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Performance Analysis of BRT System Surat

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Abstract : ***BRT system is flexible, high-performance rapid transit mode that combines a variety of physical, operating and network elements.It is a permanently integrated system with a quality image and unique identity for urban transportation. The objective of this study is to analyse existing performance of Surat BRT system andto recommend measuresto improve andmaking the BRT system sustainable. Surat BRT system is in its initial stage at present, hence improving its performance will encourage people to use BRT system efficiently. The performance of BRT system is analysed by service quality and user satisfaction survey.***

Keyword: BRT system, Performance, Surat, Service quality, User satisfaction, Urban transportation

I. INTRODUCTION

Public transport is a shared passenger transport service which is used by the people, as distinct from modes such as taxicab, carpooling or hired buses which are not shared by strangers without private arrangement. Public transport services have been fixed-route systems operating along a well-defined corridor making pre-determined stops to pick up passengers at scheduled times. Public transportation needs to be effective, efficient, integrated, multi-modal and funded in a sustainable way.

Transportation is becominga major issue for many cities andan important part of theeconomic development of thecity. Due to increased traffic, congestion, stress related to longer commute times and vehicle emissions, cities today are becoming increasingly concerned with improving their transit services, to encourage more drivers to switch to public transportation. There are many types of public transport such as airlines, railway, city bus, tram, rapid transit system and cable transit system,and so on. All of these modes have their specific importance and benefits.

BRTSis a flexible, high-performance rapid transit mode. The components of a BRT systemincludes running ways, stations and bus stops, specialised vehicles, fare collection, route structure and servicing, Intelligent Transportation Systems (ITS), and marketing with branding. It combines thequality of rail transit and flexibility of abus.

II. OBJECTIVES

The present study is carried out with following objectives:

- To explore theperformance of existing BRT system within thestudy area.
- Analyze user satisfaction based on a surveyfor services rendered bythe BRT system;
- Recommend appropriate measures for improvement for future BRT system

III. METHODOLOGY

User satisfaction and level of service approach is used to check the performance of BRT system. Authors carried out a usersurveythrough a designed questionnaire. It sought information on travel time, reliability, comfortability, identity and image, safety and security, capacity and accessibility parameters.Researchers compared the gathered informationwithstandard values to identify the performance level of BRT system. Based on the results obtained after analysis of responses, recommendations areare suggested addressing the study objectives.

IV. SURAT CITY PROFILE

Surat cityis also termed as “The Silk City”, “The Diamond City”, “City of Flyovers”. It is locatedon the banks of River Tapi, which serves its course from the South-East to the South-West. It has apositionof theninth largest urban area in the country(Registrar General & Census Commissioner, 2011). The city is famous for its textile trade, diamond cutting, and polishing industries. Area of Surat city is 326.51 Sq. Km. and population density is about 136.80 ppha as observed in 2011. Seven administrative zones- North Zone, South Zone, West Zone, East Zone, Central Zone, South-East Zone and South-West Zone divides the city geographically.

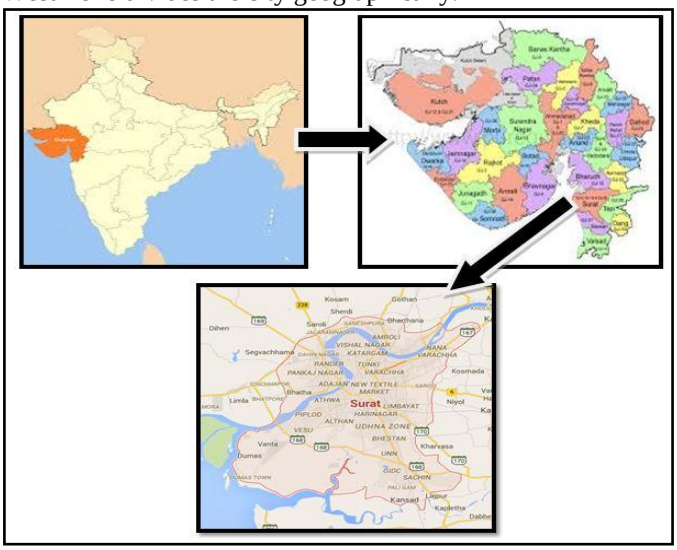

Figure 1 Surat city location

Surat has radial road pattern with a combination of agrid-iron pattern having a network ofmajor and minor roads. Roads connect about 80% of the S.M.C area. There areseven main roads (corridors)that connect the CBD area.These areVarachha-KamrejRoad,Sahara Darwaja – Kadodara, Udhna – Sachin – Navsari, Adajan – Rander OlpadRoad, Amroli – Sayan Road, Hazira Road, Airport Road.

