mode selection. These factors are observed and their effects on commuters are resulted.

Index Terms – Mode choice, O-D matrix, Household survey, Travel Behavior.

1. INTRODUCTION

Urban Transportation Planning deals with the process of developing new facilities and determining how to utilize the available facilities at its best. Travel behavior means movement of peoples from one place to another place with a particular purpose of choosing any travel mode. Urban transportation is the study of demand and supply of transport facilities. In Indian cities, a large variety of public transport modes are available such as Bus, Auto- Rickshaw, Taxi and Private Vehicle, available for long as well as short distance trips. The choice of the modes by the trip makers depend on many factors. Some of these criteria are qualitative and some are quantitative. Some of the factors are Travel purpose, Travel Time, Travel Cost, Comfort, Reliability, Pollution etc.

1.1 Literature Review

Many research works have been carried out in the field of Mode choice analysis various analytical and preliminary methods.

(Ashalatha, Manju, & Zacharia, Mode Choice Behavior of Commuters in Thiruvananthapuram City, 2013) used multinomial logistic regression to analyze the mode choice behavior of commuters in Thiruvananthapuram. The findings from the study revealed that as age increases preference to car increases and preference to two-wheelers decreases in comparison with public transport. (Sathish, Jagadeesh, & Kumar, travel delay and modal split analysis - a case study, 2013) selected the stretch from Majestic Bus Station also known as the Kempegowda Bus Station to Yelahanka Satellite Town . Modal shift analysis indicates about 70 percent of commuters are ready to shift from current system to Metro Rail System. (Ehasnabis & Cynecki, Development Of Parameters Of Multinomial Logit Models, 1988) presented a five-mode case study for a medium-sized urban area in Michigan has been presented in two separate trip categories (work and non-work) to demonstrate the procedure for developing model parameters through the use of the maximum likelihood technique, and to utilize the parameters developed for further validation.

(Ganek, A Disaggregate Modal-Split Model for Work Trips Involving Three Mode Choices) explored the determinants of commuter mode choice in the six county region around Pittsburgh. The study was part of an evaluation of the car pool-public transit program administered by the Southwestern Pennsylvania Regional Planning Commission (SPRPC). Models of the multinomial logit form were estimated on disaggregate data to predict the short run mode choices of commuters in the region, given the current work locations, residential locations, and automobile ownership patterns. The objectives of this work were to learn why commuters choose the modes they do and to suggest how they could be enticed to choose shared ride modes. (Ponnuswamy & Anantharajan, Influence of Travel Attributes on Modal Choice in an Indian City) tried two methodologies - attitude measurement and trade-off game approach, using data collected through household surveys conducted for the purpose on limited stratified samples in some locations in Madras. The results indicate how commuters value time and comfort factors more than the cost, given a choice. Due to prevailing economic conditions, cost plays a vital role, but analysis shows that users are prepared to incur additional cost, if they are assured of quicker and more comfortable services. This study thus gives a good insight into the travel attributes which should be improved upon, if any shift in the travel pattern is to be induced. (YANG, YAO, & YAN, Mode Split Model under Different Public Transit Fare, 2010) studied the effects of fare on traffic structure. Questionnaire investigations of public traffic mode split were done in Beijing. Influencing factors of selecting subways and buses were analyzed. The results show that trip time, cost, gender, age, occupation, income, and trip intention have remarkable influences on the results of trip mode split. On the basis of combination of variable factors, the variables that should be used in the model were determined and the model of public traffic mode split based on disaggregate model is given. The relationship between fare and mode split is studied, which provided a base for adjusting the structure of public traffic by using the fare policy. (Chanda, Sen, & Roy, Mode Choice Modelling of Work Trips: A Case Study of Kolkata, 2016) estimated the modal share of the Garia-Park Circus corridor in Kolkata for work trips only. Transit, Para-transit and Personal vehicles are considered here. The criteria selected for the modeling are Travel Time (TT), Travel Cost (TC), Comfort, Convenience (Waiting Time), Reliability and Dust& Noise. The study shows that personal vehicle users are giving maximum importance to comfort, dust & noise and waiting time. Whereas, the transit users try to minimize their travel cost and travel time and hence gives more importance to these two criteria.

