Engineering Analysis of Bus Rapid Transit (BRT) System at Corridor III Karachi

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***Abstract*— A sustainable urban transport system has become a unified part of development in any country. Public adequacy of sustainable transport measures is a challenge for developing cities such as Karachi, where mobility to all income groups of the society needs to be ensured without affecting travel time, cost, and environmental stability. This paper incorporated Qualitative and Quantitative analysis which has been carried out to examine public attitudes towards transit system execution, at Corridor III, by performing Cross Tabulation Test and One-way ANOVA analysis using Statistical Package for Social Sciences (SPSS) tool, which enables to assess relevant performance variables specifically time, mode of travel, cost, environmental and psychological issues and sustainability. The gathered information is beneficial to judge public opinions to shift from Private Vehicle (PV) to Bus Rapid Transit (BRT) and to predict futuristic approach for the better transit network in Karachi.**

***Index Terms*— Bus Rapid Transit (BRT) System, Transit Network, Karachi Metropolitan Corporation (KMC), Sustainable Urban Transport, Statistical Package for Social Sciences (SPSS).**

I. INTRODUCTION

The cities of Pakistan are escalating much faster than the overall population. At independence in 1947, many refugees from India settled in urban areas. By 2004, about 42 percent of all Pakistanis lived in urban areas, with 23 percent of the estimated population living in three major cities of over one million inhabitants including Lahore, Faisalabad, and Karachi [1].

Conferring to the Karachi Strategic Progress Plan 2020 estimated the baseline of 1,375,000 million inhabitants and 31.6 million population increase in 2030. This rapid population growth will affect infrastructure, and create severe complications to transportation, electricity, sewage systems which are caused due to turbulent political history, and create drastic impact on the residents [2].

Improvement in transportation network has many challenges which have to be faced by people residing in Pakistan. The Bus Rapid Transit (BRT) system is developed in main cities of Pakistan namely Lahore, Multan, Islamabad and Rawalpindi. The Islamabad and Rawalpindi bus service which is beneficial socially and economically for the residents.

Based on the statistics of 2011 data Karachi city has estimated 22,313 buses which are operated according to Karachi Metropolitan Corporation (KMC) [3]. According to a report an additional 8,676 more large buses are required to fill the shortfall of the transportation problems for the public. The number of passengers is approximately 5.6 million per day, accounting for 40% of motorized travel modes and the operational buses travel very slow i.e., the average speed of buses is as slow as 17 km/h [4]. Due to many unforeseen reasons Karachi falls behind to adopt effective measures for the transportation improvement. This is an alarming state and results in adverse consequences because this city is the largest metropolitan city.

To overcome these challenges BRT system at corridor III has been proposed in Karachi, with the partnership of Asian Development Bank (ADB) with an estimated financing of $90.5 million [5].

The Japan International Cooperation Agency (JICA) has carried out home based surveys, traffic count surveys and vehicle classification, but its implementation is facing delay due to some internal facts [6].

Globally transportation advancements have been done by taking example of the Masdar city Dubai where its operations are based on the zero tolerance for carbon and waste i.e., car free.

The sustainable city design is a model for ecofriendly environment by employing renewable energy technologies and strategies. The Three Es' concept of sustainability i.e., Environment, Economy, and Equity, has not been carried out in Pakistan transit network. It is not appropriate in contrast to renewable resources implementation process, which is the major hindrance due to unsuitable strategic planning and development, moreover the political involvement is one of the factor causing the difficulties in the implementation of these technologies which lead to the progressions in Pakistan [7].

The Karachi is the biggest as well as the most populous city of Pakistan. The metropolitan city with its suburbs is the world's second most populated city, which spreads over 3,530 square kilometers [8].

The city acclaims its growth to the mixed populations of economic and political migrants and refugees from different countries and provinces having different languages and religions. The settlers come here to settle permanently which creates shortage of the basic necessities. The major concerns are related to the lack of transportation facilities available to the daily users, composed of every individual inhabitant, by providing efficient network at low cost and economically feasible.

Due to increase in traffic congestion at all the main routes which are affecting residents and environment in an odd manner. The appropriate transport measures are adopted for BRT system execution, at Corridor III, at stretch of 24.4 km (15.16miles), covering an area from Safoora Goth to Numaish (near Mazar-e-Quaid) [9]. A Qualitative analysis is projected

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in this research to analyze public perception regarding BRT system implementation, considering significant variables i.e., time, cost, mode of travel during peak hours, socioeconomic demographics, environmental and psychological issues, which will prospect future outcome whether BRT implementation is beneficial or causing hurdles to the residents. The main objectives of this research are:

- To study comprehensive literature focused on the BRT implementation strategies and operations worldwide.
- To conduct a qualitative survey to investigate public perception towards its execution in Karachi at Corridor III.
- To analyze qualitative and technical data based on parameters such as time, cost, mode of travel during peak hours, socioeconomic demographics, psychological, environmental degradation, and sustainability.