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There is continuous vehicular growth in Surat city.Auto rickshaws increased with a rate of 116.94%, andthe motor cars had a growth rate of 217.17% per year in duration of 2003 to 2013.

V. SURAT BRT SYSTEM

Surat BRT system intends to provide speedy, safe, pollution-free, reliable and an efficient public transit to the citizens. Specially designed BRT Buses traversing on dedicated lanes along with a particular provision for other modes namely the cyclists, pedestrians, and mixed traffic.BRT system arterial road network have about 125 kilometers length in Surat. Already, 30 km network implementation is complete during the phase-1 of the project encompassing 41 bus stations. Three terminals, in future, will take care of transit. There are ten interchange stations proposed.On an average, around 15,000 passenger travel daily. The frequency of the bus is 5-8 minutes. The capacity of thebus is to carry 25 passengers.The stations situated in central median. Stations are equipped to issuetickets, bus information display, audio systems and have other support infrastructure. The off-board ticketing isnot yet in practice. The use of the smart card is expected to be extensive in future.Following are corridors of Surat BRT system:

- Corridor 1 – Surat Navsari Road
- Corridor 2 - Canal road from AaimataJn. to AnuwratDwar continuing towards Varacchatowards the East and Surat Airport towards the West
- Corridor 3 – Varachha Road
- Corridor 4 – Walled City Ring Road
- Corridor 5 – Surat Bardoli Road
- Corridor 6 – KatargamDarwaja to Amroli
- Corridor 7 – Rander Road
- Corridor 8 - Gujarat Gas circle to Anuvratdwar
- Corridor 9 – Surat Dumas Road
- Corridor 10- Hazira Road

Figure-2 illustrates the existing and proposed BRTS routes for the Surat city roads. The entire project consists of converting existing roads for the inclusion of BRTS.

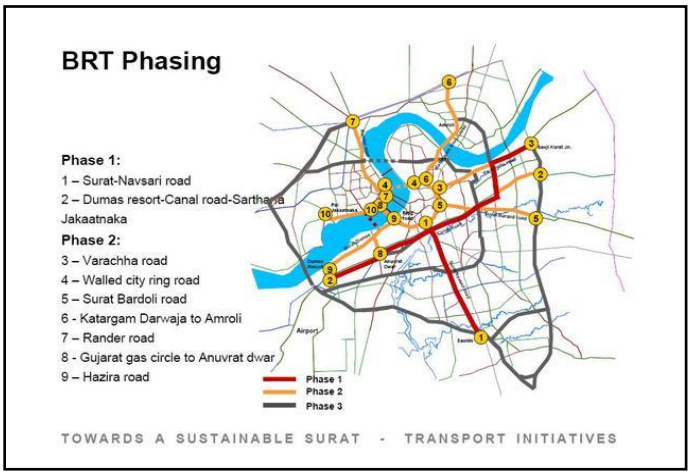

Figure 2Surat BRT system
(Source: BRTS Cell, Surat Municipal Corporation)

VI. STUDY AREA PROFILE

Surat BRT system will completein 3 phases. Out of these threesteps,phase-1 is under operation. It has30 km of thenetworkthat consists of two corridors.

Corridor 1: Surat Navsari Road [10.2 km]
Corridor 2 Dumas resort-Magdalla road-Canal Road [20 km]

There are 41 bus stations planned in phase 1. Three terminals are also proposed along withten interchange stations.

a. Corridor-1 Surat-Navsari road

This corridor starts from UdhnaDarwaja to SachinGIDCcovering a stretch of 10 km length. This corridor consists of 20 station along the route.The construction of the corridor completedback in January 2014.Major activities on this corridor include the transits of Udhana GSRTC bus stand, the Sachin and Pandesara industrial estates and the SMC – South Zone office. It carries a lot of truck and trailer traffic catering to the industrial estates.The population density of the area varies from high to moderate to low density. Below table enlists the bus stations along the corridor and its positions in the stretch.