The weight of all the attributes as perceived by the para-transit users, fall in between the transit and personal vehicle users. Travel Time, Travel Cost and Waiting Time only have been picked in the utility function development. The mode specific attribute (a_0) for the different modes i.e. Transit, Para-transit and Personal vehicle were estimated by regression analysis and the utility function for each of the modes was formulated which was used in Logit model. It is found out that, 82% of the work trip makers prefer transit for their travel over the other two modes, 17% prefers Para-transit as their travel mode and only 1% chooses personal vehicle.

2. RESEARCH OBJECTIVE

The main aim of this study is to carryout the analysis of travel behaviors of commuters in Vadodara city. Following are the objectives to fulfill the aim:

1. To study various factors affecting travel behavior of commuters in Vadodara.
2. To observe the travel pattern inside the city.
3. To find out the priorities of the commuters for selecting a travel mode.

3. METHODOLOGY

The methodology adopted in this study involves 4 stages. In the first stage, the study area selection has been done. As Vadodara is observing a rapid growth in vehicular population, Vadodara has been selected. In the second stage, Secondary data like the census data and the city map along with its electoral ward boundaries have been collected which served as an input to determine the survey pattern. In the third stage, Primary data collection by conducting Household survey has been carried out in the city. Data collection has been done using the questionnaire form designed for the survey. In the fourth stage, Analysis has been performed to determine the major factors affecting the mode choice behavior of the commuters in the city.

4. DATA COLLECTION

4.1 Study Area Profile

Vadodara - the third largest city in the Indian state of Gujarat is selected for this study. The city has a population of 16,66,495 as per census 2011. The geographic and transport details are given the table below.

Area	159.95 sq.kms. (Approx.)
Population	16,66,495
Rail	Vadodara is on the Western Railway Mumbai Delhi and Mumbai Ahmedabad line. It is 100 kms from Ahmedabad, its narrow guage line operates from Pratapnagar Railway Station and Vishwamitri Railway Station.
Road	Vadodara is connected by road on National Highway No. 8 with all the major cities of India. It is 436 kms from Mumbai and 956 kms from Delhi.
Air	The city has an airport connected with Mumbai and Delhi.
Bus	The Gujarat State Transport Corporation plies its buses between Vadodara and Ahmedabad and also on main towns and tourist centers of Gujarat.

Vadodara is divided into 13 administrative wards and 19 electoral wards. The electoral ward wise population details are given in the table below.

WARD NO.	POPULATION
1	95577
2	91381
3	85290
4	83022
5	92669
6	86383
7	85665
8	86038
9	86517
10	94036
11	87740
12	82337

13	80307
14	87286
15	82932
16	86824
17	85211
18	95411
19	94065

4.2 Household Survey

Approximately, 4000 households were surveyed. Questionnaire forms were filled by household interview method. Various Socio-economic characteristics, trip related variables and transport system characteristics were recorded. Thus, data collection was done on individual basis.

Socio-economic characteristics includes age, occupation, gender, etc.

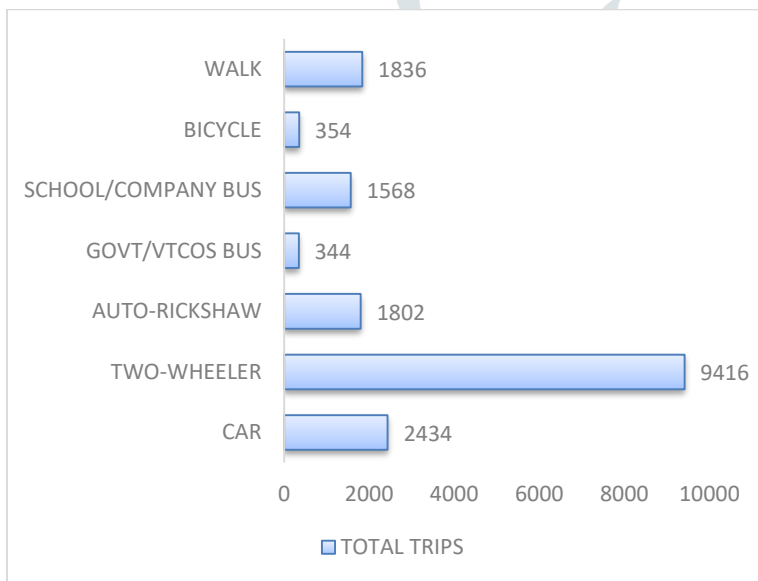
Trip related variables includes trip purpose, trip length, trip stages, start time, end time, etc.

