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Evaluating Bus Rapid Transit (BRT) line three in Tehran with international standards and providing solutions to improve it

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Abstract
The bus system in a high-speed public transportation systems are equipped with modern technology that due to accuracy, speed and flexibility have been considered as one of the improvement solutions in Tehran's public transport system. In this article the performance of BRT line three of Tehran has been evaluated based on the established standard in 2013, developed by the Institute for Development Policy and Public Transportation (ITDP) through the rankings and SWOT models. Research method of the present article is comparative and descriptive - analytical. Our results show that BRT line three in Tehran with total score 50 has the basic rank and close to bronze according to international standards. After introducing the evaluation model for BRT system and factors affecting the system, strategies to promote the quality and quantity of BRT line three have been presented.

Keywords: *Ranking, index, BRT, evaluation standards.*

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1.Introduction

Concerns over severe traffic congestion, environmental pollution and energy security issues have prompted decision-makers to look for Mass Transit systems to mitigate traffic problems. However, a considerable challenge for transport planners now is to develop a high quality transport system under limited funding (Deng & Nelson, 2013). The need for a high quality public transportation system for eliminating the mentioned results has made the developed cities in the United States, including cities such as New York, San Francisco to increase the use of high speed and high quality transportation systems. In such cities, the extremist bus systems is proposed as an attractive and effective strategy for competing with the private transportation section in order to make possible the access to city centers, settlement, and its suburbs for all the residents of city (Guidance to Identification of BRT system characteristics, 1386, 1). Advantages of BRT are low investment and operational costs that provide fast solutions to growing mobility needs (Alpkokin & Ergun, 2012). Over the past two decades, bus rapid transit (BRT) has emerged as a major alternative to a rail versus bus debae (Campo,2010,1). Despite the many advantages of a bus system in terms of its flexibility and low investment costs, but less good quality service of bus system are observed by its users. Insufficient investment in infrastructure, equipment, operational development and technology can provide context for the creation of Extremist bus system as the bus system's performance reach to an optimal quality (Guidance to Identification of BRT system characteristics, 1386, 1). In recent years, in the framework of development of public transportation policies in Tehran, the use of extremist bus system alongside the development of subway lines has been urged in order to facilitate public transportation and reduce traffic problems in the city. It seems evaluation of the public transportation's plans and projects after accomplishment, plays a major role in increasing their productivity and improving their performance and presenting strategies, provide new guidelines for managers to achieve permanent urban transportation. This study focuses on evaluating the BRT line three in Tehran, according to the international standard and to know how is its rank in comparison to the above standard? And finally revealing the strengths and weaknesses of the BRT line three in Tehran, what strategies and solutions can increase its performance?

2. Purpose of this study

The purpose of the present study is to provide guidelines for improving the quality of the performance and efficiency of the BRT line three in Tehran through the investigation of effective factors on Extremist bus system's performance in cities around the world, and to present the BRT line three in Tehran with an evaluative model for this type of systems based on the international standard of the Extremist bus system.

3. Method

The dominant approach to this study is a "descriptive – analytic" one. Library survey and academic documents, existing internal and external references and field studies have been used for collecting the required data and information. The research has been done through using descriptive -comparative analysis and according to the international standards, through the rankings and then the SWOT model (determining the strengths, weaknesses, opportunities and threats) and ultimately appropriate strategies are provided and discussed.

4. BRT system: a system of public transportation

The success story of the South American bus rapid transit systems (BRT) started 1974 in Curitiba, Brazil. Today, BRT systems are wide-spread in Brazil, and systems like Ecovia and Trolevia in Quito or Trans Milenio in Bogotá represent a world renowned label of innova¬tion in public transport (Hartmut, 2005, 117). it was in the late 1990's, that a new wave of systems in Quito (Ecuador) and Bo-

gotá (Colombia), which based their design on Curitiba's system, came to form what is known as the Latin American BRT model, having a set of common technical, financial and institutional characteristics. This model has been emulated recently in developing countries like China and India, and also in the United States. Given the different cultural, economic, and political contexts of these countries, new experience has been gained on the potential and flexibility of BRT, and also on its shortcomings. BRT is now recognized worldwide as a separate mode of transportation with unique characteristics (Campo,2010,2).

