Strategic Analysis of Bus Rapid Transit System in Improvement of Public Transportation: Case of Tehran, Iran

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Abstract

Urban transportation is one of the principal and significant elements of urban system that supplies the accessibility of citizens to different requirements. Growth of population in large cities of Iran especially in its capital, Tehran and as a result of city expansion and transportation growth have been caused many environmental problems. So, public transportation specifically Bus Rapid Transit (BRT) is suitable solution for solving these problems. This paper, tried presents required strategies to improve transit oriented development in the use of BRT in Tehran using SWOT technique through strategic planning. In this paper surveys and field studies have been used to determine the strengths, weaknesses, opportunities and threats with to results of provide strategies to improve BRT of Tehran. Analysis shows that BRT after to 6 years operation has effective and beneficial, social, economic and environmental impacts in Tehran. Indeed, the public satisfaction about BRT is high in this city.

Keywords: BRT, strategic planning, SWOT, public transportation, Tehran

1. Introduction

Cities have vital important role in developing of economic (Dill, 2006). This development depends on physical, social and educational substructures (Cain and Dario, 2009). Then inter transportation in cities is the most important factor in life of a city and important for citizens to attain the goods and services. In the other way, need of transportation in many large cities is increasing continuously because of natural increasing of the people and immigrations. Availability of motorized transportations increases the income of families and affects all the economy activities. One of the problems in cities is delay in transporting people in the cities (Gwillian et al., 2010). This will increase the cost. The main reason of this problem is the unbalance in the distribution model and insufficient substructure of transportation. Also the most important reason of pollution is transportation systems (Evans, 2004). So, we need a sustainable transportation in cities for less destruction in the environment and covering most social needs. Fig. 1 shows a simple model for sustainable transportation (OTTP, 2010; FTA, 2009).Bus Rapid Transportation (BRT) in one of the most economical solution in public transportation systems (Cheng et al., 2007; Chang and Huang, 2006; Lusk, 2001). BRT is combination of all good solutions for increasing speed of buses (Miller and Buckley, 2008).

BRT system can transport people with a high speed and good quality in a network. However it is not long time past from starting this system, it has high potential to make basic changes in city transportation (Syed and Khan, 2000). Furthermore BRT is a high quality transport solution, safe, comfort and rapid in for people transporting (Liman, 2010; McNally et al., 2003). This solution is comparable with rail transportation (Levinson et al., 2003).Tehran as capital of IRAN with 8.7 million people has important role in 3 aspects: National, Region and Local (Pourmoallem et al., 2008; Hiroyuki, 2008) and has basic problems in city transportation (Table 1). Vision of comprehensive transportation plan which shows the future of transportation of this city in 2020 expresses that the transportation of the city will meet the international standards (Municipality of Tehran, 2004).This integrated system will be well running, comfort, safe, clean and good available in the way of economic development of Tehran which is practical solution according to limited resources (Bolghari, 2004). In the past 6 years the mega city Tehran has started operation of BRT in many areas (Zamanian et al., 2010).

Table 1. Public transport and traffic situation in the Tehran-2012

Status	Year 2012
number of daily trips	17
Average daily travel speed	26.5
Average travel time	25.1
Average latency compared to the travel time	51.1
The number of public transport trips	8.4
The average travel time by public transport	15.5
Average travel speed on public transport	23.2
The share of public transport trips	54.5
The share of rail transport(metro) in the travels	10
The Share of transportation with taxi in travels	23
The Share of transportation with bus in travels	21.5
Transportation's share of administrative services, training, etc.	9.5

SWOT analysis shows the strengths, weakness, opportunities and threats. This simple and easy tool can show the global status of the system. The analysis helps to make decisions and it can be used as a guide for strategic planning. Strengths and weakness are internal and opportunities and threats are external elements (Kajanus et al., 2004). SWOT is attained usually by interview and questionnaire (Leung et al., 2001).

