***Best Standard of BRT System***

*Lecture and Hands on:*

-  BRT Standard
-  BRT Design Best Practices
-  Conceptual Planning and Design
-  Case Study (Design & Practices on site)

# BRT Standard

**Gold-standard BRT**
**85 Points or above**

Gold-standard BRT is consistent in almost all respects with international best practices. These corridors achieve the highest level of operational performance and efficiency while providing a high quality of service. The gold level is achievable on any corridor with sufficient demand to justify BRT investments. These corridors have the greatest ability to inspire the public, as well as other cities.

**Silver-standard BRT**
**70–84.9 points**

Silver-standard BRT includes most of the elements of international best practices and is likely to be cost-effective on any corridor with sufficient demand to justify BRT investment. These corridors achieve high operational performance and quality of service.

**Bronze-standard BRT**
**55–69.9 points**

Bronze-standard BRT solidly meets the definition of BRT and is mostly consistent with international best practices. Bronze-standard BRT has some characteristics that elevate it above the BRT basics, achieving higher operational efficiencies or quality of service than basic BRT.

**Basic BRT**

Basic BRT refers to a core subset of elements that the Technical Committee has deemed essential to the definition of BRT. This minimum qualification is a precondition to receiving a gold, silver, or bronze ranking.





**The BRT Standard**
**2016 Edition**
Cover Photo: The Rainbow BRT system in Pune/Pimpri-Chinchwad, India has transformed the city.

Cover Photo Credit: ITDP-India


www.itdp.org www.rockefellerfoundation.org www.barrfoundation.org

www.climateworks.org www.despacio.org www.giz.de www.theicct.org

www.unhabitat.org www.unep.org www.wri.org


## Yichang BRT

**YICHANG, CHINA**

**Ranking:** Gold

**Corridor Length:** 23km

**Riders per Day:** 240,000

**Notable Strengths:** Yichang's direct service system uses passing lanes to allow a wide range of routes to benefit from the BRT corridor.

**Areas for Improvement:** The BRT corridor would benefit from more continuous bicycle paths, bicycle parking, and the planning bike share system to improve access to stations.

# BRT Design Best Practices

## MOVE

MOVE—CRISTIANO MACHADO

**BELO HORIZONTE, BRAZIL**

**Ranking:** Gold

**Corridor Length:** 7.1 km

**Riders per Day:** 185,000

**Notable Strengths:** MOVE BRT has created very high capacity BRT corridors in areas with high demand. The BRT corridors continue into the heart of the city, where demand is the highest but space is at the greatest premium.

**Areas for Improvement:** The BRT corridor would benefit from more turn restrictions, to minimize delay at intersections. The corridor would also benefit from mid-block crosswalks to create more direct access to stations outside of downtown.

# BRT Design Best Practices

## TransMilenio

SUBA

**BOGOTÁ, COLOMBIA**

**Ranking:** Gold

**Corridor Length:** 13km

**Riders per Day:** 120,000

**Notable Strengths:** Transmilenio introduced high capacity BRT to the world. It is able to move people to a degree that equals and exceeds many metro systems.

**Areas for Improvement:** Transmilenio has been so successful that it has experienced overcrowding. More frequent bus service and network expansion would help to alleviate these issues.

## Metrobus

9 DE JULIO

**BUENOS AIRES, ARGENTINA**

**Ranking:** Silver

**Corridor Length:** 3.5km

**Riders per Day:** 255,000

**Notable Strengths:** The 9 de Julio BRT corridor makes effective use of public space on one of the widest urban arterials in the world. To allow buses with right side doors to use the open corridor, buses drive on the left. Passing lanes further increase capacity along this busy corridor, quickly moving people through the heart of the city.

**Areas for Improvement:** Off-board fare collection would further improve bus speeds and reliability on the corridor. Limited stop and express services could be introduced to take better advantage of the passing lanes on the corridor.

## Metrobús

LÍNEA 3

**MEXICO CITY, MEXICO**

**Ranking:** Silver

**Corridor Length:** 17 km

**Riders per Day:** 140,000

**Notable Strengths:** Located on a high-demand corridor, the Metrobús Linea 3 has high quality buses and stations, frequent service and good connections to Metro stations and the fiver other Metrobús corridors.

**Areas for Improvement:** Metrobús would benefit from fare integration with the Metro system, better intersection treatments, and better integration with the growing bicycle network.


## Rea Vaya

PHASE 1A

**JOHANNESBURG, SOUTH AFRICA**

**Ranking:** Silver

**Corridor Length:** 25km

**Riders per Day:** 42,000

**Notable Strengths:** Rea Vaya has high quality stations, and potential to easily increase capacity over time, as demand increases on the corridor. The corridor connects through the downtown.

**Areas for Improvement:** The corridor needs better maintenance of infrastructure and better enforcement of the exclusive bus lanes.

## CTfastrak

HARTFORD–NEW BRITAIN

**HARTFORD, UNITED STATES**

**Ranking:** Silver

**Corridor Length:** 9.4km

**Riders per Day:** 14,000

**Notable Strengths:** CTfastrak repurposed an unused freight rail corridor as bus rapid transit, minimizing delays at intersections. The corridor offers a direct service model, where routes operate on part or all of the corridor as well as off the corridor.

**Areas for Improvement:** The corridor would benefit from extending full BRT treatments into downtown Hartford. Wait times would be reduced by extending proof-of-payment fare collection to all routes on the corridor.

## Rainbow BRT

CORRIDOR 2: SANGAVI KIWALE

**PIMPRI-CHINCHWAD, INDIA**

**Ranking:** Bronze (design)

**Corridor Length:** 14km

**Riders per Day:** 120,000

**Notable Strengths:** The Rainbow BRT system introduced BRT in a challenging transportation context.

**Areas for Improvement:** Implementing off-board fare collection and better intersection priority would increase bus speeds along the corridor.

# BRT Standard Scoring Detail


## The BRT Standard Scorecard

This scorecard shows the criteria and point values that make up the *BRT Standard*, followed by a detailed description of each.

| CATEGORY | MAX SCORE |
|---|---|
| **BRT Basics** (pp. 26–37) | **38 (total)** |
| Dedicated Right-of-Way | 8 |
| Busway Alignment | 8 |
| Off-Board Fare Collection | 8 |
| Intersection Treatments | 7 |
| Platform-level Boarding | 7 |
| **Service Planning** (pp. 38–44) | **19** |
| Multiple Routes | 4 |
| Express, Limited-Stop, and Local Service | 3 |
| Control Center | 3 |
| Located in Top Ten Corridors | 2 |
| Demand Profile | 3 |
| Hours of Operations | 2 |
| Multi-Corridor Network | 2 |
| **Infrastructure** (pp. 45–52) | **13** |
| Passing Lanes at Stations | 3 |
| Minimizing Bus Emissions | 3 |
| Stations Set Back from Intersections | 3 |
| Center Stations | 2 |
| Pavement Quality | 2 |
| **Stations** (pp. 53–57) | **10** |
| Distances Between Stations | 2 |
| Safe and Comfortable Stations | 3 |
| Number of Doors on Bus | 3 |
| Docking Bays and Sub-stops | 1 |
| Sliding Doors in BRT Stations | 1 |

| CATEGORY | MAX SCORE |
|---|---|
| **Communications** (pp. 58–59) | **5** |
| Branding | 3 |
| Passenger Information | 2 |
| **Access and Integration** (pp. 60–65) | **15** |
| Universal Access | 3 |
| Integration with Other Public Transport | 3 |
| Pedestrian Access and Safety | 4 |
| Secure Bicycle Parking | 2 |
| Bicycle Lanes | 2 |
| Bicycle-Sharing Integration | 1 |
| **Operations Deductions** (pp. 66–72) | **-63** |
| Commercial Speeds | -10 |
| Peak Passengers per Hour per Direction (pphpd) Below 1,000 | -5 |
| Lack of Enforcement of Right-of-Way | -5 |
| Significant Gap Between Bus Floor and Station Platform | -5 |
| Overcrowding | -5 |
| Poorly Maintained Infrastructure | -14 |
| Low Peak Frequency | -3 |
| Low Off-Peak Frequency | -2 |
| Permitting Unsafe Bicycle Use | -2 |
| Lack of Traffic Safety Data | -2 |
| Buses Running Parallel to BRT Corridor | -6 |
| Bus Bunching | -4 |

The 9 de Julio BRT, in Buenos Aires, Argentina, reclaimed multiple lanes of traffic for transit use.