Table 1BRTS bus Station locations on corridor 1

Sr. No.	Bus station Locations	Chainage (in Km)
1	Udhna darwaja	0.0
2	Kharwarnagar CNG circle	0.75
3	Jeevan Jyotcinema	1.27
4	Udhna Cross	1.65
5	Udhna GSRTC bus stop	2.18
6	Harinagar Society	2.54
7	BRC Gate Junction	3.00
8	Daksheshwar Temple	3.87
9	BhedvaadDargaah	4.35
10	Pandesara GIDC Cross	4.75
11	Kaamnath Mahadev Jn.	5.35
12	Navin Fluorine Industries	6.20
13	Bhagvati Industrial Estate	7.00
14	Bhestan Village Cross	8.2
15	Bhestan Rly. Stn. Cross	8.8
16	Unn patia	9.20
17	Sachin GIDC	9.90

(Source: Surat Trans - vision 2030, CMP-2008)

Below figure illustrates the passenger travel information recorded for the corridor-1. It shows the records of tickets issued from each of the bus stations for the duration of November 2015 till February 2016 – a time passage of 4 months. Values in the Figure-3 show the average of all four months. The average value varies from lowest of 834 persons to a high of 52,215 persons.

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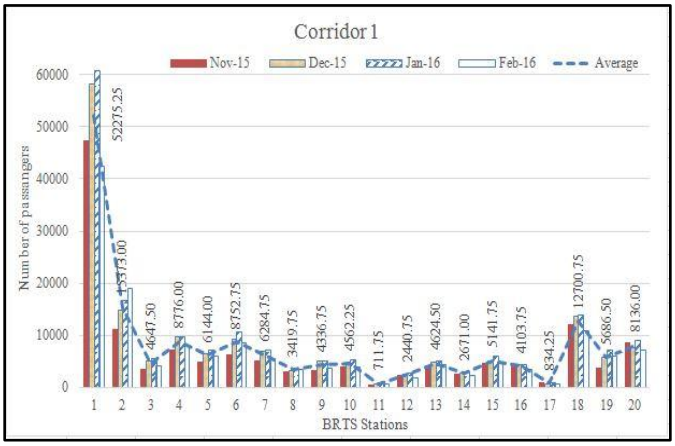

Figure 3Passenger travelling across Corridor-1

Udhna Darwaja is surely a bus station with highest of travelers. Figure-4 shows the status of monthly travel passenger for the duration and the average. It shows that the duration of December and January months picked up the travelers more in comparison to rest of the months.

Figure 4 Average monthly travelers on corridor-1

b. Corridor-2 Airport-Sarthana

This corridor initiate withone end located at Sarthana nature park and reaches to the Airport in the west of citycovering a stretch of 20 km. This corridor combines three different roads, the Surat-Dumas Road, Udhna-Magdalla Road and the Canal Road.It comprises 24 stations enlisted in Table-2.The construction workof the corridor completedin December 2014. The Surat airport and SouthGujaratUniversity are major destinations on this corridor. This corridor is aimed to act as an alternative to the walled city ring road. Population densityin the surrounding area varies from moderate to low.Land parcels in the vicinity of the corridor has a huge potential for development in near future.

Table 2BRTS bus Station locations on corridor 2

Sr. No.	Bus station Locations	Chainage (in Km)
1	Surat Airport	0.00
2	Dumas Resort	3.29
3	University (West end)	4.78
4	University (East end)	5.94
5	Centre for Social Studies	6.54
6	Anuvrat Dwar	7.58
7	New City Light	8.54
8	Ishwar Farm	9.04
9	Jamna Nagar	9.55
10	Rupali Canal (Panas)	10.02
11	New Bhatar RoadJunction	10.46
12	Bamroli Road Junction	11.21
13	Kharwarnagar CNG circle	12.06
14	Bhatena Road Junction	12.93
15	Anjana Appartments	13.63
16	Ambedkar Nagar	14.20
17	Dumas RoadJunction	15.11
18	Aai mataJunction	15.45
19	Puna Kuambharia	16.22
20	Parbat Patia Model Town	18.75
21	Savita Park Society	19.72
22	Varachcha Water Works	20.85
23	Nana Varachcha Cross	21.24
24	Savji Korat Bridge Junction	21.90
25	Sarthana Jakatnaaka	22.65

(Source: Surat Trans - vision 2030, CMP-2008)

Now, another figure below suggests the passenger travel information recorded for the corridor-2. It shows the records of tickets issued from each of the bus stations for the same duration with a time passage of 4 months. Values in the Figure-5 show the average of all four months. The average value varies from lowest of 254 persons to a high of 40,462 persons.