2. Method

Study Area

Tehran is the biggest center of politics, economics and culture in IRAN and the largest human residence and a mega city. This city is located in 51° -4' to   51° -33' E., and 51° -4' to   51° -33' N. (TTST, 2007). This city is located between Mountain and desert in south of Alborz Mountains from 900 to 1800 meter height from sea surface (Deputy of Urbanization and Architecture, 2007). The area of this city is 750 kilometer square (Municipality of Tehran, 2004). Fig. 2 shows the location of Tehran. As preview of people, the status of BRT in 153 kilometer in Tehran was attained. The research was done by questionnaire through 500 people from random users of BRT in the inner of the buses. The samples are as Fig. 3 in the route of BRT in order to have a broad spread of the users.

Before doing the research we tested the stability of the questionnaire through (Cronbakhs alpha test). The alpha before doing the test was 0.69 and after deleting two questions we get alpha equal to 0.80 (Table 2). This value according to the least stability value 0.70 is acceptable.

Table 2. Final Exam Questionnaire

Reliability Statistics	
No of items	Cronbakhs Alpha
19	0.800

Based on Likert range, which indicates the importance and sensitivity accountable compared to the factors that set. Used questionnaires and rating results for the compilation and analysis, the questionnaire results was modeled on the basis of SWOT. Used a variety Likert and evaluated 1 to 5 of respondents (Taleai et al., 2009; Kortilla et al., 2000). Ranked the final prioritization factors by respondent's opinion and multiplied every factor

from 1 to 4 on the basis of rank and importance (Amin et al., 2011). So was determined the final score for each index, and was extracted strengths, weaknesses, opportunities, and internal and external's threats faced by developing of BRT system in Tehran finally.

3. Results

In comprehensive plan of Tehran, the population of this city has been prognosticated in too bounds in 2020.

a)   Population bound: 9.1 million people

b)   Population bound: inhabitant population: 10.5 million people (Monavari and Aminsharee, 2010).

In the first attitude, the crossing network of Tehran will be 18 million mounted or equal 25.5 movements. Inhabitant stipulate population, 10.5 million people and 17.6 million mounted with 15.6% daily transportation, and also 3.3 million vacation (Chuanjiao, 2008;TTST, 2006) (fig. 4) transportation vehicle portions in several of Tehran indicates in 2020. Also it illustrates 20.9 or 20.6 million daily transportation in this city, so vehicle portion is 55% and bus driving 22 %(CRP, 2009). In spite of Tehran just BRTs constitute 4% of bus driving network has 44% Barden for bus driving transportation. So it reveals the enormous quantities of transportation system. The coefficient of seats in bus in Tehran is 35; to compare with taxies is 2.5 and car 1.5 it indicates the significance of that (Afandizadeh and Baghaee, 2008). In according to the intensity of energy in a car driver that is 8 times rigorous than bus, the percentage of providence for energy will be 300,000 liters if the diesel bus will use 7,000 liters (CTBU, 2009).

The manipulation of BRTs in Tehran and the beneficiaries of that:

1)   Diminishing the usage if private transportation.

2)   Preventing from squandering the time of folks

3)   Diminishing   traffic jam

4)   Accelerating the usage of public transportation

5)   Sending the elicit and accurate proofs to the passengers in bus station with a proper timing

6)   Taking the tickets before getting to the bus and eliminating the connection between passengers and driver.

7)   Decreasing private cars

8)   Expecting time for passengers in stations

9)   Diminishing the environment pollution

10)   Diminishing the expectation times and lingering in stations

So some problems are going to be created after exploitation the BRTs in Tehran:

1)   No places of getting the burdens

2)   Making Morse lard laconic the transporting areas

3)   Using the speed preventing a lot

4)   Lack of adequate place for crossing the BRTs buses

5)   The connection problem between two streets

6)   Not having the easy access for using paralyzing stuff

7)   Mounting and landing method

8)   Axel rating the traffic jam for private cars

9)   No public associating and any estimating for people's needs for planning exerting and setting

10)   No security for passengers

11)   No programing in a comprehensively way before exerting and evaluating the prosperity or defeating BRTs

12)   Closing the comfort zone looking for the passengers and drivers

13)   Disturbing in harmony and physiognomy for the city

14)   Disturbance in using the environment

15)   Problems for arrival and emersion of the private cars that have the authority and the owners in BRTs line