**Concept plan and design from criteria set in the Feasibility Study**

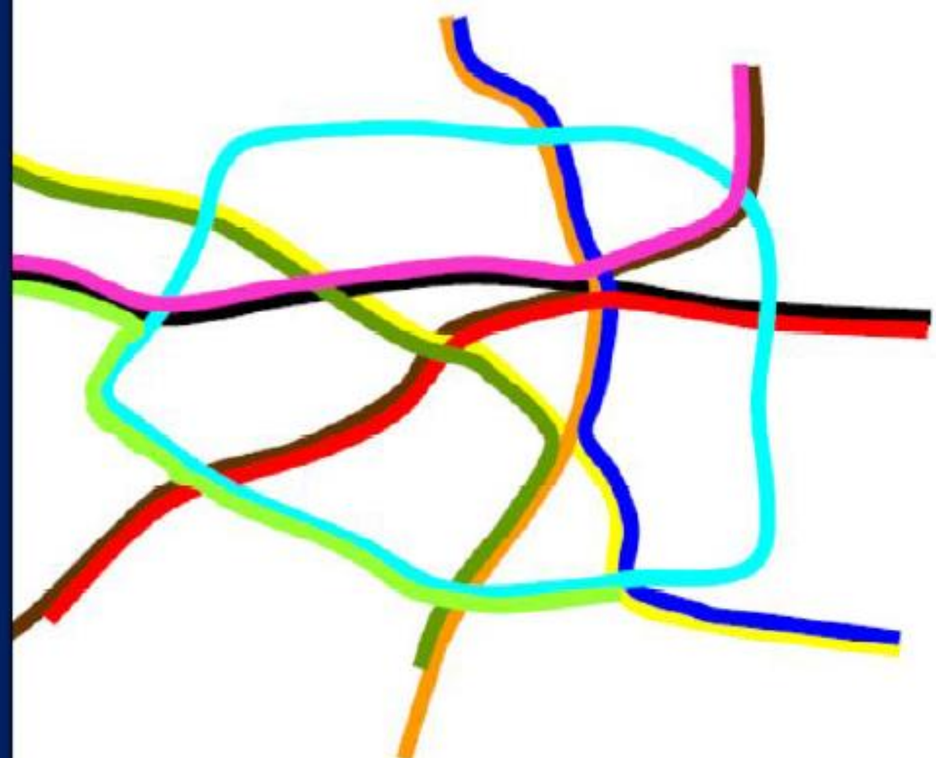
## Comparing modes in a pre-feasibility analysis

| Area | Measure |
|---|---|
| Cost | Planning costs |
| | Capital costs |
| | Operating costs |
| | Maintenance costs |
| Performance | Capacity |
| | Speed (travel time) |
| | Mode share potential |
| | Reliability |
| | Service frequency |
| | Comfort |
| | Safety |
| | Integration potential |
| Strategic | Scalability |
| | Operational flexibility |
| Impacts | Economic, Environmental, Urban, Social |

# Full Network Planning

Even if a city is only constructing a single corridor, it is recommended to conceptually plan the entire network

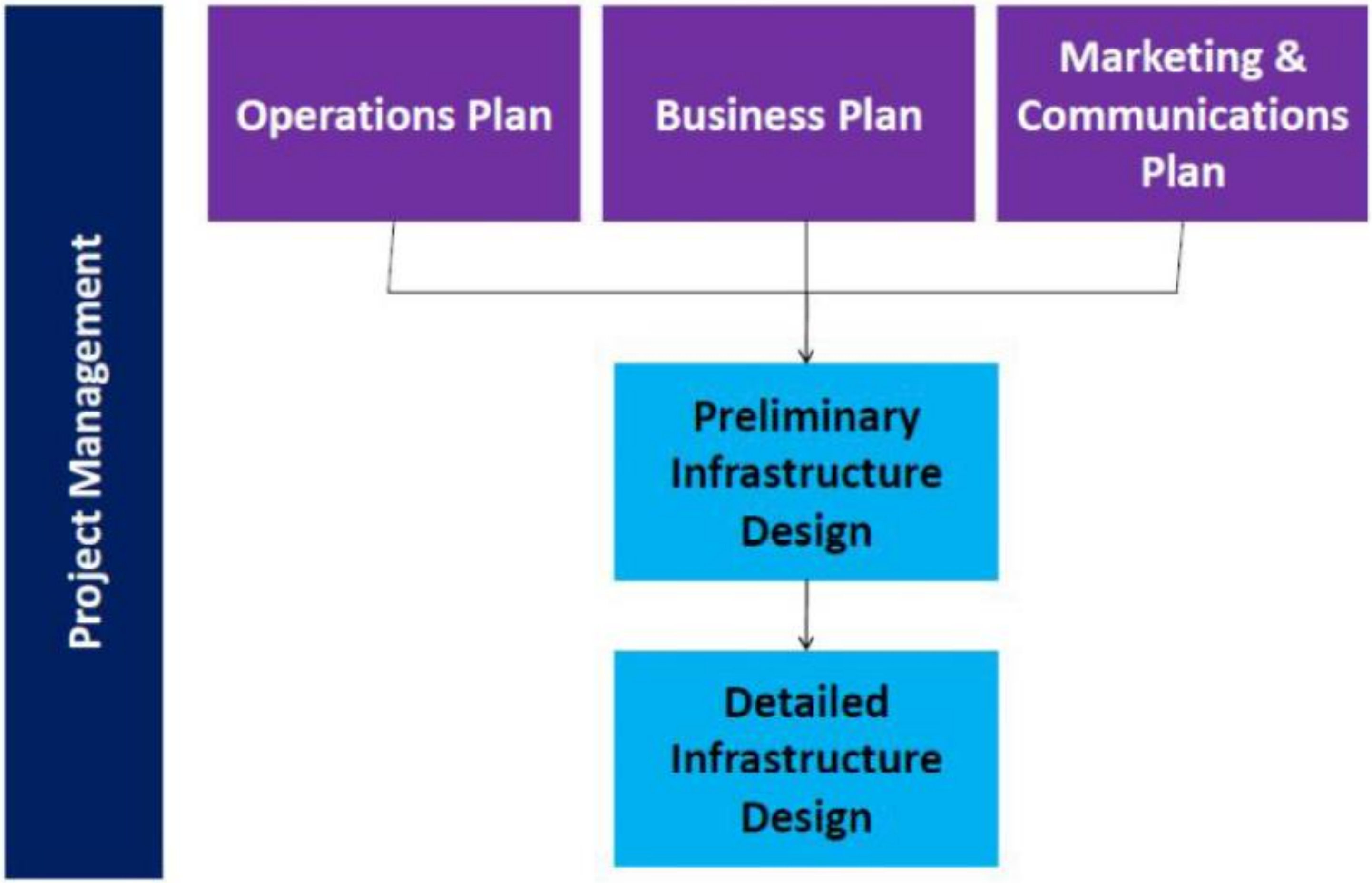
- Ensures future ease of transfers
- Allows testing of additional service scenarios



# Modelling Activities

1. Status of existing transportation model
2. Mapping of existing bus and minibus routes
3. Additional surveys and counts
4. Addition of micro-zones (especially for feeder areas)
5. Demand model interface with financial model
6. Micro-simulation and meso-level modelling for traffic impact analysis

# Planning Components



# Standard BRT Planning Structure

## Project Management

(Project management, communications, budget, time management, MIS, risk assessment, quality assurance, probity)

### Communications Plan

- ❑ Communications strategy
- ❑ Communications management
- ❑ System branding
- ❑ Marketing plan
- ❑ Marketing campaign

### Operations Plan

- ❑ Demand modelling
- ❑ Corridor and network development
- ❑ Operational characteristics
- ❑ Fare structure and policy
- ❑ Financial modelling
- ❑ Traffic modelling
- ❑ Economic analysis
- ❑ Strategic Environmental Assessment
- ❑ Social Assessment
- ❑ NMT integration
- ❑ Vehicle specifications
- ❑ Fare systems plan and specifications
- ❑ ITS specifications