Transport system characteristics relates to travel time, travel cost, travel mode, etc.

Some of the data was also collected through Google forms. Responses for the worst aspects of the existing public transport system in Vadodara were recorded. Mode choice attributes were also ranked in general.

5. DATA ANALYSIS

The trip share of the modes presently existing in the city are graphical represented as below;



Two- wheeler shares the highest number of trips in the city.

The walk trips and the Bicycle trips are used for the short distant travel. Generally for intra-zonal travel, these modes are preferred.

Approximately 10% trips are made using auto rickshaws in the city.

For longer route travel, commuters prefer the company buses.

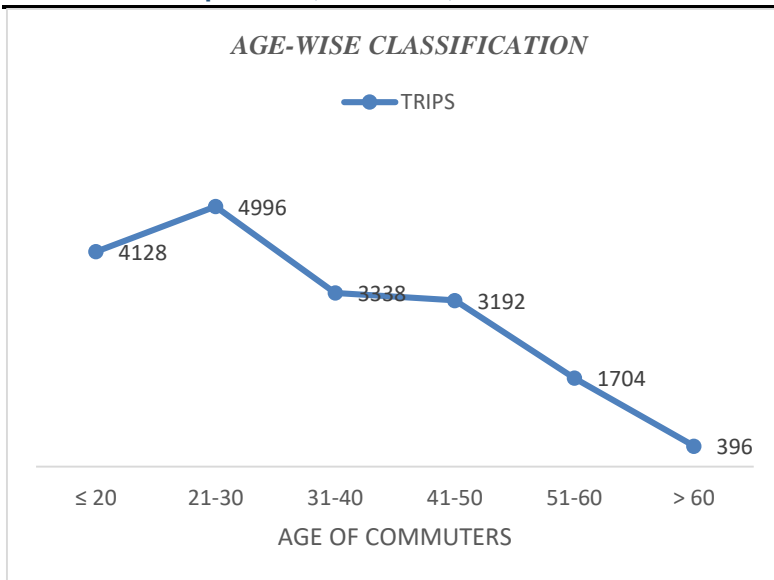
The car users in the city holds the second highest shares in travelling after two-wheelers.

Figure 1 shows the trip share of different modes in the city.

Figure 1 – Trips share of various modes.

Age plays a major role in deciding the mode of travel. Youths are generally attracted to the private modes due to different priorities in comparison to the older age travelers.

The age wise classification of trips has been shown in the figure below.



Youngsters share the highest number of trips in the city.

The age group 21-30 are the highest number of trip makers in the city.

As the age increases, the number of trips decreases.

