

PUBLIC BICYCLE SHARING - AS A FEEDER MODE FOR BRTS IN SURAT CITY

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Abstract: Increase in traffic volumes due to growth of population and vehicles ownership creates problems in traffic operation. Public Bicycle Sharing (PBS) is a term for the use of bicycles on a need basis for short trips without having to own one. The study area is selected in Surat city. There are 8 operational BRTS route in Surat city out of which Pal to Kosad route is selected for the study area. The questionnaire survey is conducted at various BRTS buses confined with the On Board commuter survey method. The study identifies public bicycle sharing stations located at along and around the BRTS corridor. Bicycle sharing is increasingly being popularized as an effective and environmentally friendly feeder system. The various problems such as short term parking problems, traffic congestion and air pollution should be decreased.

Index Terms - Bicycle sharing, Traffic congestion, Sustainable transportation, Feeder mode

I. INTRODUCTION

Urbanization is rapidly growing in India. Population density is rapidly expanding in the urban areas which are requesting large amounts of private and public vehicles in urban communities. Its impacts are congestion, delay, accidents and environmental pollution. In India public transport users generally complete their trips from origin to transportation network stations and transport stop to destination completed by walking or on IPT modes such as cycle rickshaws, auto rickshaws and shared auto rickshaws. In recent years cycling has seen a rebirth, triggered by the thrust towards greater environmental consciousness. The focus is on making cycling seem easier, healthier and safer compared to driving. Public Bicycle Sharing (PBS) is a high quality bicycle based public transport system in which bicycles, stored in a closely spaced network of stations, are made available for short-term shared use. Bicycle sharing programs involve installing multiple bicycle stations at several different key locations. A user checks-out the bicycle from one location, rides to his or her destination, and drops the bicycle to another location. The operators coordinate the redistribution of bicycles and ensure availability of cycles at locations with the highest demand at any given time. The system reduces the fears associated with owning a personal bicycle such as theft or parking concerns, thereby encouraging people to use the bicycle for short and medium length trips. PBS is increasingly serving the role of a sustainable zero emission feeder alternative to access public transit networks.

II. STUDY AREA

The study area selected is the Surat city. Surat is a city situated on the western piece of India in the territory of Gujarat. It is a standout amongst the most powerful city of India with one of the quickest development rate because of migration from different piece of Gujarat and different conditions of India. In India Surat is one of the cleanest city and is also known by names like "THE SILK CITY", "THE DIAMOND CITY", "THE GREEN CITY". The population of surat city is 44,66,826 as per 2011 census. Surat city is divided into 7 zones. The Bus Rapid Transit System will be a high quality, ultra-modern and passenger oriented rapid transit system to deliver fast, comfortable, economical and eco-friendly mobility to urban dwellers. There are 8 operational BRTS route in surat city, out of which Pal to Kosad route is selected. In this BRTS route some area falling into west zone and North zone. Study stretch length is 18 Km and 28 BRTS stop. In North zone population density is high compare to west zones. In west zone road width is more compare to North zone. In some areas of west zone Bicycle tracks are also available.

III. RESEARCH METHODOLOGY

The method used in the survey process is On board commuter survey. The questionnaire survey is conducted at various BRTS buses confined with the On Board commuter survey method and then for checking the responses from the respondents. This method of survey has many advantages such as passengers are seating inside the bus therefore they are comfortable in replying, No wastage of their time, they are inside the bus and therefore they are not in hurry not stressed, so their co operation is much better. The Questionnaire form shall be prepared. The information such as gender, age, family income, origin and destination of journey, purpose of trip, distance between origin to BRTS station, distance between BRTS station to destination, Cost of travel, mode of travel should be collected.

IV. SURVEY AND DATA COLLECTION

For the on board commuter survey method the questionnaire survey was conducted for 450 samples for 11,30,122 populations. The survey form was then analyzed using Microsoft excels through graphs and charts. With the help of graphs and charts to get the proper idea of the various answers of the commuters.