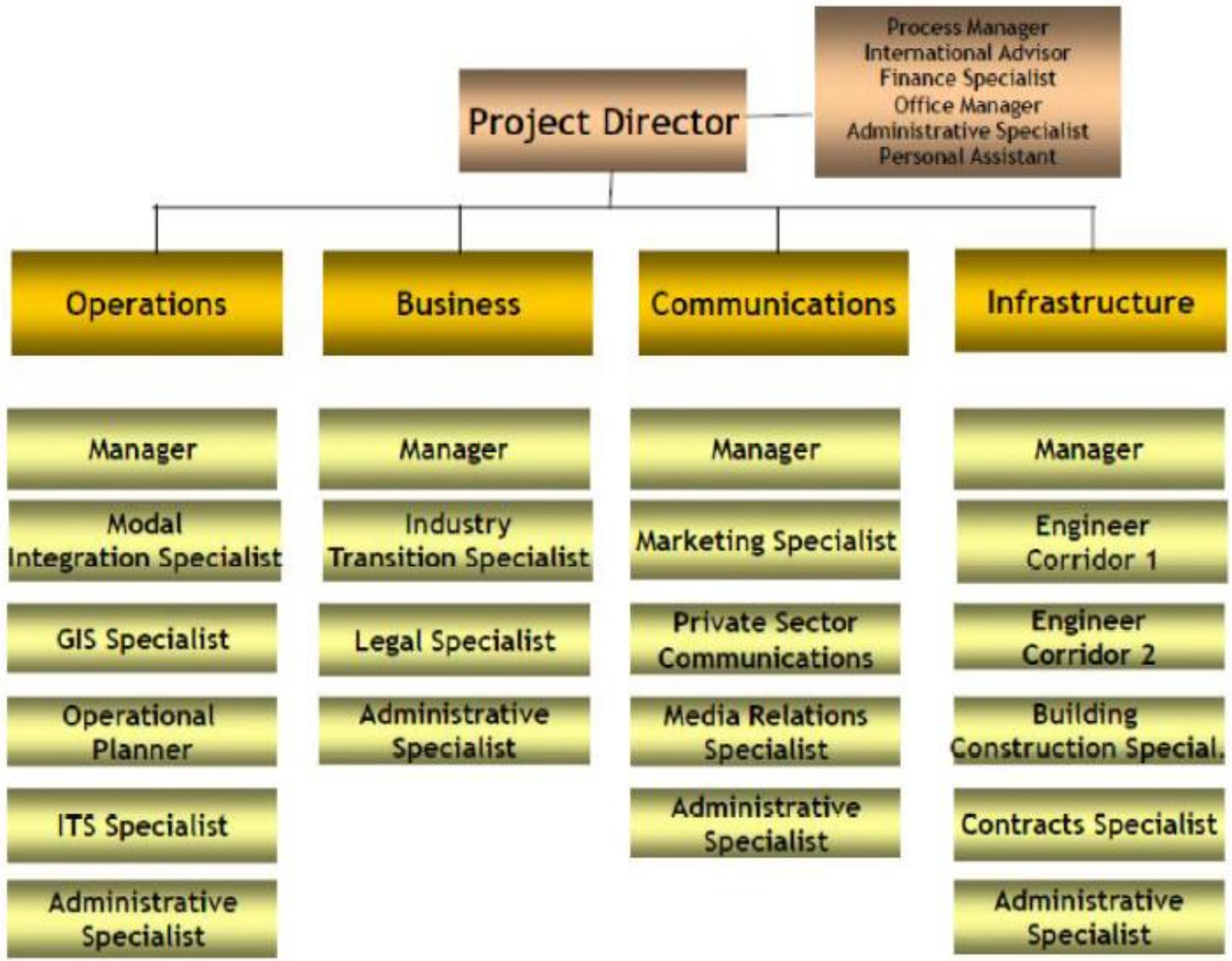
### Infrastructure Plan

- ❑ Infrastructure cost estimation
- ❑ Civil works design
- ❑ Traffic management design
- ❑ Station design
- ❑ Depot design
- ❑ Land acquisition analysis
- ❑ Environmental Impact Assessments
- ❑ Landscaping and artwork plan
- ❑ Construction disruption analysis

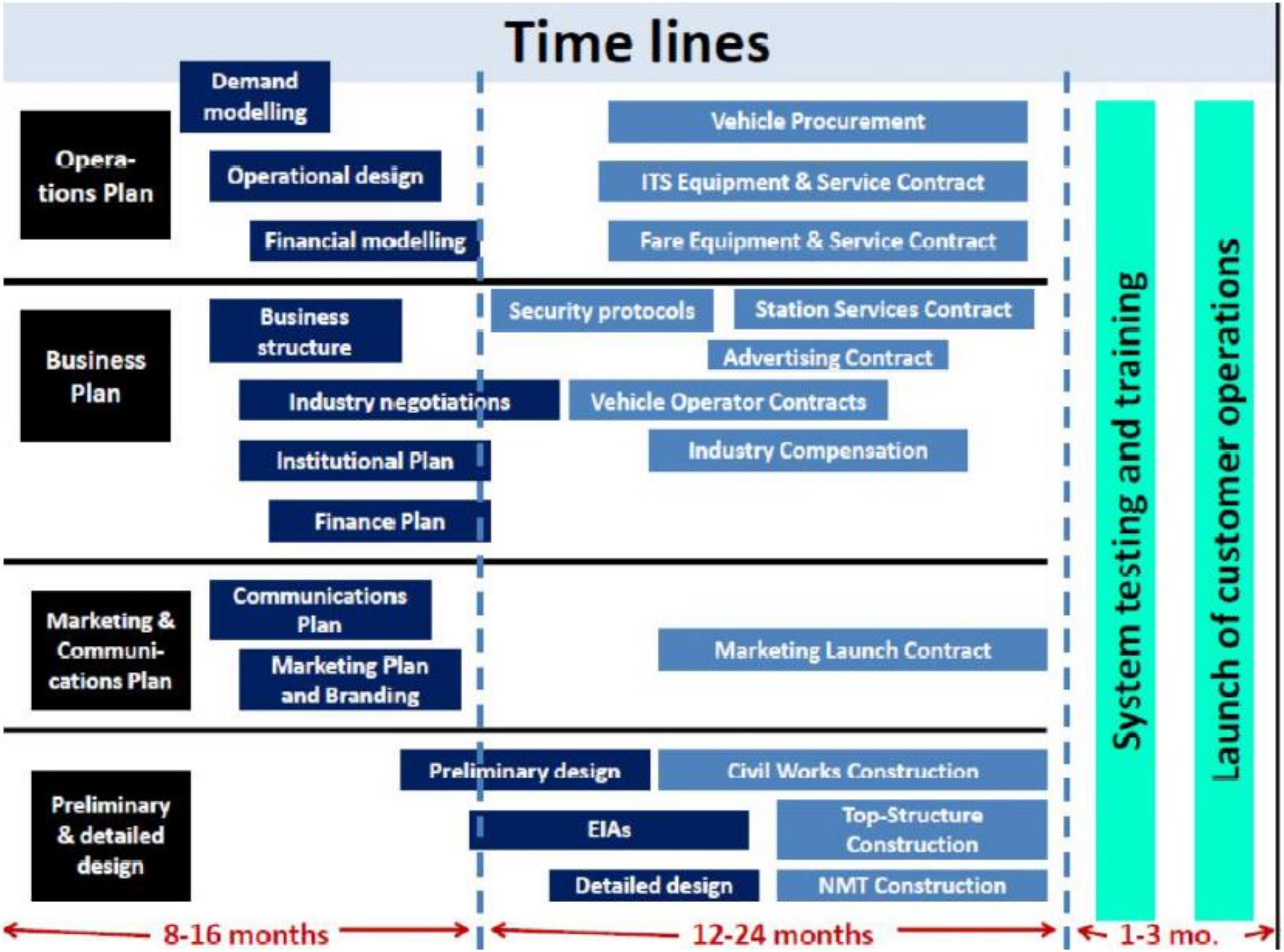
### Business and Institutional Plan

- ❑ Business structure
- ❑ Institutional Plan
- ❑ Operator contracts
- ❑ Station services contract
- ❑ Industry Transition Plan
- ❑ Finance Plan
- ❑ Land value capture
- ❑ Advertising contract(s)

# Project Team Structure



# Project Time lines



# Conceptual Planning and Design in BRT Standard

BRT BASICS

DEDICATED RIGHT-OF-WAY

## Dedicated Right-of-Way

**8 points maximum**

A dedicated right-of-way is vital to ensuring that buses can move quickly and unimpeded by congestion. Physical design is critical to the self-enforcement of the right-of-way. Dedicated lanes matter the most in heavily congested areas where it is harder to take a lane away from mixed traffic to dedicate it as a busway.

Dedicated lanes can be segregated from other vehicle traffic in different ways, but physical separation typically results in the best compliance and the easiest enforcement. Physical separation includes a physical impediment to entering and exiting the lanes. Some physical barriers, such as fences, prevent vehicles from entering and exiting bus lanes entirely, while other barriers, such as curbs, can be carefully mounted to enter or exit the bus lanes. In some designs the bus stations themselves can act as barriers. Some permeability is generally advised, as buses occasionally break down and block the busway or otherwise need to leave the corridor.

While the definition of a BRT corridor requires at least 3 kilometers (1.9 miles) of dedicated bus lanes, this element evaluates the quality of the segregation throughout the corridor, including sections without dedicated lanes.

**BRT Basics:** this is an element of BRT deemed essential to true BRT corridors. A minimum score of 4 must be achieved on this element for a corridor to be defined as BRT.

**Scoring Guidelines:** the score is calculated by multiplying the percentage of the corridor that has each type of dedicated right-of-way for BRT services by the number of points associated with the type of dedication. Corridor segments that permit the use of taxis, motorcycles, high-occupancy vehicles, and other nonemergency vehicles are not considered to have dedicated lanes.

| Type of Dedicated Right-of-Way | POINTS | WEIGHTED BY |
|---|---|---|
| Physically separated, dedicated lanes | 8 | % of corridor with type of dedicated right-of-way |
| Color-differentiated, dedicated lanes with no physical separation | 6 | |
| Dedicated lanes separated by a painted line | 4 | |
| No dedicated lanes | 0 | |

The Rainbow BRT in Pune/Pimpri-Chinchwad, India uses fences to create dedicated physically-separated bus lanes.

## Busway Alignment

**8 points maximum**

The busway is best located where conflicts with other traffic can be minimized, especially from turning movements from mixed-traffic lanes. In most cases, a busway in the central verge of a roadway encounters fewer conflicts with turning vehicles than those adjacent to the curb due to alleys, parking lots, and so forth. Additionally, while delivery vehicles and taxis generally require access to the curb, the central verge of the road usually remains free of such obstructions. All of the design configurations recommended below are related to minimizing the risk of delays caused by turning conflicts and curbside access.

**BRT Basics:** this is an element of BRT deemed essential to true BRT corridors. A minimum score of 4 must be achieved on this element for a corridor to be defined as BRT.