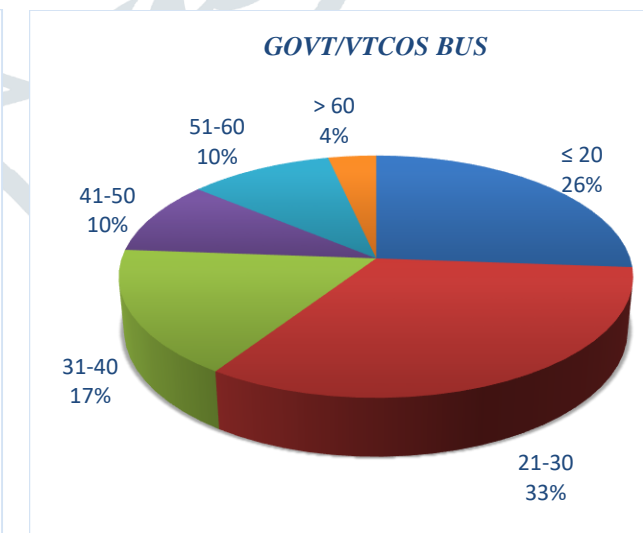
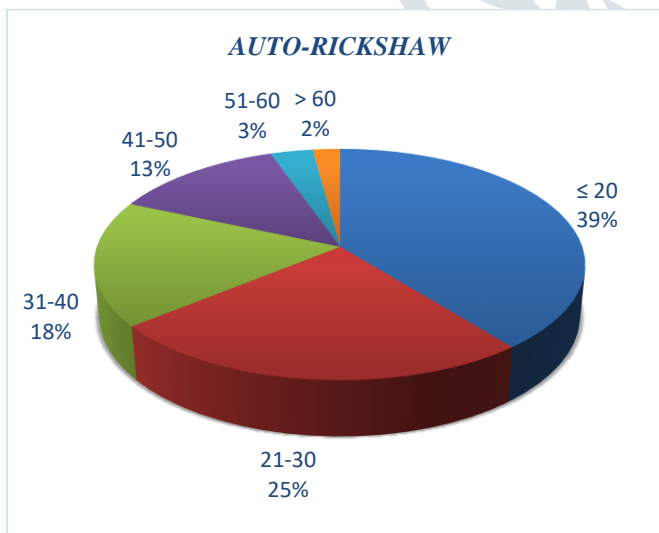
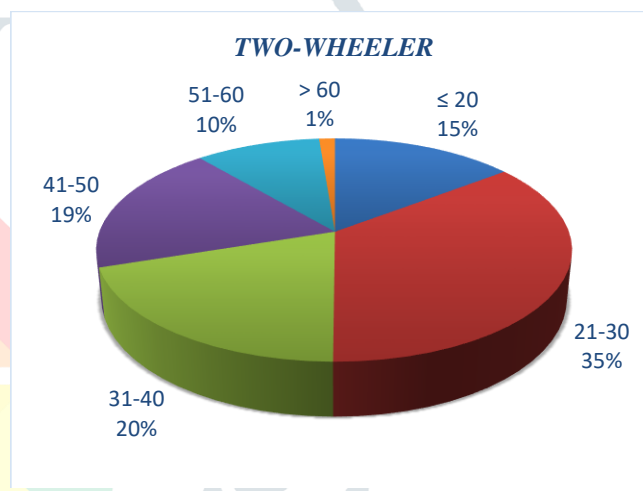
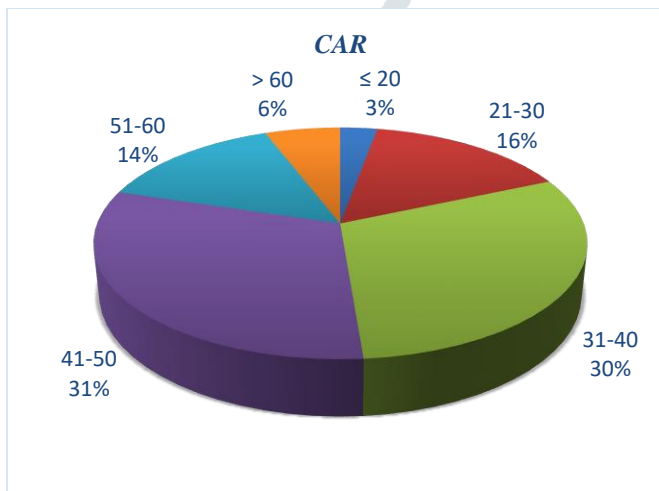
People falling in the first two age groups contributes majorly in the number of trips occurring in the city.