V. DATA ANALYSIS

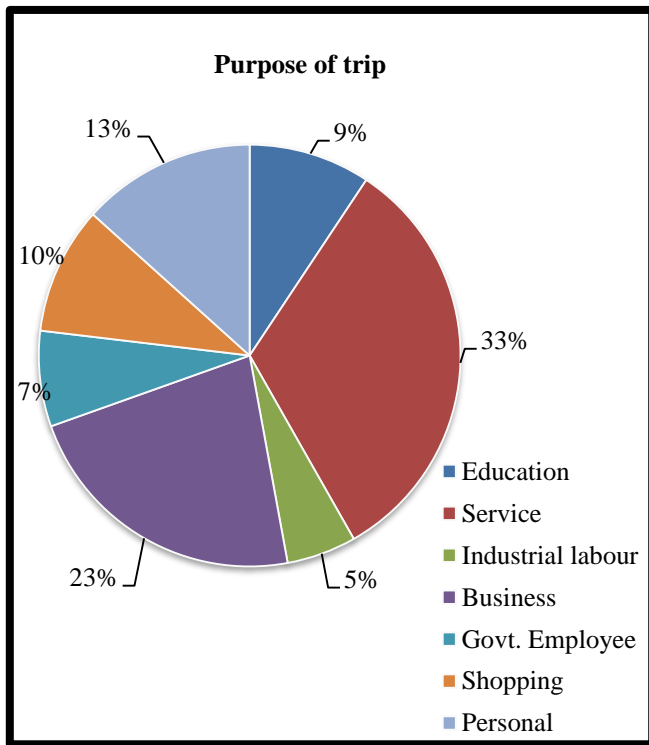


Fig.1: Purpose of trip

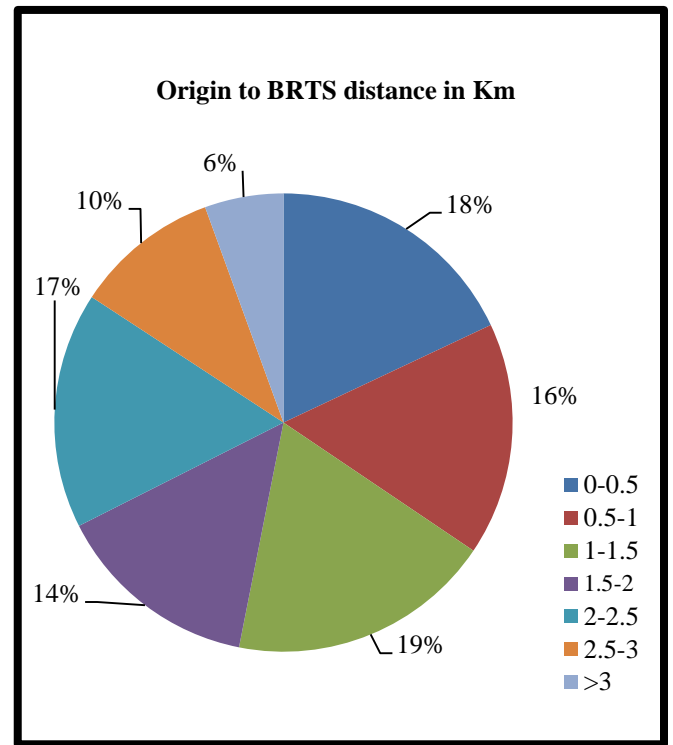


Fig.2: Origin to BRTS distance in KM

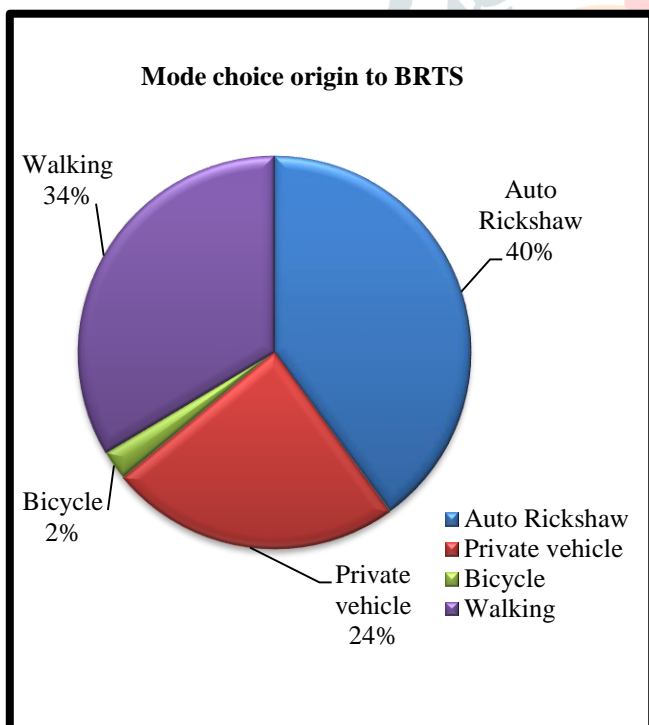


Fig.3: Mode choice origin to BRTS

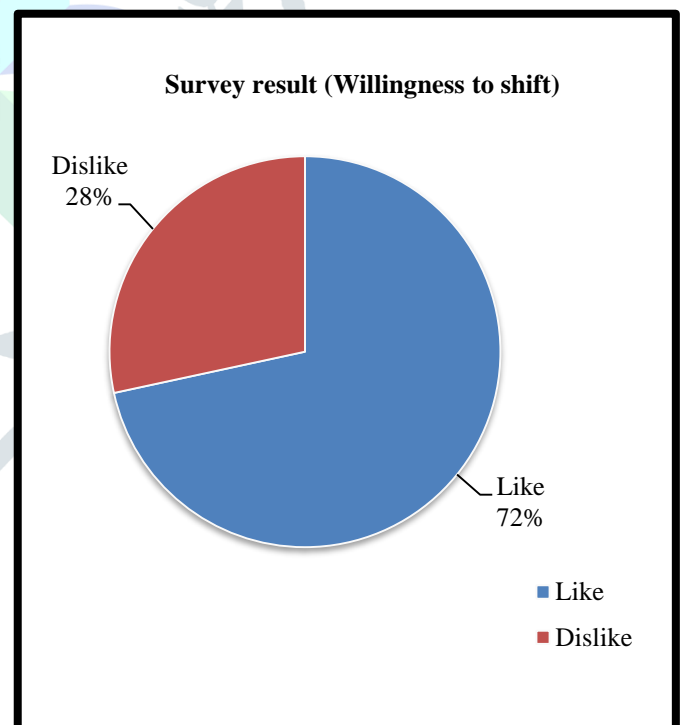


Fig.4: Survey results

In fig. shows that highest percentage of 33% trip generated for service purpose. To reach the BRTS station from home maximum people distance travel in 1-1.5Km, 19%.highest percentage. 6% lowest percentage >3 Km distance travel to reach the BRTS station. The people to reach the BRTS station mostly used auto-rickshaw 40%. Then second highest 34% people walking to reach station. To conduct the questionnaire survey out of total respondece 72% people like bicycle sharing system if it is implemented as feeder mode to BRTS and 28% people not interested to use bicycle to reach public transportation.

Bicycle station location

The locations at which a user can pick up or return a bicycle are known as stations. A station at minimum includes bicycles, docks, terminal, advertisement space or any other structures such as shade. PBS station should be placed such that they are safe, convenient, accessible and highly visible. Station provide near intersection corners, so that user an access and egress from multiple directions. Station located on streets with lower traffic volumes. Bicycle stations Integrated with commercial