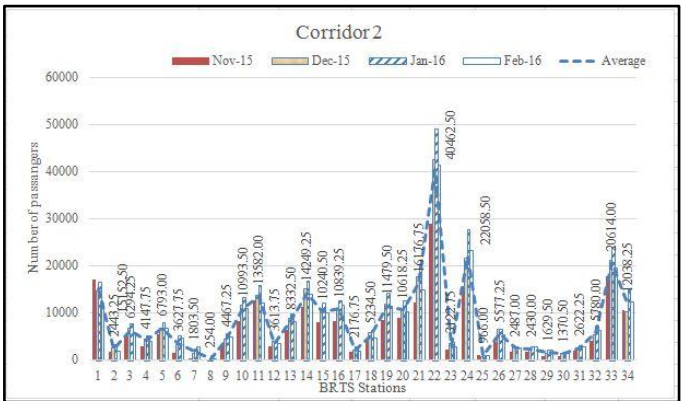

Figure 5Passenger travelling across Corridor-2

Parvat Patia Model Town is a major bus station attracting highest number of travelers. Figure-6 shows the status of monthly travel passenger for the duration and the average. It differently shows that the duration of January month picked up the travelers more in comparison to rest of the months with a lowest during November 2015.

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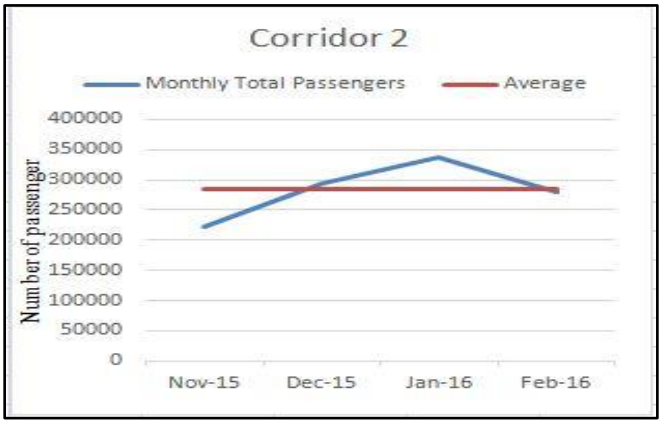

Figure 6Average monthly travelers on corridor-2

Henceforth, the busy most stations can be identified as Udhna Darwaja, Parvat Patia Model Town, Rupali Junction and Vishvakarma.

VII. ANALYSIS AND RESULTS

Authors carried out a random sample survey of 375 in size considering the total population travelling in the Surat BRTS. The sample size was derived with a confidence interval of 95%. All the respondents were real-time users of the service. First-hand analysis revealed that 57.86% were male respondent and remaining 42.14% were female. The respondents were requested to provide responses through a questionnaire seeking details as discussed earlier. The exercise resulted in formulation of an O-D Matrix for groups of stations.

A. Origin destination matrix

To obtain O-D information from responses, it was difficult to have specific details hence, the researchers formulated groups of bus stations which are in vicinity. Total 10 groups were formed encompassing both of the corridors. All responses were distributed accordingly. As per O-D matrix, maximum daily trip occurform group 2 to group 8 and from group 7 to group 8. Groups are shown in Figure-7.

