International Journal of Advanced Research in Engineering Technology & Sciences ISSN: 2394-2819
April-2016 Volume 3, Issue-4
editor@ijarets.org www.ijarets.org

FEASIBILITY STUDY FOR BUS RAPID TRANSIT INDORE, MADHYA PRADESH

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ABSTRACT:
Transportation demands in Indore areas continue to increase rapidly as a result of both population growth and changes in travel patterns. In the stage of environment concern and limited space available in cities, transport planners have to provide a system, which can ensure safe and clean mobility to Indore city residents. This requires planning a system, which is affordable, reliable and efficient from the users' as well as operator's perspectives. A road based bus system offers an opportunity for creating a system capable of meeting multiple needs of users and operators. This paper presents a Improved service quality BRT bus transport services. These methodologies offer incremental improvements in bus system to meet the capacity requirements of different size cities. It is imperative that bus systems are planned such that they satisfy the requirements of users as well as service providers within the limited resource constraints. A flexible, comfortable, easily available and reliable bus service is expected to shift people from private vehicles to public transport.

KEYWORDS: Bus, Optimization, Transfer, Synchronization, BRT Design.

I. INTRODUCTION:

1.1 INTRODUCTION:

Indore urgently needs to develop a mass transit system protected from its increasing traffic congestion. Mass transit is needed now on three central corridors, and will eventually be needed on at least nine corridors. Bus rapid transit (BRT), metro, and monorail technologies could all provide a system with sufficient capacity and speed to improve mass transit ridership in those corridors. Metro and monorail would require large capital subsidies, and subsidies for the procurement of rolling stock. By contrast, BRT would not require subsidies for operation, construction or for the procurement of rolling stock. The capital cost differences are significant. For the same amount of capital investments, ICTSL estimates Indore could build 120 km of BRT system, but only 37 km of elevated Metro or 31 km of monorail.
The primary advantage of the monorail system is that it would minimize land acquisition. Metro's main advantage is its potentially higher capacity, but this level of capacity is unlikely to be required in Indore. While all 3 systems would save travel time and so help retain passengers on public transit, the metro and monorail system would require higher fare prices which would suppress demand. In addition, a larger system has much higher potential to shift passengers to mass transit. We project that if Rs.5000 crore were spent on each system, the BRT system would lead to a 21% increase in public transit mode share. By comparison, we estimate the same amount spent on metro would lead to a 1% increase in modal share, and for monorail would keep modal share constant (a 0% increase). BRT can provide effective mass transit without requiring an increase in fare price. Thus, BRT has the highest potential to increase public transit mode share and relieve congestion in Indore.

120.23 km BRT system in Indore could be built using:
1. Private build-operate-transfer (BOT) or government investment for infrastructure Rs. 10crore (Rs. 2.1 crore/km).
2. Bus operator purchase of rolling stock: Rs.40 crore for an optimal mass transit system, the government needs to improve the right-of-way for both vehicles and pedestrians, at an estimated cost of Rs. 68 to 200 crore.

1.2 OVERALL TRAFFIC CONDITIONS IN INDORE:

The quality of life and economic vitality of the Municipality of Indore are seriously threatened by the rapid growth in polluting two-wheelers, cars, and auto rickshaws, which have been growing at 10% per annum. Indore's air pollution level is much higher than them recommended World Health Organization standard for suspended particulate matter, resulting in thousands of pre-mature deaths each year. Traffic flow is nearing capacity, so that any minor incident can bring traffic to a standstill for extended periods of time. The rapid growth in the private vehicle fleet means that if nothing is done, Indore's traffic condition will deteriorate further and result in severe congestion. Even if congestion causes only 5 minutes of additional travel time per trip in Indore, this means Rs. 150 crore per year lost to congestion. Worldwide, cities that have not developed an effective mass transit system have been unable to reduce congestion despite massive expenditures on new roads.