**Scoring Guidelines:** this scoring is weighted using the percentage of the corridor of each particular configuration multiplied by the points associated with that configuration and then adding those numbers together.

| Corridor Configurations | POINTS | WEIGHTED BY |
|---|---|---|
| TIER 1 CONFIGURATIONS | | % of corridor with type of dedicated right-of-way |
| Two-way median-aligned busway in the central verge of a two-way road | 8 | |
| Bus-only corridor where there is a fully exclusive right-of-way and no parallel mixed traffic, such as a transit mall (e.g., Bogotá, Colombia; Curitiba, Brazil; and Quito, Ecuador) or a converted rail corridor (e.g., Cape Town, South Africa, and Los Angeles) | 8 | |
| Busway that runs adjacent to an edge condition like a waterfront or park where there are few intersections to cause conflicts | 8 | |
| Busway that runs two-way on the side of a one-way street | 6 | |
| TIER 2 CONFIGURATIONS | | |
| Busway that is split into two one-way pairs on separate streets, with each bus lane centrally aligned in the roadway | 5 | |
| Busway aligned to the outer curb of the central roadway on a street with a central roadway and parallel service road | 4 | |
| Busway aligned to the inner curb of the service road on a street with a central roadway and parallel service road. Busway must be physically separated from other traffic on the service road to receive points | 4 | |
| Busway that is split into two one-way pairs on separate streets, with each bus lane aligned to the curb | 3 | |
| TIER 3 CONFIGURATIONS | | |
| Virtual busway that operates bidirectionally in a single median lane that alternates direction by block. | 1 | |
| NON-SCORING CONFIGURATIONS | | |
| Curb-aligned busway on a two-way road | 0 | |

BRT BASICS

BUSWAY ALIGNMENT

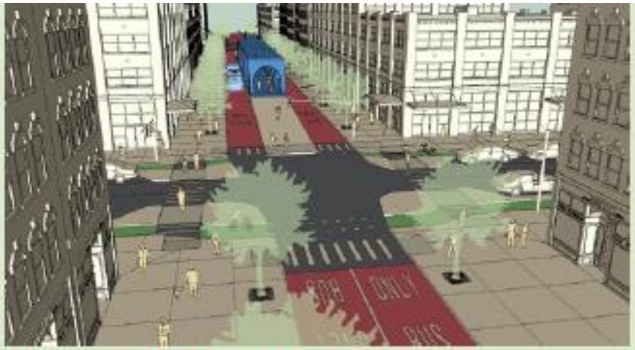
# Conceptual Planning and Design in BRT Standard



EXAMPLE OF A TWO-WAY MEDIAN-ALIGNED BUSWAY

TIER 1 CONFIGURATION

8 POINTS



EXAMPLE OF A BUS-ONLY CORRIDOR WITH EXCLUSIVE RIGHT-OF-WAY

TIER 1 CONFIGURATION

8 POINTS

EXAMPLE OF A TWO-WAY MEDIAN-ALIGNED BUSWAY WITH PASSING LANES

TIER 1 CONFIGURATION

8 POINTS

EXAMPLE OF A BUSWAY THAT RUNS TWO-WAY ON THE SIDE OF A ONE-WAY STREET

TIER 1 CONFIGURATION

6 POINTS

BRT BASICS
BUSWAY ALIGNMENT

# Conceptual Planning and Design in BRT Standard



**EXAMPLE OF A BUSWAY CENTRALLY ALIGNED ON A ONE-WAY STREET**

TIER 2 CONFIGURATION

5 POINTS

**EXAMPLE OF A BUSWAY ALIGNED TO THE INNER CURB OF THE SERVICE ROAD ON A BOULEVARD-TYPE STREET WITH A CENTRAL ROADWAY AND PARALLEL SERVICE ROAD**

TIER 2 CONFIGURATION

4 POINTS

**EXAMPLE OF A BUSWAY ALIGNED TO THE OUTER CURB OF THE CENTRAL ROADWAY ON A BOULEVARD-TYPE STREET WITH A CENTRAL ROADWAY AND PARALLEL SERVICE ROAD**

TIER 2 CONFIGURATION

4 POINTS

BRT BASICS
BUSWAY ALIGNMENT

# Conceptual Planning and Design in BRT Standard

BRT BASICS

OFF-BOARD FARE COLLECTION


TOP
A kiosk sells tickets for the proof-of-payment system used in Las Vegas, Nevada.

BOTTOM
Turnstiles control access into TransJakarta's stations in Jakarta, Indonesia.

## Off-board Fare Collection

**8 points maximum**

Off-board fare collection is one the most important factors in reducing travel time and improving the passenger experience.

Presently, the two most effective approaches to off-board fare collection are "barrier-controlled," where passengers pass through a gate, turnstile, or checkpoint upon entering the station where their ticket is verified or a fare is deducted, and "proof-of-payment," where passengers pay at a kiosk and collect paper tickets or pass with the payment marked that is occasionally checked on board the vehicle by an inspector. Both approaches can significantly reduce delays. However, barrier-controlled is slightly preferable because:

- It is easier to accommodate multiple routes using the same BRT infrastructure, without modifying the entire fare collection system for the entire urban transit network;
- It minimizes fare evasion, as every passenger must have his/her ticket scanned in order to enter the system versus proof-of-payment, which requires random checks;
- Proof-of-payment can cause anxiety for passengers who may have misplaced tickets;
- The data collected by barrier-controlled systems upon boarding, and sometimes upon alighting, can be useful in future system planning.

On the other hand, proof-of-payment systems on bus routes that go beyond BRT corridors extend the benefits of time savings to those sections of the bus routes that lie beyond the BRT corridor.

A third approach, onboard fare validation, directs passengers to purchase tickets/fares before boarding and validate them on the vehicle through rapid electronic readers available at all bus doors. While this provides time savings for passengers, it is not as efficient as barrier-controlled or proof-of-payment systems.

**BRT Basics:** this is an element of BRT deemed essential to true BRT corridors.

**Scoring Guidelines:** to be eligible for scoring, off-board fare collection needs to occur during all operating hours. Scores are weighted by the percentage of either stations or routes on the corridor that utilize that payment system. The maximum score for this element is 8 points.

| Off-Board Fare Collection (During All Operating Hours) | POINTS | WEIGHTED BY |
|---|---|---|
| Barrier-controlled | 8 | % stations on corridor |
| Proof-of-payment | 7 | % routes using corridor bus infrastructure |
| Onboard fare validation—all doors | 4 | % routes using corridor bus infrastructure |

BRT BASICS

OFF-BOARD FARE COLLECTION

# Conceptual Planning and Design in BRT Standard

BRT BASICS

INTERSECTION TREATMENTS

## Intersection Treatments

**7 points maximum**

There are several ways to reduce bus delays at intersections, all of which are aimed at increasing the green-signal time for the bus lane. Forbidding turns across the bus lane and minimizing the number of traffic-signal phases where possible are the most important. Traffic-signal priority, when activated by an approaching BRT vehicle, is useful on lower-frequency corridors but is less effective than turn prohibitions.

**BRT Basics:** this is an element of BRT deemed essential to true BRT corridors.

**Scoring Guidelines:** scores are weighted by the percentage of turns prohibited or intersections with signal priority along the corridor. On corridors with grade separation, intersections that are bypassed by the grade-separated busway count as having all turns across the busway prohibited. The score is the sum of the points for turns prohibited and signal priority. While these may add up to more than 7 points, the score is capped at 7 points for this element.

| Intersection Treatments | POINTS | WEIGHTED BY |
|---|---|---|
| Turns prohibited across the busway | 7 | % of turns across busway prohibited |
| Signal priority at intersections | 2 | % of intersections on corridor |

Left turns are not allowed at this intersection along the BRT corridor in Las Vegas, Nevada.

Platform-level boarding speeds boarding and alighting in Ahmedabad, India.

BRT BASICS

PLATFORM-LEVEL BOARDING

## Platform-level Boarding

**7 points maximum**

Having the bus station platform level with the bus floor (i.e., eliminating the vertical gap) is one of the most important ways of reducing boarding and alighting times per passenger. Boarding configurations where passengers must climb even relatively minor steps can cause significant delays, particularly for the elderly, disabled, or people with suitcases or strollers. The reduction or elimination of the vehicle-to-platform gap (the horizontal gap) is also key to passenger safety and comfort.

"Vertical gap" refers to the difference in height between bus floors and station platforms. Vertical gaps are primarily reduced by designing station platforms and purchasing buses so that the height of the bus floors matches the height of station platforms on the corridor. Station platforms should be designed and buses selected so that the vertical distance between the platform and the bus floor is less than 1.5 centimeters (⅝ inches), although larger gaps are acceptable in *the Standard*.

"Horizontal gap" refers to the distance between the bus and the platform. There are a range of ways to achieve horizontal gaps of less than 10 centimeters (4 inches), including guided busways at stations, alignment markers, Kassel curbs, and boarding bridges. The scoring does not take into account which technique is chosen.

**BRT Basics:** this is an element of BRT deemed essential to true BRT corridors.

**Scoring Guidelines:** buses with an average vertical distance greater than 4 centimeters (1 ½ inches) between the bus floor and the station platform will not qualify as "platform level." Buses with steps inside them also will not count as platform-level. Scores for each element are weighted by the percentage of buses that are platform-level and the percentage of stations that have measures to reduce the horizontal gap. A maximum of 7 points is possible for this element.

| Platform-Level Boarding | POINTS | WEIGHTED BY |
|---|---|---|
| Buses are platform level, having 4 centimeters (1 ½ inches) or less of vertical gap | 7 | % of buses operating on corridor |
| Stations in corridor have measures for reducing the horizontal gap | 6 | % of stations on corridor |

# Conceptual Planning and Design in BRT Standard

# Service Planning



## Multiple Routes

**4 points maximum**

Having multiple routes operate on a single corridor is a good proxy for reduced door-to-door travel times by reducing transfer penalties.

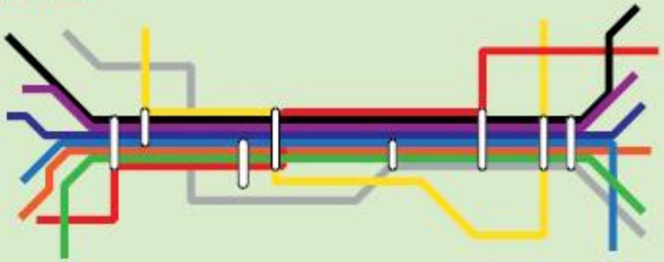
This can include:

- Routes that operate over multiple corridors, as exists with TransMilenio in Bogotá, Colombia, or Metrobús in Mexico City;
- Multiple routes operating in a single corridor that go to different destinations once they leave the corridor, as exists with the Guangzhou, China; Cali, Colombia; and Johannesburg, South Africa, BRT systems.