Bus Rapid Transit (BRT) systems are fast becoming public transport systems of choice on high density urban corridors in developed and developing countries to help address these urgent needs. BRT systems are not only relatively easier to implement and more flexible than light rail/tram systems, but are often less expensive to implement and operate (Muñoz & Hidalgo, 2013, 104).

Starting in 2010, ITDP, with support from the Rockefeller Foundation, decided that the time was right to develop a BRT Standard. It was initially developed as a metric for determining the degree to which existing BRT systems in the U.S. were consistent with international best practice. As other countries faced a similar need, ITDP began to recognize the applicability of the standard for international use.

In 2011 ITDP convened a meeting in Bogota bringing together engineers who had worked on the highest-quality BRT systems and tried to further distill the system features most critical to good BRT performance, and to weigh them in terms of their relative importance. While there was much dispute on the margins, the technical community already had a fairly common understanding of the essential elements of best practice in BRT systems. Throughout 2011 the scoring system was further vetted with experts from the U.S. and abroad, then tested on dozens of systems to see whether the scores seemed consistent with the better-performing systems. ITDP hope that the BRT Standard will help encourage municipalities to at least consider the key features of the best BRT systems, and that a few cities will be inspired to go beyond what has been done before and it will be useful to citizens' groups, allowing them to demand better quality and performance from their political leaders. Finally, ITDP look forward to certifying and celebrating those cities that succeed in developing the highest-quality BRT systems (The BRT Standard version 1.0, 2012, 4).

5.Introducing BRT systems in Tehran and the Khavaran – Elmo Sanaat line

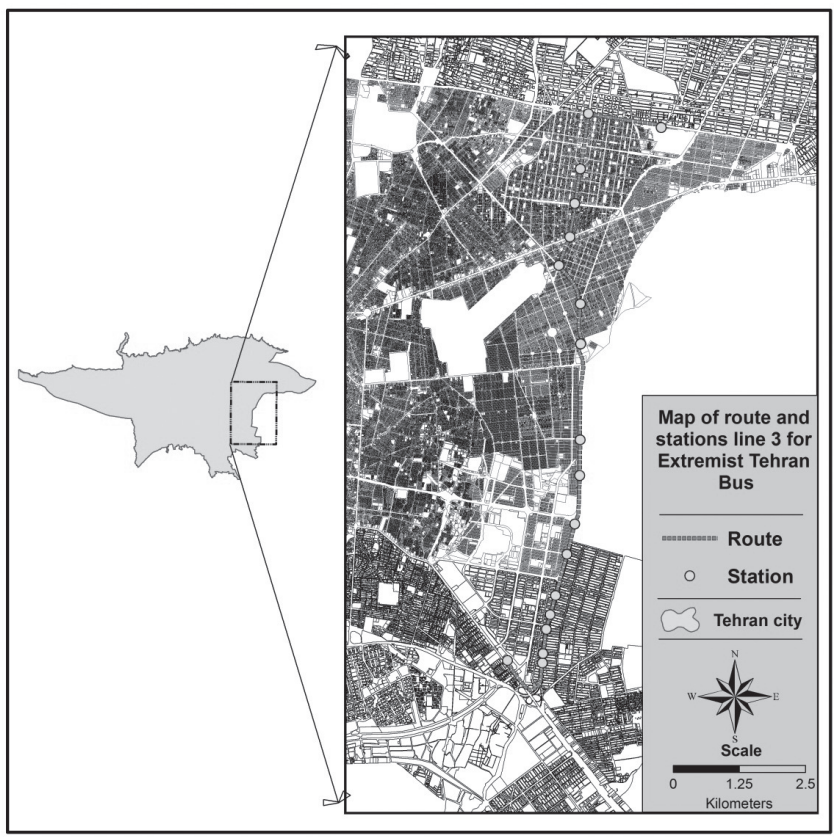
For its first BRT line, Tehran chose the most congested east-west corridor that runs through the city center. As a result, the first line, which opened in 2007, includes a dedicated, centrally-aligned bus way and pre-boarding payment system. During the first year of operation, ridership on the corridor increased by 77 percent. Now, 450,000 passengers use this BRT line each day. The first line revitalized the image of bus-based transit in Tehran and attracted new riders, specifically whitecollar, educated citizens who switched from private cars and shared taxis (sustainable transport,2012, 9). Based on the studies, 10 major corridor were selected for creating BRT bus system from which 8 line has been launched. Tehran's BRT network has yielded economic, social, and environmental benefits for the city. The system has reduced travel and waiting times for passengers, which has helped increase ridership and decrease private car use. Because of the fuel efficiency of the new buses being used on the corridor and the fact that these buses are no longer stuck in traffic, air quality has improved and CO2 emissions reduced. A recent survey conducted by an independent research group found that over 65 percent of the 2,200 people interviewed felt that implementing BRT has been the city's most effective initiative to mitigate traffic congestion in the central business districts. Private operators now run more of the city's normal bus services and are