The results obtained from this study for general assessment of Public Perception of BRT implementation at Corridor III Karachi to know what issues of transport people are facing today and its comparison with the future implementation whether it will be beneficial and sustainable and provide positive outcome for the residents with the sustainable transportation network in Karachi. That would be beneficial for the future of the Transportation network and help for the sustainability of the city.

II. RESEARH METHODOLOGY

Methodology of this study is divided into 4 phases:

A. First Phase

The first phase includes extensive literature survey which incorporates the broad accumulation of writing, exploring the way how created nations anticipated BRT system.

B. Second Phase

The second phase includes a selection of key performance variables through different methods adopted universally and questionnaire is developed by considering these variables i.e., time, mode of travel, cost, environmental, psychological issues, and sustainability of the specified performance of the bus networking in the city and its complications addressed by the residents.

C. Third Phase

The data collection is done in the third phase by distributing 200 questionnaires among the respondents in order to analyze what problems residents are facing in contrast with the selected variables. These variables are useful aspect of this phase of the data collection in order to achieve accuracy.

D. Fourth Phase

In last phase the collected data is analyzed and interpreted to evaluate variations of perception of respondents i.e., different social groups of the respondents were investigated by Cross Tabulation, T-test, and One-way ANOVA analysis, by using SPSS tool. This data analysis would contribute to determine accuracy and calculated facts and figure of recorded data at specified survey site and is helpful in analysis of data at its defined number of users which will be beneficial for future consideration of improved transportation network.

A flowchart of the research approach is shown in Fig.1.

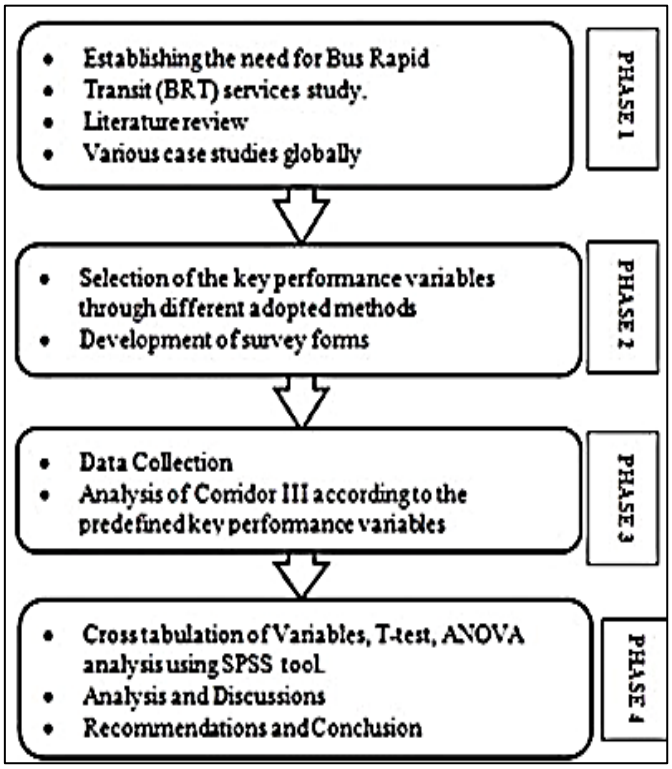

Fig. 1: Research Process Flow Diagram

III. DATA COLLECTION

A. Questionnaire Design

A questionnaire survey was conducted at Corridor III Karachi to obtain data required to accomplish the study objectives. A questionnaire was designed considering the characteristics of the target group of people who use transit or private vehicle for their daily commute. The number of questions was kept less in order to get reliable data with simplicity. This questionnaire was divided into two parts:

- Part one includes daily travel information of respondents who are using Corridor III i.e., gender, age, vehicle ownership, type of vehicle, income, the purpose of using Corridor III.
- In the second part six performance variables are discussed to analyze public attitude i.e., time, mode of travel, cost, environmental issues, psychological issues, and sustainability.

B. Survey and Sampling

A Survey is conducted at Corridor III, by distributing 100 questionnaire forms, to the respondents roadside, for conducting Origin-Destination (O-D) survey, to estimate direct impact among other travelers within the zone of influence, to estimate the indirect impact, from the students and office workers. The remaining 100 forms are filled online and different data is gathered and analyzed, as follows:

- The percentages of male and female respondents who prefer Corridor III for their daily transit are 61.5% and 38.5% respectively.