II. LITRERATURE REVIEW:

2.1 THE TRANSPORTATION SITUATION IN INDORE:

The Institute for Transportation and Development Policy (ICTSL) has conducted this preliminary assessment of transportation in Indore City with the specific aim of assessing the feasibility of a bus rapid transit (BRT) system to improve the city's transportation system. This work is being conducted with the full cooperation of the Municipal Corporation of Indore (MCH) as defined under a memorandum of agreement signed in July 2004. ICTSL's work is being financed by a grant from the US Agency for International Development. The purpose of the grant was to improve the liveability and reduce the air pollution in two Indian cities. Delhi and Indore were selected based on our assessment of the level of preparedness of several municipalities to implement sensible measures. While the Municipal Corporation of Indore cooperated in the preparation of this report, the conclusions represent are those of ICTSL alone, and do not necessarily reflect the views of the Municipal Corporation of Indore. Though we do not have access to detailed technical information regarding the cost, technical capacity, or feasibility of alternative mass transit options that may or may not be appropriate for Indore, we have tried to provide information on these alternatives to the degree that it is available. The objective set for us by the Municipality was to study the feasibility of using BRT to reduce congestion in one major corridor in Indore, providing sufficient mass transit capacity to handle both a substantial shift in trips from private vehicles to mass transit and also the projected growth of public transit trips in one corridor. We are confident that BRT can serve this purpose in Indore if designed correctly. Ultimately, it is the responsibility of the citizens of Indore to decide on their future transportation system, and we hope than in a small way this report can assist in that decision-making process. During the period from July to December, 2004, ICTSL sent the following international experts to assess the feasibility of BRT in Indore. These experts included the following: Former Mayor of Bogotá Dr. Enrique Penalosa, Paulo Custodio, (Project Manager, TransMilenio), Pedro Szasz (Senior Engineer, TransMilenio), Joao Carlos Scatena, (Consultant, Sao Paulo), and Remi Jeanneret (Consultant and Traffic Modeler, Rio de Janeiro and Paris). These experts are, in ICTSL's judgment, the foremost experts in the world on BRT planning. They were directly responsible for the most successful BRT system yet implemented, Bogotá's TransMilenio BRT. These experts were assisted by ICTSL's staff and management, including: ICTSL Executive Director Dr. Walter Hook, ICTSL Asia Regional Director John Ernst, Shreya Gadepalli, Technical Director of ICTSL India, and Nalin Sinha, Managing Director, ICTSL India. This study done to date in Indore by ICTSL is of a preliminary nature. The purpose of the study, and this report, is to provide Indore with a first assessment of the feasibility of BRT. All assessments of the transportation system and its performance in Indore are based on limited sampling. While in general, experience shows that limited samples provide reasonable estimates for initial feasibility; planning, physical design and system operational planning requires more detailed analysis.

2.2 INTRODUCTION TO INDORE'S TRAFFIC CONDITIONS:

Indore is a fast growing city. The population of the greater area increased from 1993 to 2002 from 1 million to 3.2 million. This represents a slowing of growth from the previous decade. Of this, 2 million live in the central core, governed by the Municipal Corporation of Indore (MCH). The MCH area is only 172 Sq. Km (less than 10% of Indore Urban Development Authority area of 1865 Sq. Km), but accommodates 60% of the population, more than half of the employment areas and almost all government offices. Based on the most recent household survey taken by LT Ramboll (2004), the current modal split in Indore is 37% walking trips, 9% cycle rickshaw, bicycle and other slow moving vehicles, 30% two-wheelers, 15% public transit, 7% auto-rickshaws, and 3% private cars and taxis. Together these modes generate 10,29 daily trips. Exclusive of walking, public transit constitutes 24% of total trips. If other modal split data exists, we have not seen it.

2.2 PUBLIC TRANSPORT:

losses have grown, reaching Rs. 2.17 per kilometre in 2001-2002. No dependable figures for the total number of transfers per passenger were available. Estimates range from 12% to 30% according to the method used. This information is needed to determine total demand if the route system is reconfigured with a BRT system. Competing with MPSRTC buses are seven-seat three-wheeler auto-rickshaws and three-seat three-wheeler shared auto-rickshaws that also constitute a form of public transport. According to traffic police records, a total of 2800 of the seven-seat auto-rickshaws run in the city as of today. From our calculations, each vehicle must cater to approximately 100-125 passengers per day for their operations to be profitable. This translates into a total of 280, to 350,0 passengers per day carried by this mode. Counting the smaller auto-rickshaws which are used as shared taxis, the total number might be in the range of 450,0 to 500,0 passengers per day. This number does not include the trips made by small auto-rickshaws as regular taxis. The three-wheeler shared transport is a relatively new phenomenon which has developed in the last 5 to 6 years. They ply on fixed routes on the outer edges of the city, or where bus operations are low but there is appreciable passenger demand. Formerly, these vehicles plied to the city centre, but their entry into the centre has been banned because of the congestion and pollution they create. Some of these routes act as feeders for passengers who get off buses, but a large percentage cater to areas where there is a low frequency of bus operation.