places, offices, apartments. Place stations along existing bicycle lanes. Three types of bicycle station should be provided large, medium and small depends upon population density, open space for station. Station should be provided along and around the BRTS stop. Bicycle station should be provided on Google earth software. Minimum 10 PBS stations per sq. km. area should be provided. Distance between two stations not more than 600 m.

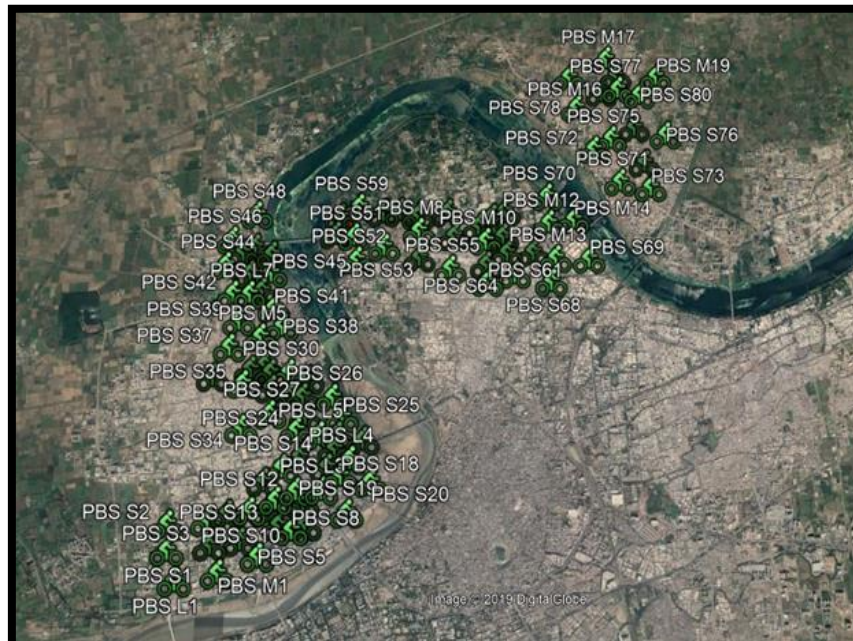


Fig.5: Density of public bicycle sharing station at Pal RTO BRTS to Kosad BRTS surroundings

Table 1: Bicycle station density

Sr. No.	Type of station	No. of station	No. of bicycle per station
1	Large	8	30
2	Medium	19	20
3	Small	80	10
Total		107	1420

In fig. shows total no. of bicycles should be located on google earth software. In Large bicycle station, 8 stations are providing at entry/exit of BRTS stop. In west zone open space easily available and more road width, large station should be provided. No. of bicycles should be 30 at large bicycle station. In medium size bicycle station should be provided in North zone BRTS stop, large population areas and density of population high. In medium size station no. of station should be 19 and 20 bicycles provided. In small size station should be provided less population areas, less open space available to build the station. In small station no. of station should be 80 and 10 no. of bicycle.