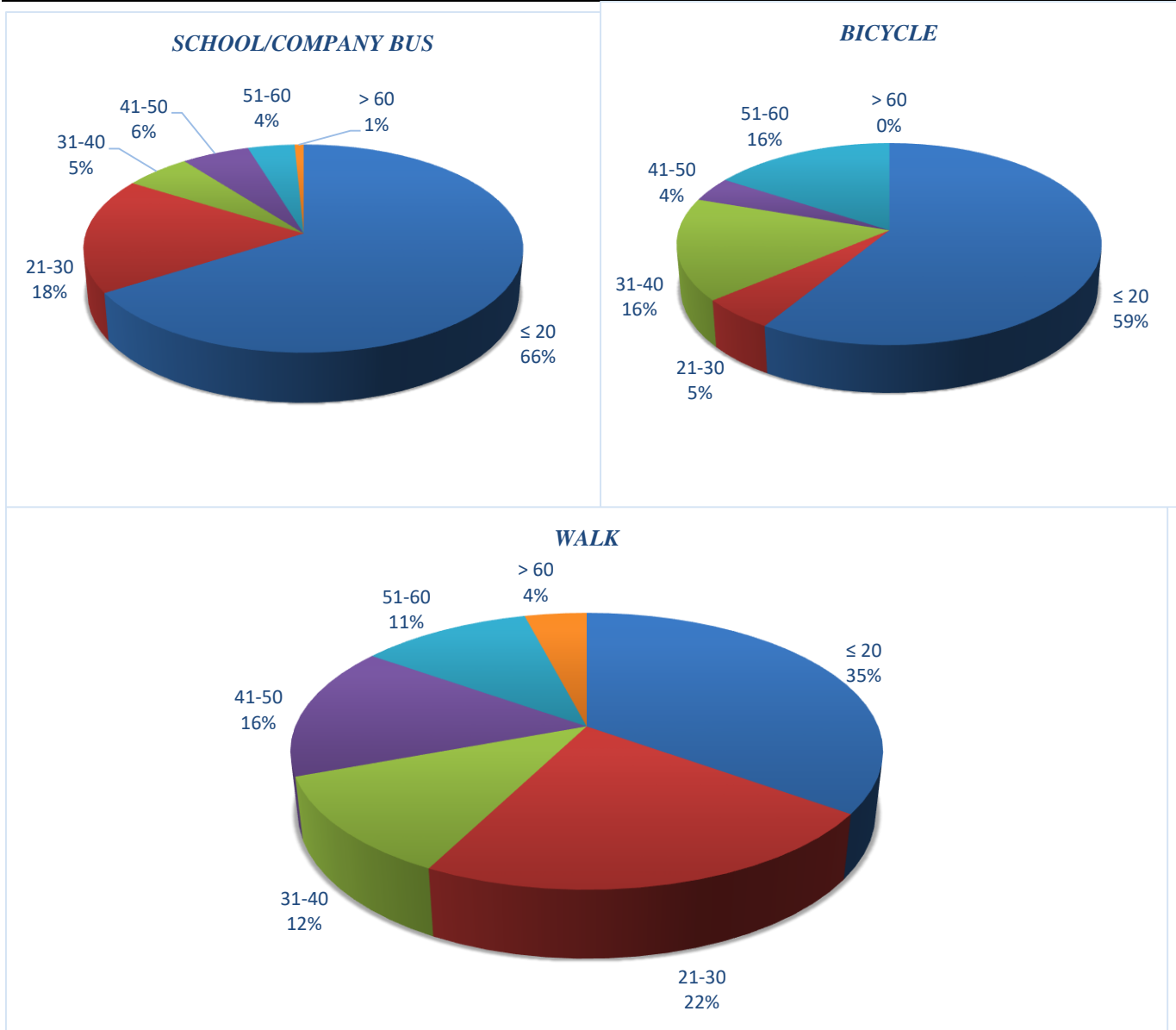
People above the age of 60 makes lesser trips.

Figure 2 shows the Age-wise classification of trips in the city.

Figure 2 – Age-wise classification of trips

The detailed analysis of the age-wise classification for different modes are shown below.





The observations say that the male trips makers are found to be very high in the city in comparison to the female trip makers. The male commuters share the highest no. of trips with respect to the female commuters.