providing a higher quality of service with newer, nicer buses. These new buses are also more energy efficient, with 50 percent of Tehran's active bus fleet now fueled by CNG.

Tehran BRT Features:

1. Multi-door buses for faster boarding and alighting
2. Weather-protected stations
3. Air conditioning system
4. Universal access
5. Passenger information system, including bus arrivals
6. LCD system for display of information and advertisements
7. Electronic ticketing system
8. Intelligent control center to monitor and adjust operations
9. All stations equipped with video monitoring cameras for safety (sustainable transport,2012, 10-11).

The third line of the BRT system of Tehran begin from khavaran terminal in South-East of Tehran and continues by passing through Afsarieh Highway, the former Kolahdooz St., Air Force, Imam Avenue, Grand Avenue, the seven dock and reaches terminal of Elm-va-Sanat in East of Tehran (reviews of the proposed route for line 3 of Tehran BRT, 2008,46). Administrative studies for this line has been began in August 2008 and was put into operation at the beginning days of December of the same year. The above line with 14.4 km long has 18 stations and a maximum displacement capacity of 160000 passengers daily (selection of Tehran traffic and transportation statistics, 2012, 6). The average distance between stations is 800 meters and the width of Extremist bus route line is 8 meters (Reviews of the proposed route for line 3 of Tehran BRT, 2008, 46). Average time of navigating the route at peak hours of morning and peak hours of evening is 60 minutes and it is respectively 40 and 50 minutes in off-peak hours. The number of active fleet in this line is 120 buses that most of



Map 1. Location of stations and BRT line three routes in Tehran

Gold: 85 points or above **Silver: 70–84 points** **Bronze: 55–69 points**

Figure 1. BRT lines are classified into three groups based on points earned gold, silver and bronze (The BRT Standard, 2013, 13)

them (100 sets) are of conventional single cab type (Shahab Khodro) and the rest of them is of King Long type. These buses have two entrances, one in back and one in front, of which the rear door is specified for men and the front door for women. But the doors have been put on the left side of the bus and are made specifically for Extremist bus system's stations. These buses have no steps and because of the height of the installed station from the ground and leveling it by bus, bus passengers enter the bus straightly (Wikipedia).

Interval time between the fleet traffic in the third line of BRT in Tehran at peak hour is 60 seconds and it is 150 seconds at off-peak hours. Service on this line is round-the-clock. Fare collection system is done by agents at bus stops and also card reader devices are used to control input. Tehran's Extremist bus system is integrated with other systems only through electronic ticketing. Tehran's Extremist bus system lines, is controlled through the use of patrol unit and video surveillance cameras in Tehran Traffic Control Company. These lines do not bare the same brand, but the color of the buses and design of bus stations make these lines distinguishable from other lines. In map 1, Location of stations and third line of BRT routes in Tehran are shown.

6. Standards for BRT

The BRT Standard functions as a means of achieving a common definition, as a scoring system, and as a planning tool. By laying out the essential elements of BRT corridors, it provides a framework for system designers, decision-makers, and the sustainable transport community to identify and implement top-quality BRT corridors. The BRT Standard celebrates cities that are leading the way on BRT excellence and offers best practice-based guidance to those in the process of planning a system (The BRT Standard, 2013).