- Almost 76% people own car, 17.5% own motorbike, 1.5% own both and 5% of the people don't own vehicle.
- The Monthly income of the respondents, starting from lower to higher side, is less than Rs 25,000 (31%); Rs 50,000-75,000 (54.5%); Rs 100,000-150,000 (13%); more than Rs. 150,000 (1.5%).
- The respondents who use Corridor III are aged as 18-30 (54%); 30-50 (35.5%); 50-60 (8.5%); >60 (2%).
- The respondents who use Corridor III for Education (26%); Work (34%); recreation (20%); all (15%), don't use (5%).

IV. ANALYSIS AND DISCUSSIONS

Average responses of the respondents were analyzed by using SPSS tool. To examine relationship and interaction between selected variables Cross tabulation analysis is carried out. Some researchers who are considered to be the first who adopted the process of Segmentation for users which is used in this research, that support to analyze transportation network sustainability. The analysis related to time spent waiting for the local bus and the age of the respondents is carried out as described below:

Table I: Time Spend Waiting for Local Bus w.r.t Age of Respondents

Time Spend	% Respondents Age			
	1830	3050	5060	Over 60
1030 Minutes	17.5 %	7.5 %	2.0 %	1 %
3040 Minutes	24 %	22.5 %	6 %	0%
4050 Minutes	9 %	5%	0.5%	0.5%
12 Hours	1.5%	0%	0%	0.5%

A. Cross Tabulation

The discoveries of the time spend waiting for the local transport with the percentages of the age of respondents came about as young group (18-30); 24% of these respondents spend 30-40 minutes while waiting, as youngsters like to work and use their beneficial time in open air exercises and a large portion of the general population are office laborers, than that of the center (30-50 or 50-60) and seniority (over 60) years as shown in Table I. This would bring disappointment to the clients who use nearby transport as additional time is squandered to achieve their coveted goal. Ranking has been done to the daily mode of transport users in order to know what factors are affecting their daily commute i.e., results are obtained which states that:

- 99% of the respondents have ranked Travel Time (1) as imperative factor used for both work and educational purpose while 1% of the respondents are unaware.
- 90% of them ranked Comfort of Travel (3) to be the most critical while 5% are unsure,
- 95% of the respondents rank Cost per Travel as (2) vital factor that would influence their day by day travel on the off chance that they are setting out to their work put they lean toward transport so it ought to be prudent and
- 81% of the respondents ranked Purpose of Travel (4) that if method of travel isn't effective it would not be utilized by the general population.

B. Variation or Similarity of Perception

A far-reaching investigation is directed in this examination to inspect the public perception in both, fulfillment and inclination among the socio-statistic distinction (mode, gender, age, education, and income) and two performance variables are considered to determine whether perception between these groups are equal or different. Collected data were analyzed by performing T-test and One-way ANOVA analysis, as described below:

Table II: Variation or Similarity in Perception of Variables

Variables	Gender	Age	Occupation	Education	Mode
Public Transport Sustainable	t=2.380	F=0.130	F=0.290	F=1.651	F=1.774
	p=0.019a	p = 0.942	p = 0.833	p=0.179	**p=0.045a**
Time Saving	t =1.420	F=0.111	F=0.756	F=0.373	F=0.504
	p=0.158	p = 0.954	p = 0.520	p=0.772	p = 0.680
Economical	t =0.790	F=0.281	F=2.081	F=0.185	F=0.104
	p=0.430	p=0.839	p=0.104	p=0.906	p = 0.958
Flexible Mode of Travel	t=0.790	F=0.281	F=2.081	F=0.185	F=0.104
	p=0.430	p = 0.839	p=0.104	p=0.906	p = 0.958
Reducing Environmental Issues	t=0.790	F=0.281	F=2.081	F=0.185	F=0.104
	p=0.430	p = 0.839	p = 0.104	p=0.906	p = 0.958
Reducing Psychological Issues	t=0.790	F=0.281	F=2.081	F=0.185	F=0.104
	p=0.430	p =0.839	p = 0.104	p=0.906	p = 0.958

Where "p" values less than 0.05 are shown in bold

The value 't' which is positive and level of significance 'p> 0.05', shown in Table II indicates that the perception of both male and female are the same in overall factors including sustainability of the current transportation network in Karachi. Impact of age on the perception came to fruition as same over each one of the elements and considered to have approach differences. While concentrating on the youthful gatherings, 18-30 years of age, are more stressed over the sustainability, timesaving, economical and essentially capable transportation orchestrate achieves lessened of biological and mental issues to the more settled social occasions (30-50) (50-60) and (more than 60), having the same perception on the said factors related to the transportation organization.

The occupation of the respondents achieved the same perception in the light of inspected factors showed up in Table II; the majority of the (students, office professionals or business persons) use Corridor III, for their regular objective and are more concerned related to the viability of transport, sort out extra time which is consumed on account of congested street conditions.