This flexibility of bus-based systems is one of the primary advantages of BRT that is frequently not well used or understood.

| Multiple Routes | POINTS |
|---|---|
| Two or more routes exist on the corridor, servicing at least two stations | 4 |
| No multiple routes | 0 |

BRT Corridor



Mexico City's Metrobús added an additional twenty thousand daily passengers by incorporating a direct route connecting Corridor I (Insurgentes) with Corridor II (Eje 4), eliminating the transfer between the two.

SERVICE PLANNING
MULTIPLE ROUTES

# Conceptual Planning and Design in BRT Standard



## Express, Limited-Stop, and Local Services

**3 points maximum**

One of the most important ways that BRT corridors increase operating speeds and reduce passenger travel times is by providing limited-stop and express services. While local services stop at every station, limited-stop services skip lower-demand stations and stop only at major stations that have higher passenger demand. Express services often collect passengers at stops at one end of the corridor, travel along much of the corridor without stopping, and drop passengers off in the city center or at the other end of the corridor.

Infrastructure necessary for the inclusion of express, limited-stop, and local BRT services is captured in other scoring metrics.

| Service Types | POINTS |
|---|---|
| Local services and multiple types of limited-stop and/or express services | 3 |
| At least one local and one limited-stop or express service option | 2 |
| No limited-stop or express services | 0 |


The BRT in Yichang, China, offers local, limited, and express services along the same corridor. Digital information tells passengers which door offers which service.



## Control Center

**3 points maximum**

Control centers for BRT systems are increasingly prevalent, allowing operators to directly monitor bus operations, identify problems, and rapidly respond to them. This can save users time and improve the quality of the BRT service.

A full-service control center monitors the locations of all buses with GPS or similar technology and can:

- Respond to incidents in real-time;
- Control the spacing of buses;
- Determine and respond to the maintenance status of all buses in the fleet;
- Record passenger boardings and alightings for future service adjustments;
- Use Computer-Aided Dispatch (CAD)/Automatic Vehicle Location (AVL) for bus tracking and performance monitoring.

A full-service center should be integrated with a public transport system's existing control center as well as the traffic signal system.

**Scoring Guidelines:** the following three elements are part of a full-service control center: 1) automated dispatch, 2) active bus control, and 3) AVL.

| Control Center | POINTS |
|---|---|
| Full-service control center with all three services | 3 |
| Control center with two of the three services | 2 |
| Control center with one of the three services | 1 |
| No control center or center with limited functionality | 0 |


The control center in Rio de Janeiro, Brazil, allows the operator to monitor BRT service across the system.

# Conceptual Planning and Design in BRT Standard

SERVICE PLANNING

LOCATED IN TOP TEN CORRIDORS

## Located In Top Ten Corridors

**2 points maximum**

If the BRT corridor is located along one of the top ten corridors, in terms of aggregate bus ridership, this will help ensure that a significant proportion of passengers benefit from the improvements. Points are awarded to systems that have made a good choice for the BRT corridor, regardless of the level of total demand.

**Scoring Guidelines:** If all top ten demand corridors have already benefited from public transport infrastructure improvements and the corridor thus lies outside the top ten, all points are awarded.

| Corridor Location | POINTS |
|---|---|
| Corridor is one of top ten demand corridors | 2 |
| Corridor is not one of top ten demand corridors | 0 |

This map showing the demand from road-based transit highlights that the first corridor of Johannesburg's BRT (in red) is one of the top corridors. The higher the demand the wider the green and red lines.

## Demand Profile

**3 points maximum**

Building dedicated BRT infrastructure in the highest-demand segments of a road ensures that the greatest number of passengers benefit from the improvements. This is most significant when the decision is made whether or not to build a corridor through a downtown area; however, it can also be an issue outside of a downtown on a road segment that has areas with particularly high demand. Building BRT infrastructure through the highest demand parts of a route will save users time and improve the quality of the service.

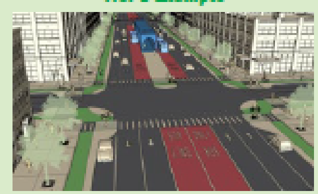
**Scoring Guidelines:** the BRT corridor must include dedicated infrastructure for the road segment with the highest demand within a 2-kilometer (1.2 miles) distance of either end of the corridor. This segment should also have the highest quality of busway alignment in that section, and the score thus relates to that. The trunk corridor configurations defined in the Busway Alignment Section (see page 29) are used here to score the demand profile.

| Demand Profile | POINTS |
|---|---|
| Corridor includes highest demand segment, which has a Tier 1 Trunk Corridor configuration | 3 |
| Corridor includes highest demand segment, which has a Tier 2 Trunk Corridor configuration | 2 |
| Corridor includes highest demand segment, which has a Tier 3 Trunk Corridor configuration | 1 |
| Corridor does not include highest demand segment | 0 |

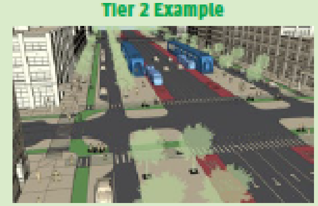
SERVICE PLANNING

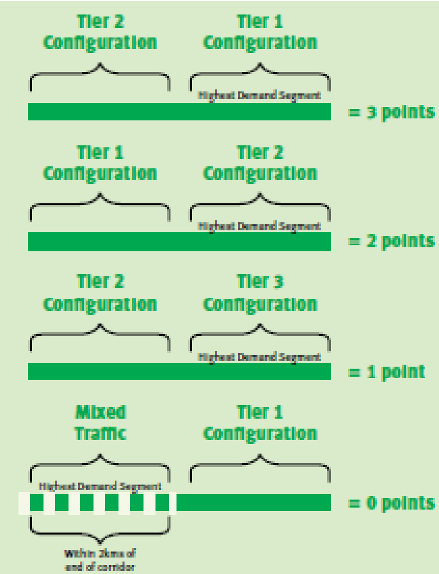
DEMAND PROFILE

Tier 1 Example



Tier 2 Example






*For more detail about the tiers and more examples, please see page 29, Busway Alignment.*

# Conceptual Planning and Design in BRT Standard



## Hours of Operation

**2 points maximum**

A viable transit corridor with a high quality of service must be available to passengers for as many hours throughout the day and week as possible. Otherwise, passengers could end up stranded or may simply seek another mode of transport.

**Scoring Guidelines:** late-night service refers to service until midnight and weekend service refers to both weekend days.

| Operating Hours | POINTS |
|---|---|
| Both late-night and weekend service | 2 |
| Late-night service, no weekends or weekend service, no late nights | 1 |
| No late-night or weekend service | 0 |


The Rainbow BRT in Pimpri-Chinchwad, India offers a multi-corridor network with interchanges.

## Multi-Corridor Network

**2 points maximum**

Ideally, BRT should include multiple corridors that intersect and form a network, as this expands travel options for passengers and makes the system more viable as a whole, improving the level of service experienced by users. When designing a new system, some anticipation of future corridors is useful to ensure that the designs will be compatible with later developments. For this reason, a long-term plan is recognized, with an emphasis on near-term connectivity through either BRT services or infrastructure.

| Multi-Corridor Network | POINTS |
|---|---|
| BRT corridor connects to an existing BRT corridor or to the next one planned in the network | 2 |
| BRT corridor connects to a future planned corridor in the BRT network | 1 |
| No connected BRT network planned or built | 0 |

# Infrastructure



## Passing Lanes at Stations

**3 points maximum**

Passing lanes at station stops are critical to allow both express and local services. They also enable stations to accommodate a high volume of buses without getting congested with buses backed up waiting to enter. On corridors with lower bus frequencies, however, it is more difficult politically to justify devoting street space to passing lanes, if those lanes appear to be unoccupied much of the time. Passing lanes are typically a good investment in the medium term, yielding multiple service options and considerable passenger travel-time savings and allowing for flexibility as a system grows.

On high-demand corridors requiring frequent service, passing lanes at stations are particularly helpful for providing sufficient corridor capacity to maintain higher speeds. Corridors with growing demand may not have high capacities at first, but passing lanes can permit extensive growth in ridership without saturating the corridor. Passing lanes also permit a variety of service options, such as express services, which can be helpful even in lower-demand corridors. In some instances, many of the benefits of passing lanes can be provided by allowing BRT buses to pass in oncoming dedicated bus lanes. However, for safety reasons this should only be done where there is good visibility and relatively low bus frequencies. Similarly, BRT corridors may also allow buses to pass in mixed traffic lanes. But this is mainly useful in locations with low bus frequencies and limited mixed-traffic congestion.

| Passing Lanes | POINTS |
|---|---|
| Dedicated passing lanes | 3 |
| Buses overtake in oncoming dedicated bus lanes given safe conditions | 2 |
| Passing in mixed traffic given safe conditions | 1 |
| No passing lanes | 0 |

The Belo Horizonte MOVE BRT allows for passing lanes at many stations, greatly increasing capacity and allowing for a variety of service options.

# Conceptual Planning and Design in BRT Standard




Rea Vaya in Johannesburg introduced Euro IV buses for the first time to South Africa.

## Minimizing Bus Emissions

### 3 points maximum

Bus tailpipe emissions are typically a large source of urban air pollution. Especially at risk are bus riders and people living or working near roadsides. In general, the pollutant emissions of highest concern from urban buses are particulate matter (PM) and nitrogen oxides ($NO_x$). Minimizing these emissions is critical to the health of both passengers and the general urban population and for creating a high-quality service that can attract and retain passengers.