The BRT Standard 2013 can help cities achieve the best quality of service for their riders. By highlighting the essential features of BRT design and best practices from systems, The BRT Standard 2013 provides a clear roadmap to high-quality BRT (The BRT Standard, 2013, 4). BRT criteria given by the technical committee of international standard in 2013 include: BRT basics, Service planning, Infrastructure, Station design and station-bus interface, Quality of service and passenger-information systems, integration and access. You can find it in the attachment tables (1 to 7) include Scoring criteria and values associated with each benchmark scores that eventually makes up the structure of the standard method for BRT (The BRT standard, 2013, 16-56). Finally, based on the points that are earned the BRT lines are divided into three gold lines, silver lines, bronze lines. Classifying BRT lines into three groups: golden, silver and bronze creates international standards in order to identify successful practices and experiences in the field of BRT lines' construction that as shown in figure 1. Those successful elements and components of BRT systems that have been identified and studied in this standard will have positive effects in a variety of fields including improving quality of

2008	Operation time
24	Average speed in corridor(km/hr)
160000	Daily demand (pnx/day)
110	Maximum number of passengers at a station
11000	Maximum number of passengers at the station during the day
13.86	Along the path special lines (km)
0.52	length of the route complex with the curren (km)
14.4	The total length of the route (km)
18	Number of Stations
30	The height of station's platform (cm)
0	The number of stations having overtaking line
800	The average distance between stations
36	The shortest Station length (m)
68	The maximum length of the station (m)
13	The speed at peak hours in the city center (km/hr)

Table 8: Status of BRT line three in Tehran city

service and the rate of usage of the system.

7. Evaluation of BRT line three in Tehran, according to the international standard

Looking at the current situation and the current performance of BRT lines in Tehran, besides the evaluation of these lines based on compiled international standard indicators, needs and opportunities to enhance and improve the existing conditions can be identified and prioritized. Table 8 shows quantitative Status, Table 9 shows qualitative Status and Table 10 shows obtained scores of the BRT line three in Tehran based on the standards.

As shown in diagram 1, BRT line three in Tehran after assessment based on international standards, has obtained 57 positive points and -7 Negative points, that the total score is 50.

Proper design of stations, quality of service and information to passengers and BRT basics have obtained most points compared to the ideal standard of six indicators. In The next level, servicing manner planning has obtained 45.83 percent in BRT line three. At the lowest level, infrastructures and integration index of BRT line 3 with other modes of public transportation and lack of provision of adequate access for people specifically with special needs as well as pedestrian, has obtained the lowest percentage that is accounted as the most important weakness of the line.

According to the results of the field survey conducted in the summary shown in Table 11. strengths and weaknesses of BRT line three system of Tehran separated by scoring indexes are given in Table 12.

8. Results and Discussion

In this article, Tehran's BRT line three system has been evaluated in six sections of Service planning, Infrastructure, Station design and station-bus interface, Quality of service and passenger-information systems, integration and access. According to the scores given in the table 10 the most significant weakness has been in the system integration and providing access as well as infrastructure. Finally, with respect to the total points obtained by BRT line three, this line by obtaining total score 50, has gained basic rank and close to the rank of Bronze in standards. In continuation, approaches to eliminate defects in BRT line three

BRT Line	Line 3	
Evaluation Indicators	Special one-way bus line or bus route	•
	Integrated network of lines	×
	Extent of the station' space (Possibility of berthing several bus)	•
	The speed at peak hours in the city center)km/h(	×
	Special buses to move into and out of line	•
	Traveling of The majority of bus passengers along the corridor using BRT	•
	Reducing the travel time using BRT	×
	Possibility of overtaking in more than half of the stations Along the path	•
	Directional displacement volume of more than ten thousand people at the peak hour	×
	Directional displacement volume of more than twenty thousand people at the peak hour	×
	Handling passenger traffic flows over a complex line (pphpd 3000)	•
	Getting fare before boarding	•
	Differentiation BRT buses	•
	Differentiation of BRT stations	×
	Dedicated BRT Bridge or tunnel	×
	protective door at station	•
	The distance between the station and the intersection	×
	several operators in BRT line	×
	Obtain the appropriate fare distance	•
	Using vehicles with low pollution	•
	Protection against Unfavorable weather conditions at the station	•
	control center	×
	Dynamic information on bus arrival time	×
	Prioritization through the lighted intersection	•
	Bus and Station in the same level	•
	High capacity BRT buses	×
	Proper informing of passengers at stations	•
	Proper informing of passengers on buses	•
	bicycle parking at stations	×
	Particular line of bicycle along the BRT route	×
	Bicycle facilities sited adjacent to the stations	•
	Stations capable of carrying a wheelchair	•

Table 9. Status of quality three BRT in Tehran

systems in Tehran and upgrade its rating standards has been offered in Table 13.