There also exists an urban rail system which has been recently renovated and renamed as the MMTS. This system is still being developed and presently carries around 34,000 passengers per day. The system uses the existing rail network. The services have not been streamlined yet and no feeder service exists, which gives it limited accessibility to a large part of the city's population. If integrated with a BRT system the demand on the MMTS system could be increased. MPSRTC operates three principal categories of buses:

- Ordinary (including suburban)
- Metro Express
- Vera and Vera-plus (initially started as metro liner)

2.3 OTHER MODES OF MOTORIZED TRANSPORT:

2.3.1 TWO-WHEELERS:

This is the major motorized mode of transport in Indore, carrying around 30% of trips (if pedestrian and NMV trips are included). The number of two-wheelers is growing very fast. It is interesting to note that there has been a role reversal of usage of bicycle with respect to two wheelers in the last 10 years. This change is an indication that a bicycle user can shift very easily to a two-wheeler. So, having no incentive for bicycle usage can be indirectly seen as an incentive for two-wheeler usage. Two-wheelers are very efficient not only in terms of transportation for the individual but also in road space utilization. They also have the advantage of point-to-point service, so that they can provide a total travel time of about half when compared to the current public transport system. They also require relatively limited space for parking. Nonetheless, many people are not happy with twowheeler travel due to the pollution and noise they create, the frequent severe accidents, exposure to weather, and operator discomfort over longer distances.

2.3.2THREE-WHEELER AUTO-RICKSHAWS:

Over 20,00 auto-rickshaws exist in Indore, making them omnipresent on the roads. They have a trip share of 10% in the city. They seem to have about the same efficiency as a western taxi because of the relatively low occupancy of 0.7 passengers/vehicle (not including the driver) A lot of them are seen moving around empty in search of passengers.

2.3.3 CARS:

The number of cars in the city, around 185,000, is still not very high compared to other Indian and Asian cities. But the growth rate of cars, almost tripling over the last decade, is the highest in the country.
Current Indore bus stops are in poor condition, and buses rarely stop there. Three-wheeler auto-rickshaws frequently move about without passengers

2.4 PARKING:

There are numerous illegally and legally parked vehicles along the roadways. At parking lots, where they exist, enforcement is slightly better but still a major cause of concern. A parking fee is imposed in private parking lots and some run by the MCH, but it is not controlled at most places in the city. The parking fee itself is highly under-priced. The annual fee for a prepaid parking card for all MCH parking is 220 rupees for a four-wheeler and 120 rupees for a two-wheeler. Single parking fee is 10 rupees for a four-wheeler and 5 rupees for a two-wheeler.

2.5 SAFETY AND TRAFFIC ENFORCEMENT:

We gathered information on traffic collisions from Traffic Police for the years 2000 – 2004 and have completed our analysis to understand the trends for the last 3 years (2002- 2004).

Table: 1 Traffic Collisions, Fatalities and Injuries in Indore

YEAR	NO. OF COLLISIONS	NO. OF FATALITIES	NO. OF PERSONS INJURED
2003	3525	419	3741
2003	3427	451	3373
2002	3039	411	3115

A system of prepaid annual parking fees in Indore is several underpriced. Indore BRT Pre-Feasibility Study, Draft Final ICTSL –apiral 2008 26 For the last three years most of the accident victims (both fatal & injury) have been young people in the 20 – 30 years age group (approximately 30-35%).Almost 80% of all collision victims are male –generally the sole earning members of their families in a developing country like India

Table:2 Victims of Traffic Fatalities 2003

Pedestrians	Two Wheelers	Auto Rickshaw	Cyclists	own vehicle	Cars & Jeeps
45%	31%	3%	7%	11%	3%

Pedestrians and two-wheeler riders were the most vulnerable in all road deaths. The top three accident prone areas in Indore, based on the occurrence during the last three years are:

1. Bombay Highway Road
2. Bhawarkua to stadium
3. Vjay nagar – LIG area

If we talk about the Bhawarkua to Vijay corridor (the 1st BRT corridor), it has the highest Number of traffic accidents on any corridor in the city. The last three years data reveal that 1st BRT corridor accounts for around 20% of total traffic accidents and fatalities in Indore city. In the year 2004 there were 150 accidents, 20 fatalities (15 pedestrians) and 612 injuries on this Corridor. In 2003 the numbers were 65 accidents, 39 fatalities (34 pedestrians) and 634 injuries. In 2002 the corridor witnessed 55accidents, 26 deaths and 580 injuries. Near Navlakha in the old city area there were 18 accidents, 3 deaths (2 pedestrians) and 39 injuries (21 pedestrians) in 2004. In 2003 the tally was 33 accidents, 5 fatalities (4 pedestrians) and 28 injuries (14 pedestrians).The city does not have a mandatory helmet rule for two-wheeler riders. The helmet rule whichwas introduced by traffic police from November 3, 2004 was immediately withdrawn by the state Government under political pressure. Lack of respect for rules and low enforcement are major issues of concern. Even though the traffic police are trying to improve conditions, they are understaffed. The traffic movement therefore is uncontrolled at most places with a very high rate of traffic infractions. A motorist isnot punished unless caught breaking the rules on site. The license plate is for most practical purposes not useful for imposing fines though mail.

III. **RESEARCH METHODOLOGY:**

3.1PRINCIPAL OF BRTS DESIGN:

3.1.1SYSTEM DESIGNS RECOMMENDATIONS METRO, BRT, AND MONORAIL COULD ALL HANDLE THE PROJECTED PASSENGER DEMAND IN THE CORRIDOR:

The DMRC metro proposal would have an initial capacity of 20,0 pphpd on 2corridor I and 150 pphpd in Corridor II at the beginning of operations, increasing to 49,6 pphpd in Corridor I and 31,02 in Corridor II by 2021. Given a projected initial demand estimate of 11,000 pphpd, we believe this system will provide more capacity than is needed, which causes higher than necessary construction and operations costs. A monorail system in Corridor I could carry about 18,00pphpd if it were four cars long, requiring the elevated stations to accommodate four car trains. Metrail and Frazer Nash are claiming 36,000 pphpd, but this has not been achieved by an existing monorail. Given our projected demand estimates, we believe the monorail would be more profitable if it were designed to carry only around 10,000 pphpd. This is because the higher fares of monorail will suppress the demand to this level. We recommend designing a BRT system to handle 18,000 pphpd upon opening in 2008 and increasing its capacity to 36,000 by 2021. While this is more than the projected demand in 2008,
the additional cost of designing a system to handle this level of demand over projected demand is marginal. We are not questioning the ability of the metro and the monorail systems to be designed with sufficient capacity to handle their projected future demand. However as fewer people are familiar with how these capacities can be achieved using bus technology, we provide a detailed explanation of how such a BRT system can be designed.

3.2 PRINCIPLES OF BRT DESIGN: OBTAINING METRO PERFORMANCE LEVELS FROM BUSES SOME CHARACTERISTICS OF BRT SYSTEMS:

3.2.1 BRTS SYSTEM DESIGN RECOMEDATIONS:

Indor Bus Rapid Transit, or BRT, refers to a group of bus systems that have many of the characteristics of metro systems. As a result, they can provide a similar level of service to metro systems, often at a fraction of the price. While not all BRT systems have all of the characteristics of BRT, the following are typical:

- Physical separation of the bus lane from mixed traffic lanes (to give buses a congestion
- free right-of-way).
- Bus station platforms are level with the bus floor (to speed and ease bus boarding).
- Busway alignment in the centre of the carriageway (to avoid conflicts with turning
- Traffic, unloading trucks, bicycles, pedestrians, and stopping taxis.).

- Payment occurs when entering a physically enclosed bus station rather than on board
- The bus. (to speed bus boarding and alighting and to give passengers greater security).
- A clear identity for the system (for marketing purposes).
- Trunk and feeder routing system with free transfer terminals (to avoid bus congestion
- and make the system more profitable).
- Large, articulated buses with multiple wide doors (to increase the capacity of the
- Bus way and the speed of boarding).
- Quality control of bus operation, cleanliness, maintenance and service.
- Traffic signal priority (typical only in Europe at low bus volumes).
- Information technologies to provide real-time information to passengers.
- Clean bus technologies to reduce emissions.

Some of the major cities where this system has been developed or is in the process of development include: Bogotá, Sao Paulo, Curitiba, Mexico City, Panama City, Quito, Boston, Eugene, Chicago, San Francisco, Vancouver, Leeds, Strasbourg, Bradford, Lyon, Jakarta, Beijing, Kunming, Taipei, Nagoya and Seoul. Using these methods, the most famous BRT systems in the world have achieved operating speeds, capacities, and service quality standards at the level of many metro systems, but at a fraction of the cost.