16)   The probability of dissatisfaction from exerting BRT plans

17) Accelerating the tension folks cause of lack of the security

18) People identify thrusting

19) Disorganizing special lines and private lines

20) Problem for getting the utensil and burdens in BRT vicinity

BRT system has the various things running ways, stations, vehicles, fare collection, information transportation system, and services. (fig.5). The special ingredients of lines, transportation, stations and managing the wise systemic in this article going to investigate   for analyzing the feebleness opportunities and threat for passengers. Public resolution SWOT for BTR systems in Tehran illustrated in (table 3) the ranked matrix and priority for analyzing and the arranges.
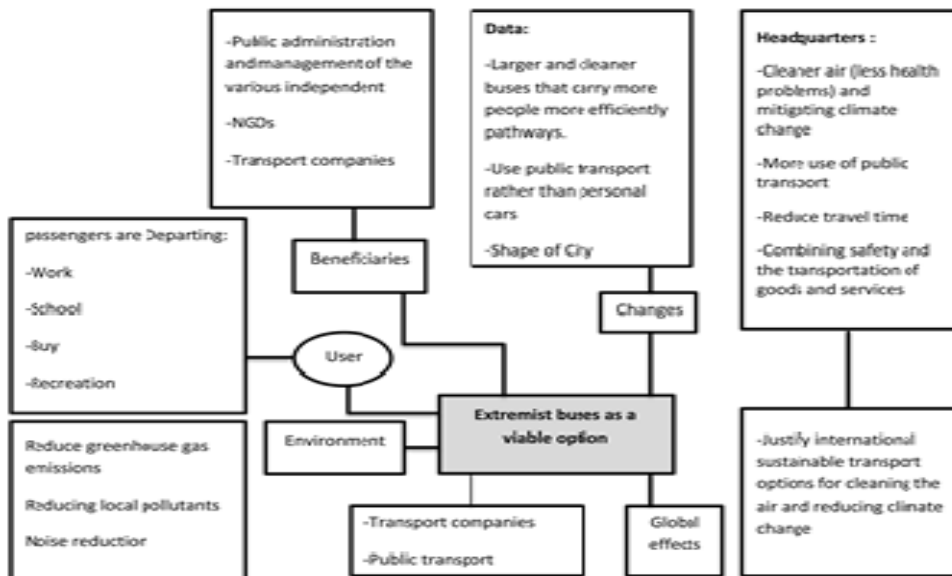

Figure 1. Summary functions of BRT in Tehran

Table 4. SWOT matrix rankings based on respondents' comments about BTR in Tehran 2012

----	Strengths	Weaknesses	Opportunities	Threats
Environment	-Reducing local pollution and greenhouse gas through the replacement of old emissions buses - Noise reduction	-Cutting down trees -Generation of waste and other pollutants during the construction period	-Improving bus fuel quality -Improved bus technology	-Increased use of personal cars
Culture and Society	-Consensus of passengers -Reduce travel time -Reduce disease -Increased space for women	-Lack of proper access for the elderly and handicapped - protested people that Nearby the way -Passengers complained about the crowded bus -Accidents and Crime	-Educating drivers. Travelers and media -Promotion of public transport	-Pickpocketing risk -Damage to stations
Infrastructure	-Separate route bus lines	-Was not crossed Lines	-Development use of larger buses	-Destroy ways and stations

	-Appropriate fare system	-use of Improper asphalt use of Inappropriate isolators	-Used hydraulic cement in ways	
Operation	-Proper implementation Appropriate -commercial speed -The full capacity of passengers -Receive e-fares	-Lack of adequate capacity for passengers and -Poor quality of service compared with metro	-Improving access and use of automatic doors	-Errors in management bus
Financial Economics	-Low cost infrastructure -Revenue generated by crane	-it seems that the ticket prices is low -lack of appropriate financial status	-Improved management rental	-Reduced ticket prices
Politics	-The role of the environment in the government will be better	-Government priorities on the double-deck buses -Construction of the bypass route is top priority	-Good relations with other government officials	-Lack of attention from government agencies -Change as a result of the recession and stop system