The primary determinant of tailpipe emission levels is the stringency of governments' emissions standards. While some fuels, like natural gas, tend to produce lower emissions, new emission controls have enabled even diesel buses to meet extremely clean standards. However, "clean" fuels do not guarantee low emissions of all pollutants. As a result, the scoring is based on certified emissions standards rather than fuel type.

Over the past two decades, the European Union and the United States have adopted a series of progressively tighter emissions standards that are being used for this scoring system. Buses must be in compliance with Euro VI and U.S. 2010 emissions standards to receive 3 points. These standards result in extremely low emissions of both PM and $NO_x$. For diesel vehicles, these standards require the use of PM traps, ultra-low-sulfur diesel fuel, and selective catalytic reduction. To receive 2 points, buses need to be certified to Euro IV or V with PM traps (note: 50 ppm sulfur diesel fuel or lower is required for PM traps to function effectively).

Vehicles certified to the Euro IV and V standards that do not require traps emit twice as much PM as vehicles meeting more recent standards. Therefore, these vehicles are awarded 1 point. Ideally, buses will include contractually stipulated requirements in the purchase order to control real-world $NO_x$ emissions from buses in use, because the actual $NO_x$ emissions from urban buses certified to Euro IV and V have been tested at levels substantially higher than certified levels. Because that is hard to verify, it is included as a recommendation, but not as a requirement, for receiving the 1 point.

Zero points are awarded for U.S. 2004 and Euro III standards and less stringent standards, because these standards allow ten times as much PM emissions as the U.S. 2010 and Euro VI standards.

Buses also generate greenhouse gas emissions. Since no clear regulatory framework exists that requires bus manufacturers to meet specific greenhouse-gas emission targets or fuel-efficiency standards, there is no obvious way to identify a fuel-efficient bus by vehicle type. For $CO_2$ impacts, we recommend the use of the TEEMP model, which incorporates the BRT Standard into a broader assessment of project-specific $CO_2$ impacts.

Other countries have established emissions standards, such as the Bharat Stage Standard in India, the China National Standard, and CONAMA PROCONVE Standards in Brazil. These countries often develop their regulations based on either the U.S. or the Euro standards and should be relatively comparable. With Bharat, the highest standard as of 2015 is currently Stage IV, which is comparable to Euro IV and thus eligible for 1 point.

| Emissions Standards | POINTS |
|---|---|
| Euro VI or US 2010 | 3 |
| Euro V with PM traps, Euro IV with PM traps, or U.S. 2007 | 2 |
| Euro V, Euro IV, Euro III CNG, or Euro III using verified PM trap retrofit | 1 |
| Below the above standards | 0 |

INFRASTRUCTURE
MINIMIZING BUS EMISSIONS

# Conceptual Planning and Design in BRT Standard

INFRASTRUCTURE

STATIONS SET BACK FROM INTERSECTIONS

## Stations Set Back from Intersections

**3 points maximum**

Stations should be located at minimum 26 meters (85 feet), but ideally 40 meters (130 feet), from intersections to avoid delays. When stations are located just beyond an intersection, delays can occur when passengers take a long time to board or alight and the docked bus blocks others from pulling through the intersection. If stations are located just before an intersection, the traffic signal can keep buses from leaving the station and thus not allow other buses to pull in. The risk of conflict remains acute, particularly as frequency increases. Separating stations from intersections is a key way to mitigate these problems.

**Scoring Guidelines:** the distance from the intersection is defined for the near side of the intersection as the stop line at the intersection to the front of a bus at the forward-most docking bay and for the far side of the intersection from the far edge of the crosswalk to the back of the bus at the rear-most docking bay. A station may be exempted from the minimum setback if:

- The stations are located on fully grade-separated busways with no intersections;
- The stations are located near intersections due to short block length (less than 100 meters/330 feet);

| Station Location | POINTS |
|---|---|
| 75% of stations on corridor are set back at least 40 meters (130 feet) from intersections or meet at least one of the above exemptions | 3 |
| 75% of stations on corridor are set back 26 meters (85 feet) from intersections or meet above exemptions | 2 |
| 25% of stations on corridor are set back 26 meters (85 feet) from intersections or meet above exemptions | 1 |
| < 25% of stations on corridor are set back 26 meters (85 feet) from intersections or meet above exemptions | 0 |


Janmarg, in Ahmedabad, India, has stations that are not immediately adjacent to the intersection.

INFRASTRUCTURE

STATIONS SET BACK FROM INTERSECTIONS

# Conceptual Planning and Design in BRT Standard

INFRASTRUCTURE

CENTER STATIONS

Center stations in the Metrobus Q BRT system in Quito minimize station space requirements and allow easy transfers between different directions of travel.

## Center Stations

### 2 points maximum

Having a single station serving both directions of the BRT corridor makes transfers between the two directions easier and more convenient—something that becomes more important as a BRT network expands. It also tends to reduce construction costs and minimize the necessary right-of-way. In some cases, stations may be centrally aligned but split into two—called split stations, with each station housing a particular direction of the BRT corridor. If a physical connection between the two directions is not provided, fewer points are awarded.

Bilateral stations (those that, while in the central verge, are at the outer edge of the busway) get no points.

**Scoring Guidelines:** the corridor receives points for center platforms, based on their prevalence and type.

| Center Stations | POINTS |
|---|---|
| >80% of stations on corridor have center platforms serving both directions of service | 2 |
| >50% of stations on corridor have center platforms serving both directions of service | 1 |
| >80% and above of stations on corridor have center platforms serving only one direction of service (e.g., Lanzhou BRT, see figure below) | 1 |

The Lanzhou BRT system has center stations that only serve one direction of travel.

INFRASTRUCTURE

CENTER STATIONS

## Pavement Quality

**2 points maximum**

Good-quality pavement ensures better service and operations for a longer period by minimizing the need for maintenance on the busway. Roadways with poor-quality pavement will need to be shut down more frequently for repairs. Buses will also have to slow down to drive carefully over damaged pavement. A smooth ride is critical for creating a high-quality service that can attract and retain customers.

No matter what type of pavement, a thirty-year life span is recommended. There are several options for the pavement structure to achieve that time span, with advantages and disadvantages for each. Three examples are described here:

**1. Asphalt:** properly designed and constructed, asphalt pavement can last thirty-plus years with surface replacement every ten to fifteen years. This can be done without interrupting service, resulting in a smooth, quiet ride. At stations and intersections, rigid pavement bus pads are important to use to resist the potential pavement damage due to braking of vehicles, a problem which is most acute in hot climates. Bus pads are constructed using cement concrete over a layer of aggregate, with dowels and/or varying amounts of reinforcing steel depending on design conditions. Each bus pad should be 1.5 times as long as the total length of buses using it at any time;

**2. Jointed Plain Concrete Pavement (JPCP):** this type of pavement design can have a thirty-plus-year life. To ensure this life, the pavement must have round dowel bars at the transverse joints, tied lanes by the use of reinforcing steel, and adequate thickness;

**3. Continuously Reinforced Concrete Pavement (CRCP):** continuous slab reinforcement can add additional pavement strength and might be considered under certain design conditions

| Pavement Materials | POINTS |
|---|---|
| Pavement structure designed for thirty-year life over entire corridor | 2 |
| Pavement structure designed for thirty-year life only at stations and intersections | 1 |
| Pavement structure designed for thirty-year life, except at stations and intersections | 1 |
| Pavement design life less than thirty years | 0 |

Lima, Peru, uses reinforced concrete over its entire busway.

# Stations



Guangzhou, China has well-spaced BRT stations.

## Distances Between Stations

**2 points maximum**

In a consistently built-up area, the distance between station stops optimizes at around 450 meters (1,500 feet). Beyond this, more time is imposed on customers walking to stations than is saved by higher bus speeds. Below this distance, bus speeds will be reduced by more than the time saved with shorter walking distances. Thus, in keeping reasonably consistent with optimal station spacing, average distances between stations should not be below 0.3 kilometers (0.2 miles) or exceed 0.8 kilometers (0.5 miles).

**Scoring Guidelines:** two points should be awarded if stations are spaced, on average, between 0.3 kilometers (0.2 miles) and 0.8 kilometers (0.5 miles) apart.

| Distance Between Stations | POINTS |
|---|---|
| Stations are spaced, on average, between 0.3 kilometers (0.2 miles) and 0.8 kilometers (0.5 miles) apart | 2 |

# Conceptual Planning and Design in BRT Standard



## Safe and Comfortable Stations

**3 points maximum**

One of the main distinguishing features of a BRT corridor as opposed to standard bus service is a safe and comfortable station environment, an important feature of a high-quality service. Four main factors contribute to that:

**1. Wide:** stations should be wide enough for passengers to move easily through them and stand without feeling like they are overcrowded. Overcrowded stations are more likely to encourage pickpocketing and harassment. Stations should have a minimum internal width of at least 3 meters (10 feet), and wider widths at stations with higher passenger volumes;

**2. Weather-protected:** stations should be weather-protected, including from wind, rain, snow, heat and/or cold, as appropriate to the conditions in a specific location;

**3. Safe:** stations that are well-lit, transparent, and have security—whether through security guards or cameras—are essential to maintaining ridership;

**4. Attractive:** a clear intention to create attractive stations is also important to the image of the BRT corridor and creates a sense of permanence and attractiveness that will attract not only riders but developers as well. Stations should be considered part of municipal infrastructure and foster civic and community pride.