3.3 ASSESSMENT OF THE DMRC METRO PROPOSAL:

The DMRC proposal for Indore estimates that the system will cost roughly Rs. 4204 crore if debt service is included (DMRC, Ch. 13, p.2) for a 38.3 km system. This is roughly Rs.110 crore/kilometre. According to the World Bank (Allport, 2000): "Based on the available evidence of outturn costs, and including often ' hidden' public sector costs, we have estimated that the all-in cost of metros in Asia today is about:

o At-grade US$ 15-30mn/km
o Elevated US$ 30-75mn/km
o Underground US$ 60-180mn/km"

Using the lowest figure for elevated metro, we believe that Rs. 135 crore/km is a more reasonable estimate for Indore. No metro system in the world covers the costs of operations, rolling stock depreciation, and the debt service on the infrastructure. Only the Hong Kong metro and parts of the Sao Paulo metro cover both their operating costs and also the full costs of depreciation of rolling stock. Some systems with very high demand cover their operating costs, such as Buenos Aires, Singapore, and Santiago. Virtually all the other metro systems world wide cannot cover their operating costs or the depreciation of rolling stock, and hence constitute an ongoing financial burden on the municipality in which they are located. The Calcutta metro for example covers only 42% of its operating costs out of farebox revenues (World Bank, 2000). Therefore, we believe it is more reasonable to assume that the price of this metro system would be any less than Rs. 135 crore/km or Rs.5170 crore for the whole system. Thus, we consider that DMRC's estimated **construction costs are roughly 20% below a realistic projection**.

The estimated operating and maintenance costs of the Indore metro, (excluding depreciation of the rolling stock) according to the DMRC**, is Rs. 108 crore ($23.5 million) in the first year of operation.** We did not analyze the feasibility of this operating cost estimate. The DMRC claims that the system will earn Rs 267 crore per year, and hence that the system will be able to cover part of the cost of the depreciation on the rolling stock and part of the debt service. In our own estimate, **a revenue of Rs. 206 crore can be expected if at least 80% of bus lines in the corridor are cut**. This Rs.98 crore 'profit' per year is not sufficient to cover the depreciation of the rolling stock or the debt service. According to the DMRC, debt service will be in the range of Rs.200 crore annually for the first three years of operation. They are assuming the availability of capital subsidies from the state and national government of Rs.1682 crore. As such, **the municipality could be inheriting an ongoing debt service burden of at least Rs.123 crore annually for at least six years.**

A double tracked metro system has higher peak capacity than BRT. However, **we believe the DMRC's demand estimates are 70% higher than reasonable demand projections for this corridor. The financial estimates for the metro include no funds whatsoever to improve the conditions for pedestrians in the corridor under the metro. These costs would be additional.**

3.4 ASSESSMENT OF MONORAIL:

The monorail companies are claiming they can build a 55 km system in Indore with a capacity of 36,000 pphpd for Rs. 2500 crore, or Rs.45 crore/km. **We believe this is less than 1/3 of what it would actually cost**. The monorail in Kuala Lumpur (KL) has a capacity of only 5000 pphpd and cost Rs.162 crore per kilometre. The capital costs were not very high because they cut corners on safety, and designed a low capacity system. It was paid for by heavily subsidized government loans. Because the fare price is high, daily demand is only 45,000, around 4000 pphpd, so the system doesn't need more capacity now. While some capacity can be added by adding trains and reducing lead times, reaching 18,000 pphpd would require reconstructing station platforms and would significantly increase costs (based on recent World Bank review classified). The monorail in KL covers its operating expenses from passenger revenues, largely because it successfully connects several light rail lines. It does not make enough money to cover its debt service payments, and i**t is unclear what will happen when the first debt service payments become due.**

A monorail would not consume as much of the existing surface right-of-way. But this would come at a very high price. Currently, there are monorail companies from Japan and Malaysia promising to invest in monorails using only private money, but in practice they have initiated construction before providing transparent financial analysis, and in the end they always ask for some sort of government subsidy, either for capital investments, or in the form of demand or revenue guarantees, or loan guarantees. Because most of their profits are made in the sale of the rolling stock and the construction contracts, they are not that concerned about whether the Monorail operating company is solvent or not.