Table 13. approaches to eliminate defects in BRT line three systems in Tehran

In the end, the native components along with the international standards in order to better evaluation of BRT systems in Tehran has been

Evaluation Criteria	Sub-Criteria	point
brt basics	Off-board fare collection	7
	Intersection treatments	2
	level boarding Platform-	4
	Bus way alignment	7
	Dedicated right-of-way	6
The amount of points earned		26
service planning	Control center	2
	operating hours	2
	multi-corridor network	2
	Multiple routes	0
	Located in top-ten corridors	0
	Peak frequency	3
	Off-peak frequency	2
	Express, limited, and local services	0
	Demand Profile	0
The amount of points earned		11
Infrastructure	Stations set back from intersections	2
	Center stations	2
	Passing lanes at stations	0
	Minimizing bus emissions	0
	Pavement quality	
The amount of points earned		4
station design and station-bus interface	Safe and comfortable stations	3
	Docking bays and sub-stops	0
	Distance between stations	2
	Sliding doors in BRT stations	0
	Number of doors on bus	3
The amount of points earned		8
Quality of service and passenger information system	passenger information	1
	branding	3
The amount of points earned		4
Pedestrian access	Secure bicycle parking	0
	Bicycle lanes	0
	Universal access	1
	Integration with other public transport	1
	Bicycle-sharing integration	0
The amount of points earned		4
Point Deductions integration and access	Commercial Speeds	0
	Peak Passengers per Hour per Direction	0
	Lack of Enforcement of Right-of-Way	3-
	Significant Gap Between Bus Floor and Station Platform	1-
	overcrowding	3-
	Poorly maintained bus way, buses, stations and technology systems	0
total positive points earned		57
Total points deducted		7-
The total score		50

Table 10. Points earned by three BRT in Tehran

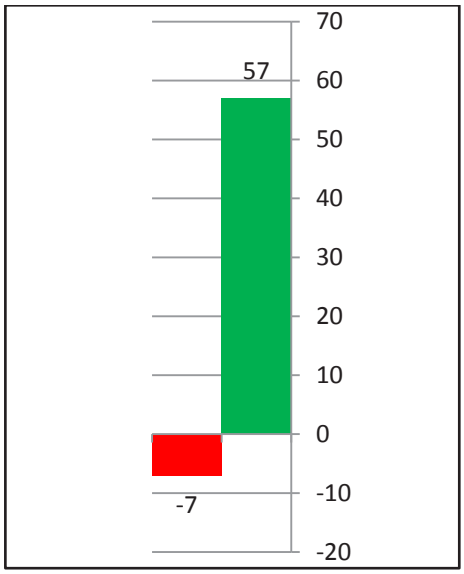


Diagram 1. Positive and negative points obtained for BRT line three in Tehran, according to the international standards

presented that Appropriate to the needs of the city and taking the consent of citizens can be offered as follows:

1. Regular assessment at various time intervals in order to monitor the lines.
2. Manpower training and the role of specific lines in crisis management.
3. Creating Management structure and good timing, especially during peak hours for passengers.
4. Installing Ventilation, heating and cooling systems in all buses.
5. Increasing the quality and quantity of buses.

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Appendices

Tables 1, 2, 3, 4, 5, 6, and 7 are international standard of bus rapid transit.

Criteria	Line 3
BRT basics	% 78/78
service planning	% 45/83
Infrastructure	% 28/57
station design and station-bus interface	% 80
Quality of service and passenger information system	% 80
integration and access	% 28/57