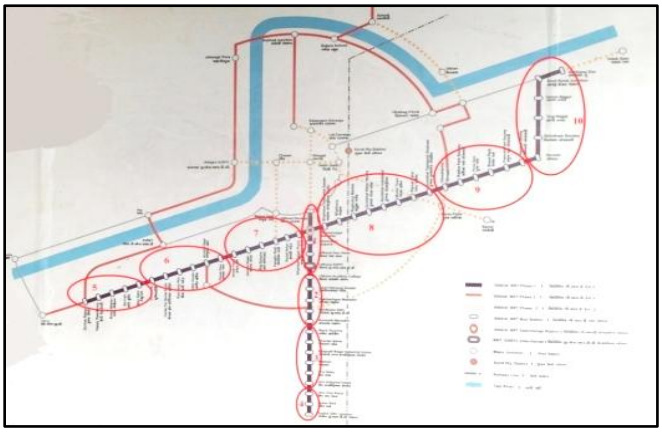

Figure 7 Distribution of bus stations in groups

The group 2 include Udhana academy college to Kamnath mahadev, group 7 include Rupali canal to Ishwar farm and group 8 include Bhathena industrial estate to Parvat patia bus stations catering the points of highest interest of travellers. Both groups 2 and 7 comprise residential colonies and establishments of LIG citizens. Obviously, travelling to Udhna industrial area for economic involvement.

Table 3Origin - Destination matrix

O / D	1	2	3	4	5	6	7	8	9	10
1	1	13	4	17	18	5	7	6	5	3
2	7	0	1	0	0	0	0	0	0	0
3	1	2	0	1	1	1	1	0	0	0
4	3	1	2	0	2	0	1	1	0	0
5	11	1	0	0	2	5	9	3	1	7
6	7	0	0	1	9	0	11	1	1	1
7	8	2	1	1	17	1	0	4	3	5
8	13	20	2	4	14	10	23	3	2	1
9	8	10	2	1	2	2	3	4	0	3
10	11	1	0	0	2	3	10	6	0	0

B. Commuter based survey

Different questions responded by the commuters during the user-satisfaction survey were compiled and analysed. Facts revealed that the most of the commuters were travelling on daily basis. Major emphasis over the lacking component in the system towards a facility of foot-over bridge connecting road-side footpaths to BRT bus station. Major issues identified were like overcrowding during peak hours, private vehicles travelling within and obstructing BRT lane, parking facility around stations, and absence of effective feeder system. Mostly,the consumers found to be satisfied with existing BRT facility. Major of commuter massdepicted the need of connectivity to railway station. Also, the need for daily commuter pass was identified. Below table comprises the responses in percentage as recorded. The important and majority of responses are marked in bold text.

Table 4 Responses by the commuters

Statement		**Total(%)**
Speed of BRT bus	Faster	25.33
	Good	**70.40**
	Slow	4.27
Reliability for timely arrival	**Reliable**	**70.40**
	Not reliable	29.60
Safety in BRT bus	**Yes**	**94.93**
	No	5.07

Statement		Total(%)
Convenient in reaching BRT station	Convenient	83.20
	Not convenient	16.80
Frequency of buses	**Less**	**52.00**
	Sufficient	48.00
	More	0.00
Comfort in the bus	**Comfortable**	**70.67**
	Not comfortable	29.33
Cleanliness of BRT station	**Yes**	**94.93**
	No	5.07
Cleanliness of BRT bus	**Yes**	**94.40**
	No	5.60
Overall satisfaction	Very satisfied	17.07
	Satisfied	**59.73**
	Neutral	23.20
	Dissatisfied	0.00
	Very dissatisfied	0.00
Delay due to vehicle running in BRT lane	**Yes**	**66.67**
	No	33.33
Sufficient parking facility	Yes	16.00
	No	24.27
	Not Applicable	**59.73**
BRT service lane properly made	**Yes**	**82.13**
	No	17.87
FOB required	**Yes**	**70.93**
	No	29.07
Overcrowding in BRT buses	**Yes**	**60.27**
	No	39.73
Buses having reasonable fare	**Yes**	**93.07**
	No	6.93

VIII. CONCLUDING REMARKS

An approximately 15,000 citizenscommute through BRTSof Surat on daily basis. BRTS Users are mostly satisfied with the service that is provided and also, the fare being charged is found reasonable. Major points of commuter clustering were found to be Udhna Darwaja, Parvat Patia Model Town, Rupali Junction and Vishvakarma stations across the BRT corridor 1 and 2. Overcrowding and private vehicles in dedicated BRT lane obstructing the bus movement were among the highlighted issues. A facility of parking alongside of the bus stations, feeder system and foot-over bridge is anticipated. At present only two corridors are in operation and hence, the demand for other routes and locations are seeming appropriate. Citizens are wanting this services as the prices are affordable, reasonable compared to other modes. Certain modifications if made, the existing service can sustain for a longer duration with effective mass movement on the roads of Surat city.

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