**Scoring Guidelines:** the scoring is determined by multiplying the percentage of the stations with each quantity of elements of safe and comfortable stations by the points associated with that number of elements. A maximum of 3 points is possible.

| Stations | POINTS | WEIGHTED BY |
|---|---|---|
| Stations have all four elements | 3 | % of stations |
| Stations have three elements | 2 | |
| Stations have two elements | 1 | |
| Stations have one element | 0 | |

Stations in the El Mio BRT system in Cali, Colombia, are comfortable and attractive.




Articulated BRT buses in Nantes, France, have four doors for boarding and alighting quickly.

## Number of Doors on Bus

**3 points maximum**

The speed of boarding and alighting is partially a function of the number of bus doors. Much like a subway in which a car has multiple wide doors, buses need the same to let higher volumes of people on and off the buses quickly, saving time for users. One door or narrow doorways become bottlenecks that delay the bus.

**Scoring Guidelines:** buses need to have three or more doors on the station side of the bus for articulated buses or two wide (defined as at least 1 meter wide) doors on the station side for regular (non-articulated) buses and allow boarding through all doors to qualify for the points below. Points are weighted based on the percentage of buses using the corridor infrastructure, with a maximum score of 3.

| Stations | POINTS | WEIGHTED BY |
|---|---|---|
| Buses have at least three Doors (for articulated buses) or two Wide Doors (for non-articulated buses) on the Station Side. System allows boarding at all doors. | 3 | % of buses using corridor infrastructure meeting criteria |

# Conceptual Planning and Design in BRT Standard

STATIONS

DOCKING BAYS AND SUB-STOPS

## Docking Bays and Substops

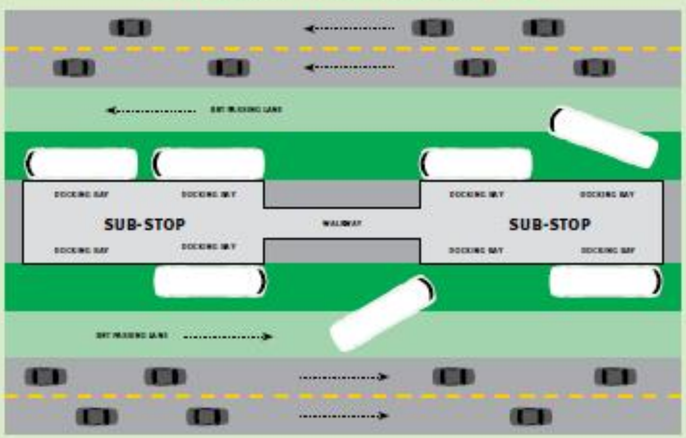
**1 point maximum**

Multiple docking bays and substops not only increase the capacity of a station, saving users time, but they also help stations provide multiple services.

A station is composed of substops that can connect to one another but should be separated by a walkway long enough to allow buses to pass one substop to dock at another. This reduces the risk of congestion by allowing a bus to pass a full substop where buses can let passengers on and off. They are usually adjacent to each other and allow a second bus to pull up behind another bus already at the station. A station may be composed of only one substop.

| Docking Bays and Substops | POINTS |
|---|---|
| At least two substops or docking bays at the highest-demand stations | 1 |
| Less than two substops or docking bays at the highest-demand stations | 0 |

**Example of Substops with Multiple Docking Bays**




Lima, Peru has sliding doors where the bus docks at the station.

STATIONS

SLIDING DOORS IN BRT STATIONS

## Sliding Doors in BRT Stations

**1 point maximum**

Sliding station doors where passengers get on and off the buses improve the quality of the station environment, reduce the risk of accidents, protect passengers from the weather, and prevent pedestrians from entering the station in unauthorized locations.

| Sliding Doors | POINTS |
|---|---|
| All stations have sliding doors | 1 |
| Otherwise | 0 |

Guangzhou, China's BRT has sliding doors at the gates.

# Conceptual Planning and Design in BRT Standard



## Communications

Las Vegas, Nevada, has a good brand and strong identity that appeals to its customers—from the stations to the buses.

Las Vegas, Nevada, used old casino signs at stations, which reinforced the city's identity.

### Branding

**3 points maximum**

BRT promises a high quality of service, which is reinforced by having a unique brand and identity.

| Branding | POINTS |
|---|---|
| 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 differ from rest of system | 2 |
| Some buses, routes, and stations in corridor follow single unifying brand, regardless of rest of system | 1 |
| No corridor brand | 0 |



### Passenger Information

**2 points maximum**

Numerous studies have shown that customer satisfaction is linked to knowing when the next bus will arrive. Giving customers information is critical to a high quality of service and a positive overall experience.

Real-time passenger information, based on GPS data, includes electronic panels, digital audio messaging ("Next bus" at stations, "Next stop" on buses), and/or dynamic information on handheld devices. Static passenger information refers to station and vehicle signage, including network maps, route maps, local area maps, emergency indications, and other user information. Passenger information should be visible from buses, stations, and nearby sidewalks in order to qualify.

More and more customers are accessing information online, including route maps, arrival times/schedules, and services alerts. A variety of means for online information sharing exist—from websites to apps to social media. This is increasingly important for conveying information to customers, as well as receiving feedback and addressing problems, especially using social media to engage with customers. This type of information should be part of a complete passenger information system, but for points, the *Standard* only scores passenger information at and near stations and on buses. Many systems still have trouble achieving this type of information, which should be the cornerstone of good communication.

**Scoring Guidelines:** scores are assigned based on which of the following criteria describes the corridor.

| Passenger Information (at Stations and on Vehicles) | POINTS |
|---|---|
| Functioning real-time and up-to-date static passenger information corridor-wide | 2 |
| Up-to-date static passenger information | 1 |


Guangzhou, China, has real-time passenger information systems.

# Conceptual Planning and Design in BRT Standard

# Access and Integration

ACCESS

UNIVERSAL ACCESS

## Universal Access

**3 points maximum**

A BRT corridor should be accessible to all special-needs customers, including those who are physically, visually, and/or hearing impaired, as well as those with temporary disabilities, the elderly, children, people with strollers, and other load-carrying passengers. Universal access is important to maintaining a high quality of service for all customers, regardless of their abilities.

**Scoring Guidelines:** accessibility includes two elements: physical and audiovisual. Physical accessibility means that all stations, vehicles, and fare gates on the corridor are universally accessible for people using wheelchairs, and stations must be free of obstacles that impede movement. The corridor must also include drop curbs at all immediate intersections. Audiovisual accessibility means that there are Braille readers at all stations and Tactile Ground Surface Indicators leading to all stations. Scores are determined by measuring the percentage of stations and buses that provide each level of access by the points associated with that level and tallying the result. A maximum of 3 points is possible.

| Universal Accessibility | POINTS |
|---|---|
| Full accessibility provided | 3 |
| Physical accessibility provided | 2 |
| Audiovisual accessibility provided | 1 |

Metrobús in Mexico Mexico City provides universal access to people in wheelchairs.

## Integration with Other Public Transport

**3 points maximum**

When a BRT corridor is built in a city, a functioning public transport network often already exists, be it rail, bus, or minibus. The BRT corridor should integrate into the rest of the public transport network, saving customers time and creating a more seamless high-quality experience. There are two components to BRT integration:

- **Physical transfer points:** physical transfer points should minimize walking between modes, be well-sized, and not require passengers to completely exit one system and travel a distance to enter another;
- **Fare payment:** the fare system should be integrated so that one fare card may be used for all modes.

**Scoring Guidelines:** the BRT corridor should integrate physically with other rapid transit modes (BRT, LRT, and metro) where lines cross the corridor. If no lines cross, points may still be awarded for fare integration with other public transport modes. If no other formal public transport modes exist in the city, full points may be awarded for all aspects of integration.

| Integration with Other Public Transport | POINTS |
|---|---|
| Integration of both physical design and fare payment | 3 |
| Integration of physical design or fare payment only | 2 |
| No integration | 0 |

ACCESS

INTEGRATION WITH OTHER PUBLIC TRANSPORT

Guangzhou, China, has physical integration, such as this tunnel connecting the BRT to the metro.

# Conceptual Planning and Design in BRT Standard



## Pedestrian Access and Safety

**4 points maximum**

A BRT corridor could be extremely well-designed and functioning but if customers cannot access it safely, it cannot achieve its goals. Good pedestrian access is imperative in BRT corridor design. Additionally, a new BRT corridor is a good opportunity to improve the pedestrian environment on the streets and public spaces along the corridor and on side streets leading to stations. Good access to the corridor is vital for creating a high level of service for users.

Good pedestrian access includes all of the following:

- At-grade pedestrian crossings where pedestrians cross a maximum of two lanes of traffic before reaching a pedestrian refuge (sidewalk, median). While at-grade crossings are preferred, pedestrian bridges or underpasses with working escalators or elevators can also be considered;
- Safe crossings provided on average every 200 meters (650 feet) in areas where there is continuous activity on both sides of the corridor;
- Signalized crosswalks where pedestrians must cross more than two lanes at once;
- Table-top crossings or speed bumps to slow down traffic when approaching unsignalized crosswalks;
- Signals timed so that pedestrian waiting time is not excessive (i.e., generally below 30–45 seconds);
- Wide (at least 2 meters), well-lit, well-demarcated crosswalks where the footpath remains level and continuous or ramps exist to ensure accessible crossings;
- Dedicated and protected sidewalks along corridor that are at least 3 meters (10 feet) wide and unobstructed, including from encroachment from parked vehicles, debris, signs, and street vendors;
- Direct station access, with no time-consuming detours and other delays;
- Posted speed limits set to prioritize safety (e.g., below 30 kilometers per hour in dense urban centers);
- Design that matches posted speed limits to prevent speeding and help with enforcement.

| Pedestrian Access | POINTS |
|---|---|
| Good, safe pedestrian access at every station and many improvements along corridor | 4 |
| Good, safe pedestrian access at every station and modest improvements along corridor | 3 |
| Good, safe pedestrian access at every station and no other improvements along corridor | 2 |
| Good, safe pedestrian access at most stations and no other improvements along corridor | 1 |
| Stations lack good, safe pedestrian access | 0 |

Metrobús in Mexico City provides good pedestrian access to stations.