The Education level of the users as shown in Table II, examines whether (university, postgraduates, or college) respondents have the same perception as for the manageability issues of transportation in Karachi. Perception of different mode of users shown in Table II was examined and resulted in huge distinction among private autos, motor bike or both users. The motorbike users are more disappointed by the manageability of the present transport of the city.

Table III: Variation or Similarity in Perception of Variables

Variables	Education Purpose	Work Purpose	Asthma Problem	Headache
Public Transport Sustainable	F= 1.315	F= 6.607	F= 0.198	F= 1.004
	p = 0.253	p = 0.11	p = 0.657	p = 0.368
Time Saving	F= 0.046	F=0.262	F=0.245	F=0.459
	p = 0.830	p = 0.609	p = 0.621	p = 0.633
Economical	F=1.355	F=0.491	F=1.995	F=0.144
	p = 0.246	p = 0.484	p = 0.159	p = 0.866
Flexible Mode of Travel	F=1.355	F=0.491	F=1.995	F=0.144
	p = 0.246	p = 0.484	p = 0.159	p = 0.866
Reducing Environmental Issues	F=1.355	F=0.491	F=1.995	F=0.144
	p = 0.246	p = 0.484	p = 0.159	p = 0.866
Reducing Psychological Issues	F=1.355	F=0.49	F=1.995	F=0.144
	p = 0.246	p = 0.484	p = 0.159	p = 0.866

Where "p" values less than 0.05 are shown in bold

No significant difference of variance resulted; Table III shows respondents who use Corridor III for education and work purpose. Moreover considering environmental and psychological issues are not statistically significant which were caused by the poor transportation system. The data analysis shown that by considering data problems related to asthma and headache, as shown in Table III, are found mostly among youngsters who use Corridor III for education purpose.

C. Analysis and Comparison of, Private Vehicle (PV), with the prospects of Bus Rapid Transit (BRT) System, at Corridor III Karachi.

Analysis of BRT in Comparison with Private Vehicle (PV) users, is done to interpret impression of various methods of transport users, that will be favorable for future implementation of the BRT at proposed Corridor III from Safoora Chowk to Numaish (near Mazar e Quaid) which covers 24.4 km (15.16 miles) as shown in Fig. 2.

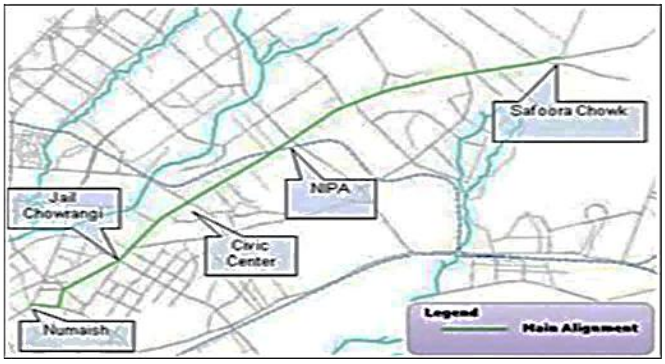

Fig. 2: Proposed Bus Rapid Transit (BRT) at Corridor III

D. First Phase

The First Phase consists of the analysis of each station, with traffic jam, by assuming origin to destination:

i. Station 1:

Consider 15 passengers who use Station 1 and covers a distance of 6.6 km, from Safoora Chowk to Nipa as shown in Table IV.

Due to massive traffic jam passengers are facing trouble in accordance with time, fuel, and cost incurred in daily route towards their desired destination. Assumption has been made for 15 passengers who favor PV as their day by day mode of travel and 15 passengers who want to use BRT information is aggregated between parameters expressed as appeared:

Average speed in (km/hour), time expended (minutes), time spared (minutes) or fuel utilization (liters/100 km), environmental and psychological issues caused because of enormous congested driving conditions.

On the off chance that 15 travelers go from car without congested driving conditions, assessed normal speed which is recorded as 20 km/hour, at an expected length of 6.6 km, it takes 45 minutes-1.5 hours at peak hours, to achieve wanted goal which brought about little advantage to time saving. Suppose normal fuel utilization for car is computed according to 1 vehicle may be (1 liter = 8 km) in car influx with traffic stick, fuel utilization is recorded as 120 liters/100 km (for 15 vehicles), contingent upon the separation secured, at an expected cost of 100-125 PKR/vehicle for 15 vehicles.

Expect 15 numbers of passengers lean toward going from motorbike with a normal speed of 20 km/hour at a separation of 6.6 km which requires normal investment utilization of 30 minutes-1 hour to achieve wanted goal. This brought about little advantage to efficient, normal fuel utilization for motorbike which is figured according to 1 vehicle expend roughly as 3 liters/100 km for 1 vehicle and came about as 48 liters/100 km for 15 vehicles, contingent upon the separation secured, with an expected cost of 40-50 PKR/vehicle for 15 vehicles.