ITS Management		Special Route		Station		Vehicle	
Ave	**rank**	**Ave**	**rank**	**Ave**	**rank**	**Ave**	**rank**
437.9	Wi1	461.3	Ww1	506.2	Ws1	417.3	Wv1
335	Wi2	442.6	Ww2	471.39	Ws2	285.2	Wv2
327.5	Wi3	415.3	Ww3	453.9	Ws3	361.7	Wv3
324.7	Wi4	365.4	Ww4	412.6	Ws4	354.9	Wv4
315	Wi5	253.2	Ww5	418.5	Ws5	352.7	Wv5
254.3	Wi6	250.4	Ww6	386.1	Ws6	318.2	Wv6
249.6	Wi7	232.9	Ww7	314.9	Ws7	318.1	Wv7
247.3	Wi8	211.5	Ww8	312.5	Ws8	357	Wv8
245.5	Wi9	204.7	Ww9	121.7	Ws9	302.3	Wv9
136.8	Wi10	119.5	Ww10	120.5	Ws10	300.7	Sv1
127.3	Wi11	472.7	Sw1	114.1	Ws11	300.1	Sv2
499.6	Si1	435.4	Sw2	114	Ws12	299.7	Sv3
244.2	Oi1	282.9	Sw3	107.6	Ws13	298.6	Sv4
170.8	Ti1	181.6	Sw4	335.3	Ss1	295.6	Sv5
151.4	Ti2	162.2	Sw5	254.3	Os1	288.4	Sv6
		150.7	Sw6	171.9	Ts1	307.1	Ov1

101.5	Sw7	135	Ts2	368	Ov2
459.2	Ow1			317	Ov3
512.4	Tw1			281.4	Ov4
493.1	Tw2			218.7	Ov5
490.7	Tw3			446.3	Tv1
433	Tw4			335.6	Tv2
349.2	Tw5			318.6	Tv3
347.4	Tw6			315.4	Tv4
218.5	Tw7			150.4	Tv5
				140.9	Tv6

Table 5. Final weight matrix factors influencing Tehran BRT system

rank	Final weight	Weak-nesses	rank	Final weight	Weak-nesses	rank	Final weight	Weak-nesses	rank	Final weight	Weak-nesses	rank	Final weight	Weak-nesses
1	2049.6	Tw1	1	1837.1	Ow1	1	1890.8	Sw1	23	578	Ww10	1	1845.2	Ww1
2	1972.4	Tw2	2	777.7	Wv1	2	1885.5	Sw2	24	508.6	Wi6	2	1770.4	Ww2
3	1962.8	Tw3	3	491.5	Ov2	3	1815.6	Sw3	25	499.2	Wi7	3	1661.2	Ww3
4	1372	Tw4	4	325	Ov3	4	997.8	Si1	26	494.6	Wi8	4	1512.6	Ws1
5	1396.8	Tw5	5	320	Ov4	5	992.2	Ss1	27	491	Wi9	5	1466.6	Ww4
6	1389.6	Tw6	6	273.5	Ov5	6	946.6	Sw4	28	417.3	Wv1	6	1272.8	Ws2
7	874	Tw7	7	269	Oi1	7	942.8	Sw5	29	365.1	Wv9	7	1272.4	Ws3
8	515.7	Ts1	8	256.4	Os1	8	941.6	Sw6	30	362.4	Wv10	8	1222.8	Ws5
9	438.2	Tv2				9	931.6	Sw7	31	361.4	Wv1	9	1209.2	Ws4
10	399.3	Ti1				10	396.9	Sv1	32	361.3	Ws9	10	1156.3	Ws6
11	361.1	Tv3				11	309.5	Sv2	33	361	Ws10	11	1012.8	Ww5
12	350.7	Tv4							34	354.1	Wv2	12	1001.6	Ww6

13	346.2	Tv2			35	342.3	Ws11	13	944.7	Ws7
14	305.7	Tv5			36	342	Ws12	14	937.5	Ws8
15	305.4	Tv6			37	341.5	Wv3	15	931.6	Ww7
					38	338	Wv4	16	875.8	Wi1
					39	336.8	Wv5	17	846	Ww8
					40	322.8	Ws13	18	818.8	Ww9
					41	319.9	Wv7	19	710	Wi2
					42	316.67	Wv8	20	655	Wi3
					43	254.9	Wi10	21	649.4	Wi4
					44	254.6	Wi11	22	630	Wi5

Results with the base of averages and various points of views are:

A) Transportation

1- The intensity and weakness:

1-1- The most principle weakness for internally BRTs

1-2- Varity's of transportation in Tehran

2- The most principle intensity:

2-1- the applicable altitude for 2 cabins bus for getting in for defective people

2-2- various appearances for 2 cabins bus

  2-3- Facility in a congenial

3- Opportunities and threats:

3-1- the most significant opportunities

3-1-1- existing the condition for privatization under the elicit looking

3-1-2 treasure helping from budget

4-The most important threats (external)

4-1- no services and repairing and keeping cause of limitation and confining for buying busses

4-2- no treasure supporting for buying the developed bus

4-3- using insalubrious gas confronting from the environment

B) Stations:

1-The most vital weaknesses

1-1-Diminishing the passenger's security and the accessibility for pedestrian and sidewalks

1-2-Planning and building the inappropriately stations

1-3- lots of expenses for keeping the stations

C) Special lines for BRT

1- the most vital weaknesses (internal)

1-2- exactly lots of equals intersections

2- The most important internal strengths

2-1- separating the special BRT lines with fencing and the problem for pedestrian from the places that they are not designed

3- The most principle for external opportunities:

3-1- increase safety of vehicle movement due to reduce pedestrian access due to build fence.

4- The most important external threats:

4-1- one-side of the lines

4-2- use the other cars from special lines and creating disturbance for buses

D) Management (ITS)

1-The most important intensities (internal)

   1-1- not manipulating the management system

   1-2- no existing the vital wisely systems in intersections

   1-3- inappropriate behaving drivers

4. Conclusion

The compulsory need for accelerating teaching in all levels with the attention of pollution and transportation (Masumoto, 2010; Yuksel and Leviren, 2007).For supporting the teaching program in universities and making improvement the connection and information sharing with political experts in cities and the other areas can be vital. The vocational patterns for private organization are undeniable (Roberts and Skyes, 2000), Tehran city deserves having pure environment and healthy people. So cognation is vital investigations indicate that transportation BRT system in Tehran is having a good manipulation and in comparison with ordinary bus driving system has more performance. Diminishing time for waiting in station, accelerating speed for access to the target and healthy and security for passengers are the cause of people s approval and satisfaction. Consent between public transportation fleet in Tehran the most approval is about the under grounds and the approval average 49.91 from 100 with 17.47 standard devotion (table 6).   Two benefits of BRT are the expenses are 10 times rather than line transporting and second the exerting speed that makes passengers satisfaction (Goodman and Laube, 1999).

Table 6. Distribution of Tehran citizens' satisfaction of public transport-2012

Vehicle	Average	Standard deviation
Metro	4.13	1.44
Bus	3.23	1.35
Taxi	3.42	1.2
Taxi Agency	3.19	1.33

The investigation has some consequence from passenger's satisfaction and it has some relation between passengers and nimble buses, also the function for treatment between workers behavior has the 1.99 average in the first rank also the acceleration of BRT system has 2.04 average in the second steps environment engineering has the third rank with average of 2.87 and also BRT system with average of 3.10 in the 4th Sep.

High speed with qualified buses with the applicable quality has lots of quantities and capacities so the entering and exiting would be so comfortable besides the developed innovations the majority of passengers they are choosing BRT system. So it observes lots of passengers on Tehran this systems transport 500,000 people paring a day observing folks the other transportation system line private vehicle, taxies, etc. are so highlighted and principle. But 50% of people one utilizing BRT systems so it indicates the traffic has been descend and also pollution going to be diminished. Another benefit for BRT is peoples points of views for the buses become better these days and abort 41% of workers in BRT are almost educated with high level of services in a modern direction. The 250% increasing of BRT system passengers in studying line has the 33% rebate vacation time in comparison with before and also 22% bus fleet with acceleration the benefit and diminishing the polluted gases. Another benefit of BRTs system is providence in time expenditure the merit would be 50 billion in a year (TTST, 2007).Another point to be noted is that, BRT system compared to another system is be proportional to

government agencies to implement (Karbassi et al.,2012). All the above indicates acceptable performance for BRT system compared to the previous ordinary bus system. BRT system also has some problems and negative points that solving the makes people satisfaction with the lowest treasure. We have 6350 fleet they wouldn't be adequate so we should do some significant exerting for reducing the percentage of pollutions, traffic and developing the transportation system.

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