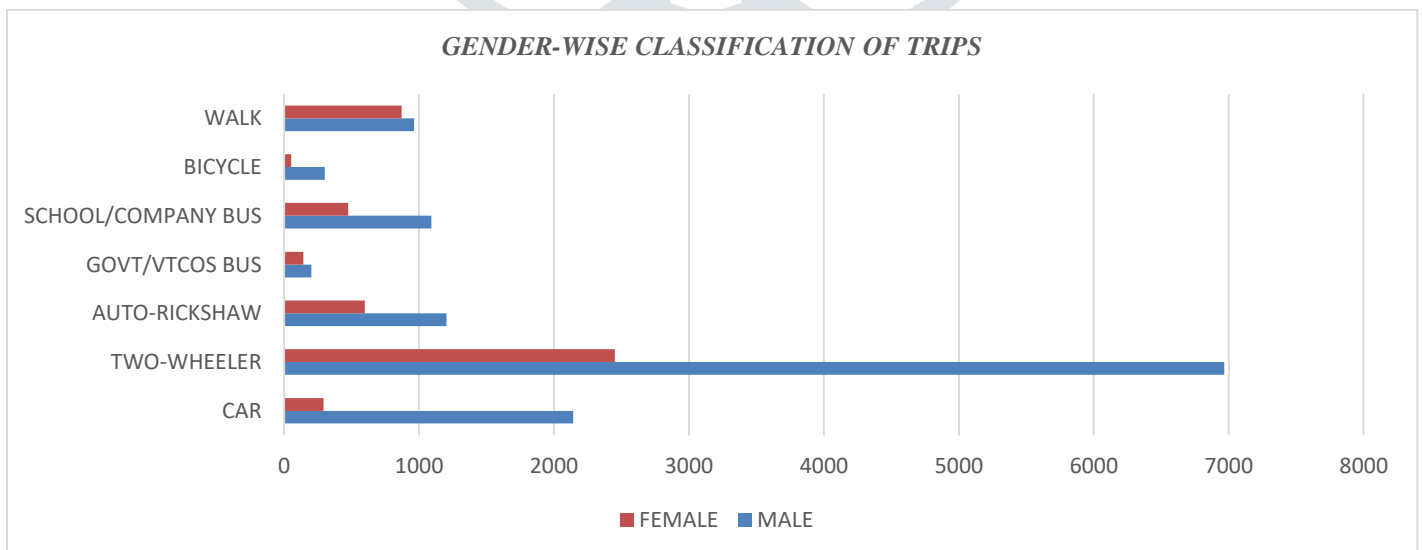


Figure 3 - Gender-wise classification of trips

Figure3 shows that amongst the two-wheeler users the maximum number of trips are carried out by the males. Car and two-wheelers are the two modes which shows the major difference in the male-female trip makers. Female car users in comparison to

the male users are very low. 26% of the two-wheeler trips are made by the females and 74% of the two-wheeler trips are made by males. 12% of the car trips are made by females and the rest 88% are made by females.

In general, the gender classification shows that 27% of the total trips are made by females and 73% are made by males.