Expect 15 numbers of passengers lean toward going from nearby bus with a normal speed of 17-18 km/hour, at a separation of 6.6 km, which requires normal investment utilization of 1.5 hours to achieve wanted goal. This brought about little advantage of time saving; average fuel utilization is recorded as 39 liters/100 km with 15 numbers of travelers at an expected cost of 15-20 PKR/traveler, relying upon the separation secured.

ii. Station 2:

Station 2 includes Safoora Chowk to Nipa at an estimated distance of 10 km, shown in Table IV.

If 15 passengers travel from car without traffic jam, the estimated average speed is recorded as 20 km/hour at an estimated length of 10.0 km, which takes 11.5 hours at peak hours to reach desired destination, it resulted in very small benefit to time saving. Suppose average fuel consumption for car is calculated according to 1 vehicle is (1 liter = 8 km) in traffic jam. With traffic jam, fuel consumption is recorded as liters/100 km for 15 vehicles depending on the distance covered, at an estimated cost of 100-150 PKR/vehicle for 15 vehicles.

Assume 15 numbers of passengers prefer to travel from motorbike with an average speed of 20 km/hour at a distance of 10.0 km, it takes average time consumption of 45 minutes-1.5 hours to reach desired destination which resulted in very small benefit to time saving. Average fuel consumption for motorbike is calculated according to 1 vehicle consume approximately 3 liters/100 km for 1 vehicle and resulted as 50 liters/100 km for 15 vehicles depending on the distance covered, with an estimated cost of 50-60 PKR/vehicle for 15 vehicles.

Assume 15 numbers of passengers prefer travel from local bus with an average speed of 17-18 km/hour at a distance of 10.0 km, it takes average time consumption of 1.5 hours to reach desired destination which resulted in very small benefit to time saving. Average fuel consumption is recorded as 39 liters/100 km with 15 numbers of passengers at an estimated cost of 15-20 PKR/passenger depending on the distance covered.

iii. Station 3:

Station 3 includes Safoora Chowk to Jail Chawrangi at an estimated distance of 13.4 km.

Assume if 15 passengers travel from car without traffic jam, estimated average speed is recorded as 20 km/hour at an estimated length of 13. 7 km, it takes 11.5 hours at peak hours to reach desired destination which resulted in very small benefit to time saving. Suppose average fuel consumption for car is calculated as per 1 Vehicle is (1 liter = 8 km) in traffic jam. With traffic jam, fuel consumption is recorded as 185 liters/100 km for 15 vehicles depending on the distance covered, at an estimated cost of 100-150 PKR/vehicle for (15 vehicles).

Assume 15 numbers of passengers prefer travel from motorbike with an average speed of 20 km/hour at a distance of 13.7 km, it takes average time consumption of 40 minutes-1.5 hour to reach desired destination which resulted in very small benefit to time saving. Average fuel consumption for motorbike is calculated as per 1 vehicle consume approximately 3 liters/100 km for 1 vehicle and resulted as 35 liters/100 km for 15 vehicles depending on the distance covered, with an estimated cost of 50-65 PKR/vehicle for 15 vehicles.

Assume 15 numbers of passengers prefer travel from local bus with an average speed of 17 km/hour at a distance of 13.7 km, it takes average time consumption of 1 hour to reach desired destination which resulted in very small benefit to time saving. Average fuel consumption is recorded as 43 liters/100 km with 15 numbers of passengers at an estimated cost of 15-20 PKR/passenger.

iv. Station 4:

Station 4 includes Safoora to Numaish at an estimated distance of 15.5 km shown in Table IV.

Due to traffic jam environmental and psychological issues give rise to noise level headache and fatigue. Air Pollution causing extraordinary ecological and mental issues bring about colossal sicknesses like asthma and other respiratory harms.

E. Second Phase

The Second Phase consists of the analysis of each station without traffic jam by assuming origin to destination:

i. Station 1:

Consider 15 passengers who use Station 1 as shown in Table V.

If 15 travelers go from car without congested road, assessed normal speed is recorded as 45 km/hour at an expected length of 6.6 km, it takes 40 minutes to achieve wanted goal that outcomes in time sparing of 30 minutes. Assume normal fuel utilization for car is ascertained according to 1 vehicle seems to be (1 liter = 8 km), in automobile overload, immediately fuel utilization is diminished to 30% come about as 84 liters/100 km for 15 vehicles, contingent upon the separation secured, at an expected cost of 90 PKR/vehicle for 15 vehicles.