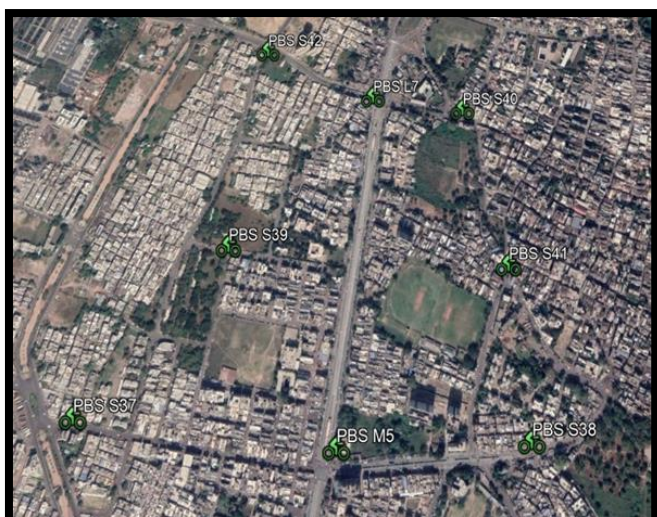


Fig.6: Bicycle station surrounding Morabhagal

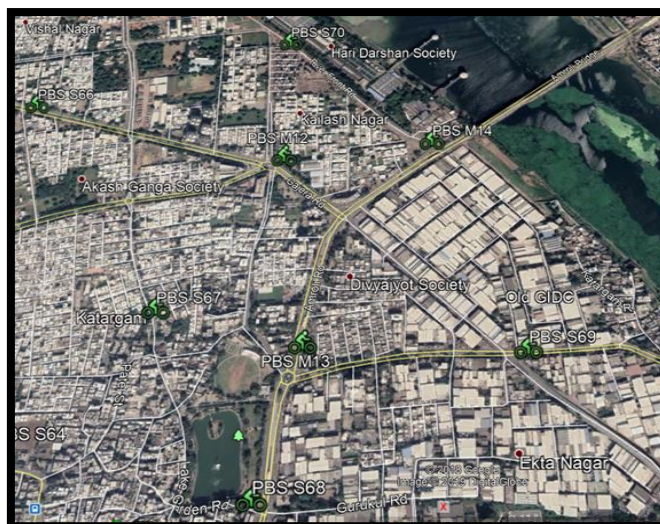


Fig.7: Bicycle station surrounding Gajera circle

In fig. shows bicycle location surrounding west zone of mostly busiest BRTS station morabhagal and North zone busiest BRTS stop Gajera circle. Other areas adajan, palanpur patiya, jahangirpura, SMVS mandir, Dabholi, Kosad bicycle station should be located. Station should be located every BRTS stop, intersections and major activity nodes areas. Affordable pricing rate and membership options for ride bicycle should be provided for commuters and daily users. Advertising and branding through various sources of media to aware the people for non motorized public bicycle sharing system.

VI. RESULTS

Financial Evaluation

Capital cost: Include equipment purchase, bicycle and station assembly, station installation, software development, control centre set up and purchasing redistribution vehicles.

Operating cost: Are the cost to operate and maintain the system. These include hiring employees for operational task such as maintaining the stations, bikes and other infrastructure, providing customer service etc.

Maintenance cost: Include operations facility, purchasing tools and spare parts, upkeep of software, communications and IT.