Table 11. The BRT line three of Tehran scores compared to the ideal standard

Threats	opportunities	Weakness	Strengths	Criteria
	-Taking advantage of the reinforced concrete pavement path.	-Reducing the safety of passengers in terms of access to sidewalks at some stations.	-Getting fares from passengers before entering the station. - Low Interval time between the fleet traffic in peak hours and non-peak hours. - Boarding activity of service line in holidays. -Connected and integrated network of BRT lines. -Existence of a control center. -installing ticket gates at stations.	service planning
-Increased air pollution due to the use of buses with Euro.	- Improve fleet in terms of reducing emissions and achieving standard.	- The lack of overtaking line at stations. - crossing through narrow passages. - non Eco-friendly fuel in fleet line.	- Special bus line traffic. - Providing Intermediate stations for transportation and changing direction of passengers within the way.	Infrastructure
	Possibility of turning single cab buses to two cab buses with higher quality and increased capacity and passenger's comfort.	- The absence of protective sliding doors. - The lack of proper lightning in stations at night. - Lack of proper lighting at the station during the night. - Low quality, low capacity and no passenger comfort in single cab buses. - Small dedicated space for women. -Large Swarm of passengers.	- using buses with high passenger capacity and several wide doors. - Presence of bus stations aligned with the bottom. - Safety and comfort of stations. - Protect passengers from weather elements.	station design and station-bus interface
		- Lack of Electronic displays to precise announce of the arrival time of the next bus at stations.	- Audio and text information inside the bus. - video surveillance systems at the stations and increasing the safety of the stations.	Quality of service and passenger information system
-Use of other vehicle from the specific path of buses and causing disturbance for buses at stations.		- Lack of adequate facilities for bicycles, such as bicycle parking line. - Providing Bicycle sharing facilities in a very limited manner. - Not providing adequate facility for the handicapped. - Lack of proper physical integration between different modes of public transport.	- Extremist in Grand connection to BRT line 1 in Ayat-Damavand junction and connection to subway line 2 and the possibility of passenger exchange. - The use of electronic fare collection system with card readers shared with other modes of public transport.	integration and access

Table 12: SWOT matrix BRT line3 Tehran

Suggested Solutions	criteria
- Increasing desirability and reducing travel time by setting up express services with limited stops. - Equipping line Control centers and creating well-timed communication with the fleet, systems for collecting and providing information on stations in order to efficient management and also timely and integrated informing in public transportation network and BRT lines.	Service planning
- Increasing in pavement quality by constructing concrete pavements at the stations. - Using the bus fleet with environmental standards Euro 5 and above. - Applying Priority actions through the lighted intersections. - Imposing certain restrictions and prohibitions on the movement of vehicles in circulation interferes with BRT. - Using Supplementary programs SCAT to give priority to the busses at intersections and using non-planar intersections to reduce traffics at those points.	Infrastructure
- Installing guard sliding doors at stations.	Station design and station-bus interface
- Comprehensive information for bus passengers to stations.	Quality of service and passenger-information systems
- Providing appropriate access for pedestrians and making BRT lines convenient for specific groups, particularly the handicappeds. - Providing Bicycle facilities and bicycle rental stations at all the lines. - Predicting the proper connection between modes of public transport such as metro and BRT lines at confluence. - Access to the station via a pedestrian bridge mechanized. - Applying Regulations to non-use of illegal vehicles of specific lines.	integration and access

Criteria	Sub-Criteria	point	Criteria	Sub-Criteria	point
Off-board fare collection	100% of trunk stations have barrier-controlled, off-vehicle fare collection	7	Bus way alignment	Two-way median-aligned bus ways that are in the central verge of a two-way road	7
	75% + of trunk stations have barrier-controlled, off-vehicle fare collection	6		Bus-only corridors where there is a fully exclusive right-of-way and no parallel mixed traffic, such as transit malls (e.g. Bogotá, Curitiba, Quito, and Pereira), and converted rail corridors (e.g. Cape Town and Los Angeles)	7
	Proof-of-payment on all routes that touch the trunk corridor	6		Bus ways that run adjacent to an edge condition like a waterfront or park where there are few intersections to cause conflicts	7
	60 – 75% of trunk stations have barrier-controlled, off-vehicle fare collection	5		Bus ways that run two-way on the side of a one-way street	7
	45 – 60% of trunk stations have barrier-controlled, off-vehicle fare collection	4		Bus ways that are split into two one-way pairs but are centrally aligned in the roadway	4
	Proof-of-payment on some routes that run on the trunk corridor	3		Bus ways that are split into two one-way pairs but aligned to the curb	4
	30 – 45% of trunk stations have barrier-controlled, off-vehicle fare collection	2		Bus ways that operate through virtual lanes produced by a series of bus queue-jump lanes at intersections	1
	15–30% of trunk stations have barrier-controlled, off-vehicle fare collection `	1		Curb-aligned bus way that is adjacent to the curb	0
	< 15% of trunk stations have barrier-controlled, off-vehicle fare collection	0		Dedicated lanes and full enforcement or physical segregation applied to over 90% of the bus way corridor length	7
Intersection treatments	All turns prohibited across the bus way	6	Dedicated right-of-way	Dedicated lanes and full enforcement or physical segregation applied to over 75% of the bus way corridor length	6
	Most turns prohibited across the bus way	5		Delineators only or colorized pavement only without other enforcement measures applied to over 75% of the bus way corridor length	4
	Approximately half of the turns prohibited across the bus way and some signal priority	4		Delineators only or colorized pavement only without other enforcement measures applied to over 40% of the bus way corridor length	2
	Some turns prohibited across the bus way and some signal priority	3		Camera-enforcement with signs only	1
	No turns prohibited across the bus way but signal priority at most or all intersections	2			
	No turns prohibited across the bus way but some intersections have signal priority	1			
	No intersection treatments	0			
Platform level boarding	100% of buses are platform level; system-wide measures for reducing	6			
	the gap in place	5			
	80% of buses; system-wide measures for reducing the gap in place	4			
	60% of buses; system-wide measures for reducing the gap in place	4			
	100% of buses are platform level with no other measures for reducing the gap in place	3			
	40% of buses	2			
	20% of buses	1			
	10% of buses	0			
	No platform-level boarding				