In Jakarta, construction on the monorail began, and then stopped when an agreement could not be reached on the financing. After initially stating they would build the monorail at their expense, the developer is now asking the Jakarta government for a $20 million annual operating subsidy for 7 years and a $60 million dollar initial equity investment. Even if DKI Jakarta agrees to provide this subsidy, they are still exposed to substantial risk. If the system still loses money, the company can threaten to bankrupt the system unless the subsidy is increased. The Jakarta monorail agreement requires that all the bus lines in the corridor be cut, and are asking to charge a fare price of $1.50 per trip (Rs68), many times higher than the current bus fares. Thus, the transit passengers, many of them low income, will pay much higher transit fares, or shift to two-wheelers. Private companies have a strong incentive to exaggerate the projected demand figures and underestimate the system costs to make the project look low risk to the government. **We recommend that our own demand estimates above be considered before any ridership guarantees are issued by the government, and that whoever certifies the demand estimate be made financially responsible for the outcome.** Furthermore, where will the monorails be manufactured, where will the spare parts come from, where will the construction jobs and maintenance jobs go? The rolling stock from monorails is proprietary, which means that you can not buy monorails from one company and use them on another company's monorail. You are locked into a single supplier. That is why Japan and Malaysia are willing to invest in these systems. In the long run, even if the monorail operator goes bankrupt and the city has to take over the system, they will still be dependent on the equipment supplier for repairs and spare parts. Indore will be trapped using their suppliers into perpetuity. Should the Indian taxpayers be creating jobs in Malaysia and Japan rather than supporting Indian firms?

Safety and breakdowns are also a concern. Maintenance is a major problem in all countries, including India. When systems are new they break down, until 'teething problems' are resolved. Then as they age, they begin to break down frequently again and leak oil. When a monorail breaks down, the whole service has to be suspended as there is no way of getting around the stopped vehicle. On BRT you simply make the buses enter mixed traffic until the problem is fixed. Furthermore, the monorails built in Kuala

Lumpur were built without catwalks, so when the monorail breaks down, the passengers are stuck up there. A recent tire explosion in Kuala
Lumpur led to two serious injuries and it took hours for the service to return to normal. The old monorails also drip oil down on the street below. Construction standards in Malaysia are not so
high, and safety regulations not so tight. We estimate that a monorail in Indore with a capacity of 18,000 pphpd would cost at least Rs.162 crore/km, and the whole system would cost around Rs. 8910 crore, or $1.98 billion. If **Ten months after monorail construction was officially**
Inaugurated in Jakarta in June 2004, the project has foundered due to the private developer's demands to the city for additional funding.

IV. RESULT AND CONCLUSION:

In present research work, investigations on various dimensions of service quality of BRTS, Indore are targeted. Different dimensions used for this purpose are tangibles, reliability, responsiveness, assurance, and empathy.
For the purpose of data collection, a systematically designed questionnaire based on different SERVQUAL dimensions was distributed to different occupants travelling the BRTS, Indore. For the purpose of quantification of responses, a 5-point Likert scale was used. Following are the details of responses:

Table 3: Details of responses obtained

S.NO	Entity	Value			
1.	No. Of questionnaire distributed	150			
2.	No. of responses received	102			
3.	No. of complete responses received	102			
4.	% age responses collected	68%			

All the collected responses, are then, fed to SPSS 16.0 software and following statistical tools are applied on it to obtain results:

1. Reliability analysis;
2. Descriptive statistics;
3. Correlation analysis; and
4. Multiple regression analysis.

Following are the results obtained from different statistical tools along with the inferences drawn:

1. Reliability analysis

First of all, reliability analysis on the data was conducted on the received data from respondents. For this purpose cronbatch's alpha was investigated. Values of cronbatch's alpha above 0.5 provided satisfactory results. Following are the results:

Table 4: Results of Reliability Analysis

S.No	SERVQUAL Dimension	Cronbatch's Alpha Value			
1.	Tangibles	0.606			
2.	Reliability	0.531			
3.	Responsiveness	0.623			
4.	Assurance	0.639			
5.	Empathy	0.603			

2. DESCRIPTIVE STATISTICS:

In descriptive statistics, maximum and minimum value, mean, and standard deviation were calculated for different dimensions. Following are the results:

Table 5: Results of Descriptive Statistics applied to SERVQUAL Dimensions

	N	Minimum	Maximum	Mean	Std. Deviation
Tangibles	102	1.00	5.00	3.7667	.87838
Reliability	102	1.50	5.00	4.0539	.83594
Responsiveness	102	1.00	5.00	3.7667	.87838
Assurance	102	1.00	5.00	3.0353	.97307
Empathy	102	2.00	5.00	3.9706	.77099
Valid N (list-wise)	102	**AVERAGE**		3.71864	0.867352

On the basis of results obtained for mean and standard deviation, average mean and standard deviation was calculated as 3.718, and 0.867. On the basis of these values different SERVQUAL variables were segregated on the basis of their criticality. Following are the details of classification:

Mean > 3.8: Most Critical
3.8 > Mean < 3.6: Critical
Mean < 3.6: Less Critical

Following are the interpretation drawn on the above basis:

Table…: Interpretations about criticality of SERVQUAL Variables

S.No	SERVQUAL Dimension	Mean Value	Level of Criticality
1.	Tangibles	3.7667	Critical
2.	Reliability	4.0539	Most Critical
3.	Responsiveness	3.7667	Critical
4.	Assurance	3.0353	Less critical
5.	Empathy	3.9706	Most Critical

Above results show that SERVQUAL dimensions reliability and empathy are most important for the passengers travelling BRTS system, whereas the dimension assurance shows the least critical value for employees. At the same time, the dimensions tangibles, and responsible score for sub critical values. On the basis of criticality values, BRTS system needs to be focused on the requirements of passengers.

3. CORRELATION ANALYSIS

In next step, correlation analysis of the received responses was carried out. Following are the results of the analysis:

Table 6: Results of Correlation Analysis correlations

		Tangibles	Reliability	Responsiveness	Assurance	Empathy
Tangibles	PearsonCorrela	1	.120	1.000**	-.055	.078
	Sig. (2-tailed)		.230	.000	.585	.435
	N	102	102	102	102	102
Reliability	Pearson Correlation	.120	1	.120	-.041	.749**
	Sig. (2-tailed)	.230		.230	.685	.000
	N	102	102	102	102	102
Responsiveness	Pearson Correlation	1.000**	.120	1	-.055	.078
	Sig. (2-tailed)	.000	.230		.585	.435
	N	102	102	102	102	102
Assurance	Pearson Correlation	-.055	-.041	-.055	1	.484**
	Sig. (2-tailed)	.585	.685	.585		.000
	N	102	102	102	102	102
Empathy	Pearson Correlation	.078	.749**	.078	.484**	1
	Sig. (2-tailed)	.435	.000	.435	.000	
	N	102	102	102	102	102

**. Correlation is significant at the 0.01 level (2-tailed).

Following are the results of strong correlations observed between SERVQUAL elements:

Table 7: Strong correlation between SERVQUAL Dimensions

S.No	**SERVQUAL Dimension**	**Strong Correlation found**
1.	Tangibles	Responsiveness
2.	Reliability	Empathy
3.	Responsiveness	Tangibles
4.	Assurance	Empathy
5.	Empathy	Reliability and Assurance

The value of correlation between tangibles and responsiveness is 1.000, which may be due to inability of respondents in differentiating between the SERVQUAL dimensions tangibles, and responsiveness. Informal discussions with some customers of BRTS, Indore yielded that customers used to response in parallel manner while the questions related to tangibles, and empathy are asked to them. **It also means that if the firm focuses on fulfilling the tangible requirements of customers, dimension responsiveness will be simultaneously enhances, and vice versa.** Strong correlation between reliability and empathy also shows the parallelism between the dimensions. On the other hand, correlation between assurance and empathy shows that firm needs to spend more resources on enhancing assurance and empathy of the customers on the firm.

4. MULTIPLE REGRESSION ANALYSIS:

In order to identify extent of correlation among different SERVQUAL dimensions, multiple regression analysis on the responses was performed. For this purposes, according to literature survey, dimensions reliability, and responsiveness were chosen as dependent variables.

Following are the details or results obtained by choosing reliability as dependent variable:

MODEL SUMMARY:

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.880[a]	.774	.767	.40327

a. Predictors: (Constant), Tangibles, Assurance and Empathy

Value of R Square is 0.774. This value indicates that 77.4% variation in reliability is explained by tangibles, assurance, and empathy.