Table 2: Capital cost of PBS

Sr. No.	Items	Unit	Quantity	Rate (Rs.)	Total Cost (Rs.)
1	Bicycle stations				
	Stations with 30 bicycles	Nos.	8	3,00,000	24,00,000
	Stations with 20 bicycles	Nos.	19	2,00,000	38,00,000
	Stations with 10 bicycles	Nos.	80	1,00,000	80,00,000
2	Geared bicycle with GPS	Nos.	1,420	25,000	3,55,00,000
3	Docking	Nos.	1,704	40,000	6,81,60,000
4	Redistribution Vehicles	No.	5	8,00,000	40,00,000
5	Control Centre	No.	1	2,00,00,000	2,00,00,000
6	Maintenance station	No.	1	8,00,000	8,00,000
Total Capital cost					14,26,60,000

Table 3: Operating and Maintaining cost of PBS

Sr. No.	Items	Total Cost Annual (Rs.)
1	Station maintenance cost (10% of capital cost of station)	14,20,000
2	Bicycle maintenance cost (10% of capital cost of bicycle)	35,50,000
3	Redistribution vehicle maintenance (10% of capital cost of redistribution vehicle)	4,00,000
4	Spare parts	2,00,000
5	Manpower cost	1,26,00,000
6	Administrative expenses (50,000 per month)	6,00,000
7	IT cost	3,00,000
8	Advertisement (Publicity)	5,00,000
Total Operating cost		1,95,70,000

Subscription scenarios

In PBS system user may take daily, monthly and annual subscription.

Table 4: Subscription scenario

Assume some % of population in the coverage area	Number of subscribers
2% of 11,30,122	22,600
4% of 11,30,122	45,200
6% of 11,30,122	67,800

Annual earnings from revenue sources:

Annual subscription: 22,600 @ 1,500 per subscription per year = Rs.3,39,00,000

Monthly subscription: 45,200 @ 500 per subscription = Rs.2,26,00,000

Daily subscription: 67,800 @ 50 per subscription = Rs.33,90,000

Advertising revenue: Total 107 stations 63,000 per station per year = Rs.67,41,000

(Source: Pune bicycle sharing system)

Advertisement revenue from bicycles: 1,000 per bicycle/month

= 1,000 x 12 x 1,420

= Rs. 1,70,40,000

Total revenue: 8,36,71,000 (Total revenue increases 10% every year)

Table 5: Operation and Maintenance cost increases every year

Year	Station main. cost	Bicycle main.	Redistri. vehicle main.	Spar parts	Admin. Expen.	IT cost	Adv. cost	Manpower cost	Total
	In Lacs							In Crores	
0	14.20	35.50	4.00	2.00	6.00	3.00	5.00	1.26	1.95
	10%	10%	10%	1%	1%	1%	1%	10%	
1	15.62	39.05	4.40	2.02	6.06	3.03	5.05	1.38	2.13
2	17.18	42.95	4.84	2.04	6.12	3.06	5.10	1.52	2.33
3	18.90	47.25	5.32	2.06	6.18	3.09	5.15	1.67	2.55
4	20.79	51.97	5.85	2.08	6.24	3.12	5.20	1.84	2.79
5	22.86	57.17	6.44	2.10	6.30	3.15	5.25	2.02	3.06
6	25.15	62.89	7.08	2.12	6.36	3.18	5.30	2.23	3.35
7	27.67	69.17	7.79	2.14	6.43	3.21	5.36	2.45	3.67

Table 6: Financial evaluation of PBS using Benefit cost ratio method

Year	Operating & Maintenance cost (C)	Benefits (B)	$\frac{(B-C)}{(1+r)^n}$
1	2,13,83,000	8,36,71,000	5,56,14,285
2	2,33,75,860	9,20,38,100	5,49,29,792
3	2,55,56,550	10,12,41,910	5,40,60,971
4	2,79,74,839	11,13,66,101	5,31,15,453
5	3,06,22,474	12,25,02,711	5,22,04,680
6	3,35,43,375	13,47,52,982	5,13,75,435
7	3,67,33,851	14,82,28,280	5,04,49,967
Total			37,17,50,583

B = Value of benefits

C = Value of costs

r = Discount rate per annum

n = Number of years

For the present project, discount rate of 12% per annum is considered as per IRC: SP: 30- 2009.

Cost of the project = 16,22,30,000

Benefit / cost ratio = 37,17,50,583 / 16,22,30,000

= 2.29 greater than 1. Hence, the project is economically justified

VII. CONCLUSION

To complete short trips people mostly selected mode choice is auto rickshaw and walking. After the survey results 72% people willing to shift bicycle sharing system. Station location should be designed at every BRTS stop and mainly densely populated areas. Financial evaluation should be carried out greater than one. So, project is economical justify. If people reach with their own private vehicle, there is no parking facility available near the station. Rickshaw is the only option to reach the BRTS stations and rent is high. If the user to choose bicycle instead of auto rickshaw to reach BRTS station then save their money and to choose bicycle instead of walking to reach BRTS station then save their time by using bicycle sharing as feeder mode for BRTS. First mile to last mile connectivity problem should be solving by bicycle sharing system. Bicycle sharing concept improves health of people, improves cycling image and increases catchment area of public transport.

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