Table 1. brt basics 2013

Criteria	Sub-Criteria	point	Criteria	Sub-Criteria	point
Control center	Full-service control center	3	Bus way alignment	%100 have at least 8 buses per hour	3
	Control center with most services	2		%75 have at least 8 buses per hour	2
	Control center with some services	1		%50 have at least 8 buses per hour	1
	No control center	0		< %25 have at least 8 buses per hour	0
operating hours	Both late-night and weekend service	2	Off-peak frequency	%100 of all routes have at least 4 buses per hour	2
	Late-night service, no weekends OR weekend service, no late-nights	1		< %35 of all routes have at least 4 buses per hour	0
	No late-night or weekend service	0	Express, limited, and local services	Local services and multiple types of limited and/or express services	3
multi-corridor network	Intersecting or connecting to an existing or planned BRT network	2		At least one local and one limited or express service option	2
	Part of, but not connected to, an existing or planned BRT network	1		No limited or express services	0
	No BRT network planned or built	0	Demand Profile	Corridor includes highest-demand segment	3
Multiple routes	Two or more routes exist on the corridor, servicing at least two stations	4		Corridor does not include highest-demand segment	0
Located in top-ten corridors	Corridor is outside top-ten demand corridors	0			
	Corridor is outside top-ten demand corridors	0			

Table 2. service planning 2013

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Criteria	Sub-Criteria	point	Criteria	Sub-Criteria	point
Stations set back from intersections	100% of trunk stations are at least one of the following: • Set back at least 40 m (120 ft.) from intersection • Fully exclusive bus ways with no intersections • Grade-separated stations where stations are at-grade • Stations located near intersection due to block length (such as downtowns where blocks are relatively short)	3	Passing lanes at stations	Physical, dedicated passing lanes	4
	65% of trunk stations meet above criteria	2		Buses overtake in on-coming dedicated lanes	2
	35% of trunk stations meet above criteria	1		No passing lanes	0
	< 35% of trunk stations meet above criteria	0	Minimizing bus emissions	Euro VI or U.S. 2010	3
Center stations	%80 and above of trunk stations have center platforms serving both directions of service	2		Euro IV or V with PM traps or US 2007	2
	%50 of trunk stations	1		Euro IV or V or Euro III CNG or using verified PM trap retrofit	1
	< %20 of trunk stations	0		Below Euro IV or V	0
Pavement quality	New reinforced concrete designed to fifteen-year life or higher over entire corridor	2			
	New reinforced concrete designed to fifteen-year life only at stations	1			
	Projected pavement duration is less than fifteen years	0			