Expect 15 number of passengers incline toward go from motorbike with a normal speed of 50 km/hour at a separation of 6.6 km it requires normal investment utilization of 30 minutes and 40 minutes of time is spared without congested roads. Average fuel utilization for motorbike is ascertained according to 1 vehicle devour roughly 3 liters/100 km in motorbike influx immediately fuel utilization is decreased to 30% come about as 31.5 liters/100 km for 15 vehicles, contingent upon the separation secured, at an expected cost of 30 PKR/vehicle for 15 vehicles.

Accept 15 number of passengers favor go from neighborhood bus with a normal speed of 40-50 km/hour at a separation of 6.6 km it requires normal investment utilization of 40 minutes and 30 minutes of time is spared without roads turned parking lot, fuel utilization is recorded as 26.4 liters/100 km with 15 number of travelers at an expected cost of 1520 PKR/traveler.

ii. Station 2:

Station 2 includes Safoora Chowk to Civic Centre at an estimated distance of 10 km , If 15 passengers travel from car without traffic jam estimated average speed is recorded as 30-45 km/hour at an estimated length of 10.0 km it takes 40 minutes to reach desired destination, those results in time saving of 20 minutes.

Suppose average fuel consumption for car is calculated as per 1 vehicle is (1 liter = 8 km) in traffic jam, without delay fuel consumption is reduced to 30% resulted as 105 liters/100 km for 15 vehicles depending on the distance covered, at an estimated cost of 90 PKR/vehicle for 15 vehicles.

Assume 15 numbers of passengers prefer travel from motorbike with an average speed of 45-50 km/hour at a distance of 10.0 km it takes average time consumption of 30 minutes and 30 minutes of time is saved without traffic jams. Average fuel consumption for motorbike is calculated as per 1 vehicle consume approximately 3 liters/100 km in traffic jam without delay fuel consumption is reduced to 30% resulted as 33.6 liters/100 km for 15 vehicles depending on the distance covered, at an estimated cost of 6070 PKR/vehicle for 15 vehicles.

Assume 15 numbers of passengers prefer travel from local bus with an average speed of 50 km/hour at a distance of 10.0 km it takes average time consumption of 40 minutes and 30 minutes of time is saved without traffic jams. Fuel consumption is recorded as 35 liters/100 km with 15 numbers of passengers at an estimated cost of 15-20 PKR/passenger depending on the distance covered.

iii. Station 3:

Station 3 includes Safoora Chowk to Jail Chawrangi at an estimated distance of 13.4 km as shown in Table V.

If 15 passengers travel from car without traffic jam estimated average speed is recorded as 30-45 km/hour at an estimated length of 13.7 km it takes 40 minutes to reach desired destination that result in time saving of 20 minutes. Suppose average fuel consumption for car is calculated as per 1 vehicle is (1 liter = 8 km) in traffic jam without delay fuel consumption is reduced to 30% resulted as 130 liters/100 km

for 15 vehicles depending on the distance covered, at an estimated cost of 100 PKR/vehicle for 15 vehicles.

Assume 15 numbers of passengers prefer travel from motorbike with an average speed of 45-50 km/hour at a distance of 13.7 km it takes average time consumption of 30 minutes and 30 minutes of time is saved without traffic jams. Average fuel consumption for motorbike is calculated as per 1 vehicle consume approximately 3 liters/100 km in traffic jam without delay fuel consumption is reduced to 30% resulted as 24.5 liters/100 km for 15 vehicles depending on the distance covered, at an estimated cost of 40 PKR/vehicle for 15 vehicles.

Assume 15 numbers of passengers prefer travel from local bus with an average speed of 50 km/hour at a distance of 13.7 km it takes average time consumption of 50 minutes and 15 minutes of time is saved without traffic jams. Fuel consumption is recorded as 37.8 liters/100 km with 15 numbers of passengers at an estimated cost of 15-20 PKR/passenger depending on the distance covered.

iv. Station 4:

Station 4 includes Safoora Chowk to Numaish at an estimated distance of 15.5 km. If 15 passengers travel from car without traffic jam estimated average speed is recorded as 38 km/hour at an estimated length of 15.5 km, it takes 40 minutes to reach desired destination that result in time saving of 20 minutes. Suppose average fuel consumption for car is calculated as per 1 vehicle is (1 liter = 8 km) in traffic jam without delay fuel consumption is reduced to 30% resulted as 157.5 liters/100 km for 15 vehicles depending on the distance covered, at an estimated cost of 100-200 PKR/vehicle for 15 vehicles.

Assume 15 numbers of Passengers prefer travel from motorbike with an average speed of 48 km/hour at a distance of 15.5 km it takes average time consumption of 40 minutes and 30 minutes of time is saved without traffic jams. Average fuel consumption for motorbike is calculated as per 1 vehicle consume approximately 3 liters/100 km in traffic jam without delay fuel consumption is reduced to 30% resulted as 32.5 liters/100 km for 15 vehicles depending on the distance covered, at an estimated cost of 50-90 PKR/vehicle for 15 vehicles.