CORRELATIONS:

		Tangibles	Reliability	Responsiveness	Assurance	Empathy
Tangibles	Pearson	1	.120	1.000**	-.055	.078
	Sig. (2-tailed)		.230	.000	.585	.435
	N	102	102	102	102	102
Reliability	Pearson Correlation	.120	1	.120	-.041	.749**
	Sig. (2-tailed)	.230		.230	.685	.000
	N	102	102	102	102	102
Responsivenes	Pearson Correlation	1.000**	.120	1	-.055	.078
	Sig. (2-tailed)	.000	.230		.585	.435
	N	102	102	102	102	102
Assurance	Pearson Correlation	-.055	-.041	-.055	1	.484**
	Sig. (2-tailed)	.585	.685	.585		.000
	N	102	102	102	102	102
Empathy	Pearson Correlation	.078	.749**	.078	.484**	1
	Sig. (2-tailed)	.435	.000	.435	.000	
	N	102	102	102	102	102

Correlation is significant at the 0.01 level (2-tailed).

Following are the results of strong correlations observed between SERVQUAL element

Table 8: Strong correlation between SERVQUAL Dimensions

S.No	SERVQUAL Dimension	Strong Correlation found
	Tangibles	Responsiveness
	Reliability	Empathy
	Responsiveness	Tangibles
	Assurance	Empathy
	Empathy	Reliability and Assurance

The value of correlation between tangibles and responsiveness is 1.000, which may be due to inability of respondents in differentiating between the SERVQUAL dimensions tangibles, and responsiveness. Informal discussions with some customers of BRTS, Indore yielded that customers used to response in parallel manner while the questions related to tangibles, and empathy are asked to them. It also means that if the firm focuses on fulfilling the tangible requirements of customers, dimension responsiveness will be simultaneously enhances, and vice versa. Strong correlation between reliability and empathy also shows the parallelism between the dimensions. On the other hand, correlation between assurance and empathy shows that firm needs to spend more resources on enhancing assurance and empathy of the customers on the firm.

Multiple Regression Analysis

In order to identify extent of correlation among different SERVQUAL dimensions, multiple regression analysis on the responses was performed. For this purposes, according to literature survey, dimensions reliability, and responsiveness were chosen as dependent variables.

Following are the details or results obtained by choosing reliability as dependent variable: Value of R Square is 0.774. This value indicates that 77.4% variation in reliability is explained by tangibles, assurance, and empathy.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.880[a]	.774	.767	.40327

a. Predictors: (Constant), Tangibles, Assurance and Empathy

ANOVA[a]

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	77.927	3	25.976	.	.[b]
Residual	.000	98	.000		
Total	77.927	101			

a. Dependent Variable: Responsiveness

b. Predictors: (Constant), Tangibles, Assurance and Empathy

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Constant)	.000	.000		.	.
Tangibles	1.000	.000	1.000	.	.
Assurance	.000	.000	.000	.	.
Empathy	.000	.000	.000	.	.

a. Dependent Variable: Responsiveness

Above results show strong influence of **tangibles with responsiveness**, and insignificant correlation of assurance and empathy with responsiveness

CONCLUSIONS:

Bus Rapid Transit offers the lowest cost means of dramatically improving Indore's transportation system while simultaneously making the city a nicer place to live, work, and shop at a price 1/8 or less of the cost of the next cheapest alternative to meet this level of demand, and requires less land acquisition than a metro. If done well, the first BRT Corridor in Indore could satisfy all of the public transit demand in Corridor I into perpetuity, while also decongesting the mixed traffic lanes. These same funds will not only leave in place a top quality BRT system, they will also leave the city with beautiful tree lined pedestrian promenades that could fundamentally transform the quality of the CBD to one befitting a world class city. Real estate values along the much improved and much more accessible corridor would rise dramatically. The authority which develops the BRT system would be in a position to profit from the appreciation of this property, just as with a metro system.

Furthermore, the buses operating in the BRT system could be Indian buses, manufactured in India and eventually assembled in Indore. Potentially these buses could be exported all over the world to other cities developing BRT systems. All the buses, spare parts, components, and maintenance and repair jobs would go to people in Indore, adding to the local tax base, and creating a new vital export industry. The IT used in the BRT system could be done by local Indian experts. ICTSL recommends that Indore seriously consider BRT coupled with improvements in pedestrian and other non-motorized travel conditions in Corridors I – III, and a tightened regulatory regime for parking. We believe these will be the fastest, most sustainable, and most cost effective means of addressing Indore's growing traffic woes.

Result and discussion

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