Table 3. infrastructure 2013

Criteria	Sub-Criteria	point	Criteria	Sub-Criteria	point
Safe and comfortable stations	All trunk corridor stations wide, attractive, weather-protected	3	Sliding doors in BRT stations	All stations have sliding doors	1
	Most trunk corridor stations wide, attractive, weather-protected	2			
	Some trunk corridor stations wide, attractive, weather-Protected	1		Otherwise	0
	No trunk corridor stations wide, attractive, weather-protected	0			
Docking bays and sub-stops	At least two sub-stops or docking bays at the highest-demand stations	2	Number of doors on bus	%100 percentage of buses with +3 doors or 2 wide doors	3
	Less than two sub-stops or docking bays at the highest-demand stations	1		%65 percentage of buses with +3 doors or 2 wide doors	2
Distance between stations	Stations are spaced, on average, between 0.8 km (0.5 mi.) t0.3 0 km (0.2 mi.) apart	2		%35 percentage of buses with +3 doors or 2 wide doors	1
				%0 percentage of buses with +3 doors or 2 wide doors	0

Table 4: station design and station-bus interface 2013

Criteria	Sub-Criteria	point
passenger information	Real-time and static passenger information corridor-wide (at stations and on vehicles)	2
	Moderate passenger information (real-time or static)	2
	Very poor or no passenger information	0
branding	All buses, routes, and stations in corridor follow single unifying brand of entire BRT system	3
	All buses, routes, and stations in corridor follow single unifying brand, but different from rest of the system	2
	Some buses, routes, and stations in corridor follow single unifying brand, regardless of rest of the system	1
	No corridor brand	۰

Table 5: Quality of service and passenger information system 2013

Criteria	Sub-Criteria	point	Criteria	Sub-Criteria	point
Pedestrian access	Good, safe pedestrian access at every station and for a 500-meter catchment area surrounding the corridor	3	Universal access	Full accessibility at all stations and vehicles	3
	Good, safe pedestrian access at every station and many improvements along corridor	2		Partial accessibility at all stations and vehicles	2
	Good, safe pedestrian access at every station and modest improvements along corridor	1		Full or partial accessibility at some stations and vehicles	1
	Not every station has good, safe pedestrian access and little improvement along corridor	0		Corridor not universally accessible	0
Secure bicycle parking	Secure bicycle parking at least in terminal stations and standard bicycle racks elsewhere	2	Integration with other public transport	Integration of physical design, fare payment, and informational systems	3
	Standard bicycle racks in most stations	1		Integration of two of the following: physical design, fare payment, and informational systems	2
	Little or no bicycle parking	0		Integration of one of the following :physical design, fare payment, and informational systems	1
Bicycle lanes	Bicycle lanes on or parallel to entire corridor	2		No integration	0
	Bicycle lanes do not span entire corridor	1	Bicycle-sharing integration	Bicycle sharing at 50% of trunk stations minimum	1
	No bicycle infrastructure	0		Bicycle sharing at less than 50% of trunk stations	0

Table 6: integration and access 2013

Criteria	Sub-Criteria	point
Commercial Speeds	Minimum average commercial speed is 20 kph and above	0
	Minimum average commercial speed is between 16 – 19 kph	-3
	Minimum average commercial speed is between 14 – 16 kph	-6
	Minimum average commercial speed is 14 kph and below	-10
Peak Passengers per Hour per Direction	Peak Passengers per Hour per Direction (pphpd) Below 1,000	-5
Lack of Enforcement of Right-of-Way	Regular encroachment on BRT right-of-way	-5
	Some encroachment on BRT right-of-way	-3
	Occaisional encroachment on BRT right-of-way	-1
Significant Gap Between Bus Floor and Station Platform	Large gaps everywhere or kneeling buses required to minimize gaps	-5
	Slight gap remaining at some stations, large gap at remaining stations	-4
	Slight gap at most stations	-3
	No gap at some stations, slight gap at remaining stations	-2
	No gap at most stations, slight gap at remaining stations	-1
	No gap at all stations	0
overcrowding	Passenger density on maximum load during peak hour in bus is > 5 m2 or at station is > 3 m2. If there are visible signs of passengers unable to board buses or enter stations, then an automatic deduction is taken.	-3
Poorly maintained bus way, buses, stations and technology systems	Bus way has significant wear, including potholes, warping, trash, debris, snow	-2
	Buses have graffiti, litter, seats in disrepair	-2
	Stations have graffiti, litter, occupancy by vagrants or vendors, or have structural damage	-2
	Technology systems, including fare 2- collection machines, are not functional	-2

Table 7: Point Deductions2013