Passengers who prefer travel from local bus with an average speed of 50 km/hour at a distance of 15.5 km it takes average time consumption of 40 minutes and 15 minutes of time is saved without traffic jams. Fuel consumption is recorded as 37 Liters/100 km with 15 numbers of passengers at an estimated cost of 15-20 PKR/passenger depending on the distance covered.

Results are gathered without traffic jam resulted in minor rise in noise and headache because of activity horns and exhaustion. Pollution level is minimized, minor health problems are generated for passengers on their daily travel.

Comparison is made by considering 45 passengers who prefer Bus Rapid Transit system (BRT in traffic jams), the average frequency would remain constant as 26 km/hour, time consumption is resulted as 20 minutes and time saved is resulted as 40 minutes instead of 1 hour per direction, standards of BRT referred to the average fuel which is consumed at 15 liters/100 km. The BRT is cost effective service with a fixed amount of 20 PKR/passenger per direction.

Data analysis resulted from Table IV and V shows that majority of the young people are affected by the existing transportation system in Karachi related to key performance variables that would be affecting their daily commute, moreover analysis has been done with comparison of Private Vehicle (PV) with Bus Rapid Transit (BRT) system with the conclusion that more fuel is use by PV than BRT. BRT referred to the energy efficient mass transit system which will helps in reduction of CO_2 emissions due to Intelligent Transportation System (ITS) ecofriendly service [8].

Table IV: Analysis of Time and Fuel Consumption with Traffic Jam at Different Stations of Corridor III

Mode of Transport	No of Passengers (Passenger's/Vehicle)	Average Speed (Km/Hour)	Time Consumed (Minutes)	Time Saved (Minutes)	Fuel Consumption (Liters/100km)	Cost (PKR/Passenger)
Station 1: Safoora Chowk to Nipa						
Car	15	45	40 Minutes	30 Minutes	84 Liters/100 Km (15 Vehicles)	90 (PKR/Vehicles)
Motor Bike	15	50	30 Minutes	40 Minutes	31.5 Liters/100 Km (15 Vehicles)	30 (PKR/Vehicles)
Local Buses	15	4550	50 Minutes	20 Minutes	26.4 Liters/100 Km	1520 PKR/Passenger
Bus Rapid Transit (BRT)	30[8]	26[18]	20 Minutes [8]	40 Minutes[8]	15 Liters/100 Km [8]	20 PKR/Passenger[8]
Station 2: Safoora Chowk to Civic Centre						
Car	15	3045	40 Minutes	20 Minutes	105 Liters/100 Km (15 Vehicles)	90 (PKR/Vehicles)
Motor Bike	15	4550	30 Minutes	30 Minutes	35 Liters/100 Km (15 Vehicles)	30 (PKR/Vehicles)
Local Buses	15	17	50 Minutes	10 Minutes	36 Liters/100 Km	1520 PKR/Passenger
Bus Rapid Transit (BRT)	30 [8]	26[8]	20 Minutes[8]	40 Minutes[8]	15 Liters/100 Km [8]	20 PKR/Passenger[8]
Station 3: Safoora Chowk to Jail Chawrangi						
Car	15	3045	40 Minutes	20 Minutes	130 Liters/100 Km (15 Vehicles)	100 (PKR/Vehicles)
Motor Bike	15	4550	30 Minutes	30 Minutes	24.5 Liters/100 Km (15 Vehicles)	40 (PKR/Vehicles)
Local Buses	15	50	50 Minutes	15 Minutes	37.8 Liters/100 Km	1520 PKR/Passenger
Bus Rapid Transit (BRT)	30 [8]	26[8]	20 Minutes [8]	40 Minutes[8]	15 Liters/100 Km (Depending on Number of Passenger)[8]	20 PKR/Passenger[8]
Station 4: Safoora Chowk to Numaish						
Car	15	38	40 Minutes (15 Vehicles)	20 Minutes (15 Vehicles)	157.5Litres/100 Km (15 Vehicles)	100200 (PKR/Vehicles)
Motor Bike	15	48	40 Minutes (15 Vehicles)	30 Minutes (15 Vehicles)	32.5 Liters/100 Km (15 Vehicles)	5090 (PKR/Vehicles)
Local Buses	15	50	40 Minutes	15 Minutes	37 Liters/100 Km	1520PKR/Passenger
Bus Rapid Transit (BRT)	30 [8]	26[8]	20 Minutes[8]	60 Minutes[8]	15 Liters/100 Km[8]	20 PKR/Passenger[8]

Table V: Analysis of Time and Fuel Consumption with Traffic Jam at Different Stations of Corridor III