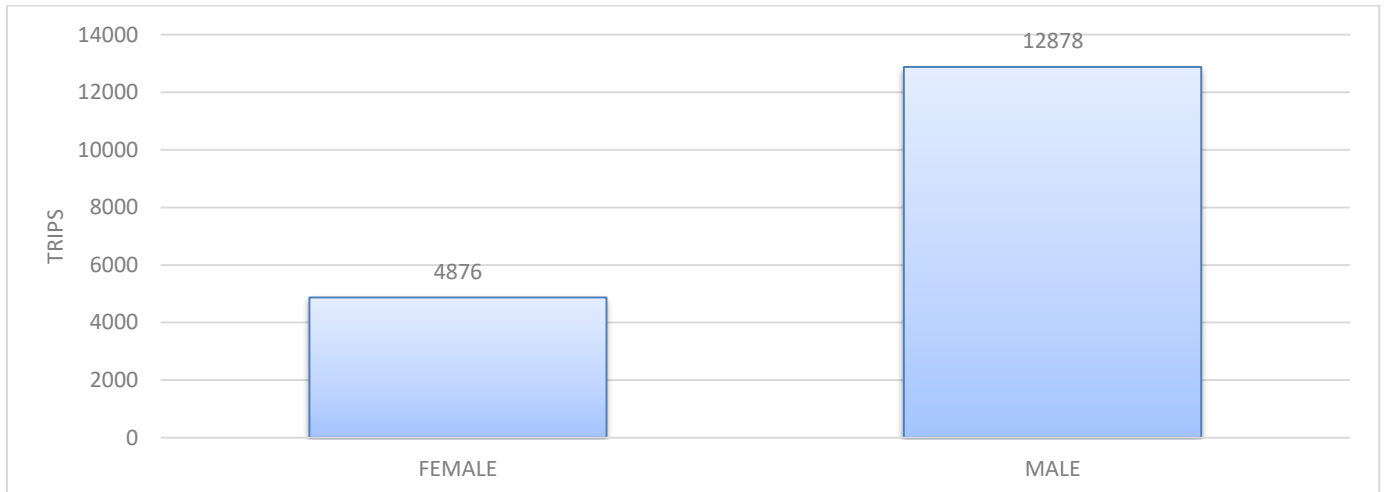


Figure 4 - Percentage share of Male-Female trips

The attitudinal variables which includes the factors such as comfort, reliability, frequency, etc. were also recorded. The results show that maximum people gives priority to the Comfort level of the travel mode. The following charts shows the priority given to various attributes by the commuters.

CHOOSE FROM THE FOLLOWING FACTORS WHICH ARE IMPORTANT FOR MODE CHOICE

1,671 responses



WHAT ARE THE 3 WORST ASPECTS OF THE EXISTING PUBLIC TRANSPORT IN YOUR LOCALITY?

1,659 responses

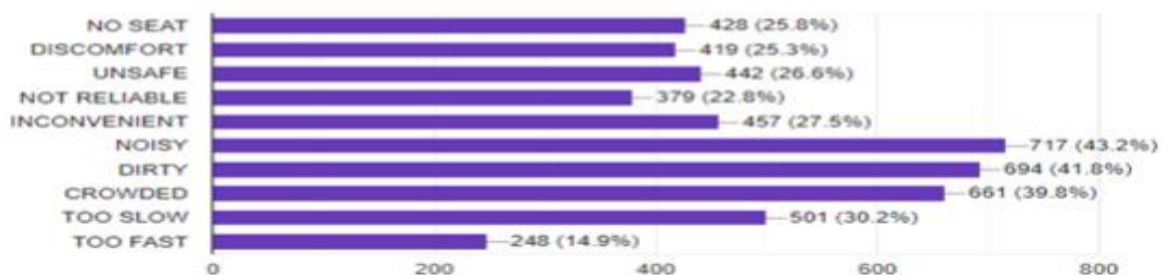


Figure 5 – Responses from the commuters

The chart shows that highest priority is given to Comfort of travel by the commuters. Travel Cost is given the second priority by the people in Vadodara. The worst aspects for the city’s existing public transportation system were also recorded. ‘NOISY’, ‘DIRTY’ and ‘CROWDED’ were the highest ranked parameters for describing the worst aspects of public transport in the city.

6. RESULTS AND CONCLUSIONS

The City faces lack of street space, resulting in conflicts between people, goods and vehicles, accentuated by the recent high motorization rate. Studies have shown that the VTCOS bus services in the city are not available in some of the areas. The frequency of the buses is also not adequate. People in Vadodara majorly prefer two-wheeler for travel purpose. Auto-rickshaws are generally preferred for short length trips in the area by the captive riders mainly. The comfort offered to passengers is not satisfactory. The rising number of vehicles pose a problem in urban areas as the road width has not increased accordingly. Even vehicle parking has become a major issue in congested areas. The cumulative effects of all these factors have a negative impact on the travel efficiencies of commuters.

The responses of some 1674 individuals were recorded describing the transportation in the city. These records can be used to conclude the satisfaction level of commuters for transportation in the city. Some of the worst aspects of the existing public transport in the city in opinion of the commuters were recorded. Also the priority factor while making a travel decision by the commuters was also entered. The data results are classified in the figure 5.

The results shows that the commuters give more importance to the comfort of travel while travelling. Travel purpose and travel time shares almost equal priority. Travel cost is the second most crucial factor In choosing the mode of travel for the people of Vadodara city. According to the majority of commuters, the existing public transport in the city is not satisfactory. The 3 worst aspects recorded for the same are “Noisy”, “Dirty” and “Crowded”. 43.2% finds the city’s public transportation noisy. 41.8% of the people finds it dirty. And 39.8% of people marks it as crowded.

Also from the analysis it can be found that two-wheelers shares the highest number of trips amongst all modes. Two-wheeler shares the highest number of trips in the city.

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