Mode of Transport	No of Passengers (Passenger's/Vehicle)	Average Speed (Km/Hour)	Time Consumed (Minutes)	Time Saved (Minutes)	Fuel Consumption (Liters/100km)	Cost (PKR/Passenger)
Station 1: Safoora Chowk to Nipa						
Car	15	20	45 Minutes 1.5 Hours (Peak Hours)	Very Small Benefit to Time Saving	120 Liters/100 Km (15 Vehicles)	100125 (PKR/Vehicle)
Motor Bike	15	20	30 Min1 Hour (Peak Hours)	Very Small Benefit to Time Saving	45 Liters/100 Km (15 Vehicles)	4050 (PKR/Vehicle)
Local Buses	15	17	1.5 Hours	Very Small Benefit to Time Saving	35 Liters/100 Km	1520 PKR/Passenger
Bus Rapid Transit (BRT)	15[8]	26[8]	40 Minutes [8]	Benefit to Time Saving[8]	15 Liters/100 Km (Depending on Number of Passenger)[8]	20 PKR/Passenger[8]
Station 2: Safoora Chowk to Civic Centre						
Car	15	20	11.5 Hours	Very Small Benefit to Time Saving	150 Liters/100 Km (15 Vehicles)	100125 (PKR/Vehicles)
Motor Bike	15	20	45 Minutes 1.5 Hours	Very Small Benefit to Time Saving	50 Liters/100 Km (15 Vehicles)	5060 (PKR/Vehicles)
Local Buses	15	17	1.5 Hours	Very Small Benefit to Time Saving	40 Liters/100 Km	1520 PKR/Passenger
Bus Rapid Transit (BRT)	30 [8]	26[8]	1hours[8]	40 Minutes[8]	15 Liters/100 Km (Depending on Number of Passenger)[8]	20 PKR/Passenger[8]
Station 3: Safoora Chowk to Jail Chawrangi						
Car	15	20	11.5 Hours	Very Small Benefit to Time Saving	185 Liters/100 Km (15 Vehicles)	100125 (PKR/Vehicles)
Motor Bike	15	20	40 Minutes 1.5 Hours	Very Small Benefit to Time Saving	35 Liters/100 Km (15 Vehicles)	5060 (PKR/Vehicles)
Local Buses	15	17	1 Hours	Very Small Benefit to Time Saving	43 Liters/100 Km	1520 PKR/Passenger
Bus Rapid Transit (BRT)	30 [8]	26[8]	30 Minutes [8]	50 Minutes[8]	15 Liters/100 Km (Depending on Number of Passenger)[8]	20 PKR/Passenger[8]
Station 4: Safoora Chowk to Numaish						
Car	15	20	12 Hours (Peak Hours)	Very Small Benefit to Time Saving	225 Liters/100 Km (15 Vehicles)	100125 (PKR/Vehicles)
Motor Bike	15	20	11.5 Hours (Peak Hours)	Very Small Benefit to Time Saving	46 Liters/100 Km (15 Vehicles)	50100 (PKR/Vehicles)
Local Buses	15	17	1.5 Hours	Very Small Benefit to Time Saving	49 Liters/100 Km	2030 PKR/Passenger
Bus Rapid Transit (BRT)	30 [8]	26[8]	45 Minutes [8]	60 Minutes[8]	15 Liters/100 Km (Depending on Number of Passenger)[8]	20 PKR/Passenger[8]

V. CONCLUSIONS AND RECOMMENDATIONS

This paper focuses on the evaluation of public perception and the prospects of Bus Rapid Transit (BRT) system at proposed Corridor III to examine whether this transit system is economical and feasible and what problems public is facing during its implementation phase. Qualitative analysis resulted in situational aspects of respondents' whose age lying between 18-30 years, are college or university students and spent 30-40 minutes waiting for local traffic (including buses or any other means of travel) and complained about the time spent waiting each day. Most ordinary people are office workers, and interviewees who aged between 30-50 and 50-60 years. People over the age of 60 do not like to use Corridor III for their daily travel. Generally young and highly educated, center paid interviewees had the highest degree of disappointment and security for the current transport arrangements in Karachi. In addition, results also show disappointment and enthusiasm of young people and higher educated middle-income people for most factors are unprecedented. The findings of this research concluded that the BRT system is considered to have a very auspicious future for developing cities, offers the benefits of a cost-effective rail option that will be conducive to congestion and air quality for all concerned groups through proper planning and implementation. To meet needs and preferences of different social groups a unified transportation framework and strategies are created without harming land utilization of encompassing ranges.

FUTURE WORK

Karachi city requires unified Transportation Planning and strategies that led to develop high quality transport network according to the needs and preferences different social groups rather than supply driven methodologies, the city may head toward a more sustainable future. Moreover, inquiry is relied upon to investigate the association between individual fulfillment of the respondents and stable framework ought to create without harming land utilization of the encompassing ranges.

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