## Secure Bicycle Parking

**2 points maximum**

Bicycle parking at stations allows customers to use bicycles as feeders to the BRT corridor, increasing system coverage. More options for accessing the BRT corridor can save users time and create a higher quality experience. Formal bicycle parking facilities that are secure (either monitored by an attendant or observed by security cameras) and weather-protected are more likely to be used by customers.

| Bicycle Parking | POINTS |
|---|---|
| Secure bicycle parking at least in higher-demand stations and standard bicycle racks elsewhere | 2 |
| Standard bicycle racks in most stations | 1 |
| Little or no bicycle parking | 0 |

Secure bike parking is provided at a TransMilenio terminal in Bogotá, Colombia.

A bike locker along the Orange Line in Los Angeles provides secure bicycle storage.

# Conceptual Planning and Design in BRT Standard

ACCESS

BICYCLE LANES

## Bicycle Lanes

**2 points maximum**

Bicycle-lane networks integrated with the BRT corridor improve customer access, provide a full set of sustainable travel options, and enhance road safety. This can save time and improve the quality of the experience for users of the corridor.

Bicycle lanes and bicycle-friendly streets should ideally connect BRT stations to all major residential areas, commercial centers, schools, and business centers within 2 kilometers (1.2 miles). This helps the BRT by providing a low-cost feeder to the system, and by connecting riders safely and comfortably to their destinations. Also, by ensuring that the BRT corridor is designed as a complete street, it increases the safety of all users of the corridor.

Moreover, in most cities, the best BRT corridors are also the most desirable bicycle routes, as they are often the routes with the greatest travel demand. Yet there is a shortage of safe cycling infrastructure on those same corridors. If some accommodation for cyclists is not made, it is possible that cyclists will use the busway. If the busway has not been designed for dual bike and bus use, it is a safety risk for cyclists. Bicycle lanes should be built either within the same corridor or on a nearby parallel street and should be at least 2 meters (6.5 feet), for each direction, of unimpeded width.

| Bicycle Lanes | POINTS |
|---|---|
| Bicycle lanes on or parallel to entire corridor | 2 |
| Bicycle lanes do not span entire corridor | 1 |
| Poorly-designed or no bicycle infrastructure | 0 |

A bikeway is located parallel to MyCiTi, in Cape Town, South Africa.

## Bicycle-Sharing Integration

**1 point maximum**

Having the option to make short trips from the BRT corridor by a shared bicycle is important to providing connectivity to some destinations. Operating costs of providing bus service to the last mile (i.e., feeder buses) are often the highest cost of maintaining a BRT network; thus, providing a low-cost bicycle-sharing alternative to feeders is generally seen as best practice. Providing this option can save users time and improve the quality of their experience, while increasing the coverage of the transit system.

| Bicycle-Sharing Integration | POINTS |
|---|---|
| Bicycle-sharing at minimum of 50% of stations on corridor | 1 |
| Bicycle-sharing at <50% of stations on corridor | 0 |

ACCESS

BICYCLE-SHARING INTEGRATION

A bike-share station is located along a BRT corridor in Nantes, France.

DEDUCTIONS

# Operations Deductions

Operations deductions are only relevant to corridors already in operation. They have been introduced as a way of mitigating the risk of recognizing a corridor as high quality that has made significant design errors or has significant management and performance weaknesses not readily observable during the design phase. The penalties from improperly sizing the infrastructure and operations or from poor corridor management are as follows:

## Commercial Speeds

**-10 points maximum**

Most of the design features included in the scoring system will always result in higher speeds. However, there is an exception: higher-demand corridors in which too many buses carrying too many passengers have been concentrated into a single lane. In this case, bus speeds could be lower than in mixed-traffic conditions. This penalty was imposed to mitigate the risk of rewarding such a corridor with a quality standard.

**Scoring Guidelines:** the minimum average commercial speed refers to the corridor-wide average speed and not the average speed at the slowest link. To measure commercial speeds along a corridor, divide the total distance travelled along the corridor by the total time to travel the corridor or use the average speed from a GPS measurement. Where commercial speed is not readily available, the full penalty should be imposed if buses are backing up at many BRT stations or junctions.

| Commercial Speeds | POINTS |
|---|---|
| Minimum average commercial speed is 20 kilometers per hour (12 miles per hour) and above | 0 |
| Minimum average commercial speed is 16 kilometers per hour–19 kilometers per hour (10–12 miles per hour) | -3 |
| Minimum average commercial speed is 13 kilometers per hour–16 kilometers per hour (8–10 miles per hour) | -6 |
| Minimum average commercial speed is 13 kilometers per hour (8 miles per hour) and below | -10 |

## Peak Passengers per Hour per Direction (pphpd) Below 1,000

**-5 points**

BRT corridors with ridership levels below a thousand passengers per hour per direction (pphpd) during the peak hour are carrying fewer passengers than a normal mixed-traffic lane. Very low ridership can be an indication that other bus services continue to operate in the corridor alongside and in competition with the BRT services. Alternatively, such low ridership indicates that a corridor was poorly selected.

Almost all cities have corridors carrying at least a thousand pphpd during the peak hour. Many cities, however, have corridors where transit demand is very low, even below this level. While many Gold Standard BRT features would still bring benefits in these conditions, it is unlikely that such levels would justify the cost and dedicated right-of-way intrinsic to BRT. This penalty has been created to penalize BRT corridors that have poor service planning or are not well-selected, but the threshold is intended to be low enough to avoid overly penalizing corridors in smaller cities with lower transit demand.

**Scoring Guidelines:** all 5 points should be deducted if the ridership on the link in the corridor with maximum peak-hour ridership is under a thousand pphpd in the peak hour. Otherwise, no deduction is necessary.

| Passengers per Hour per Direction (PPHPD) in Peak Hour | POINTS |
|---|---|
| PPHPD below a thousand | -5 |

## Lack of Enforcement of Right-of-Way

**-5 points maximum**

A BRT corridor may have a good alignment and physical separation, but if the right-of-way is not enforced, bus speeds will decline. This penalty addresses corridors that do not adequately enforce the busway to prevent encroachment from other vehicles. There are multiple and somewhat context-specific means of enforcing the exclusive right-of-way. The committee generally recommends onboard camera enforcement and regular policing at points of frequent encroachment, coupled with high fines for violators, to minimize invasions of the lanes by nonauthorized vehicles. Solely relying on camera enforcement deployed at high-risk locations is somewhat less effective.

| Lack of Enforcement | POINTS |
|---|---|
| Regular encroachment on BRT right-of-way | -5 |
| Some encroachment on BRT right-of-way | -3 |
| Occasional encroachment on BRT right-of-way | -1 |

DEDUCTIONS

DEDUCTIONS

# Significant Gap Between Bus Floor and Station Platform

**-5 points maximum**

Even corridors that have been designed to accommodate platform-level boarding could have horizontal gaps if the buses do not dock properly. A significant horizontal gap between the platform and the bus floor undermines the time-savings benefits of platform-level boarding and introduces a significant safety risk for passengers. Such gaps occur for a variety of reasons, from poor basic design to poor driver training. Technical opinion varies on the best way to minimize the horizontal gap. Most experts feel that optical guidance systems are more expensive and less effective than measures such as the use of simple painted alignment markers and special curbs at station platforms where the drivers are able to feel the wheel touching the curb yet the curb does not damage the wheel. Boarding bridges are used successfully on many corridors and would tend to eliminate gap problems.

**Scoring Guidelines:** a "minor horizontal gap" is defined as 15–20 centimeters (6–8 inches) and a "major horizontal gap" is defined as greater than 20 centimeters (8 inches). A sample of at least twenty instances of buses docking at stations should be used to determine scoring. The percentage of docking instances observed with each type of gap should be multiplied by the associated deduction and tallied. The maximum possible deduction is -5.

Note: If a corridor does not have platform-level boarding by design, no penalty points should be given. Deductions for significant gaps must not exceed the points awarded for Platform-Level Boarding.

| Gap when Docking | POINTS | WEIGHTED BY |
|---|---|---|
| Major horizontal gap | -5 | % of observed dockings |
| Minor horizontal gap | -3 | |

# Overcrowding

**-5 points**

This criterion was included because many corridors that are generally well-designed are so overcrowded that they become alienating to customers. While average "passenger standing density" is a reasonable indicator, getting this information is not easy, so a more subjective measure is allowed in cases of obvious overcrowding.

**Scoring Guidelines:** the full penalty should be imposed if the average passenger standing density during the peak hour is greater than five passengers per square meter (0.46 per square feet) on more than 25% of buses on the critical link in the predominant direction, or the average passenger standing density during the peak hour is greater than three passengers per square meter (0.28 per square feet) at stations.

If this metric is not easily calculated, then clearly visible signs of overcrowding on buses or in stations should be used, such as doors on the buses regularly being unable to close, stations overcrowded with passengers because they are unable to board full buses, and so forth.

| Overcrowding | POINTS |
|---|---|
| Passenger density during peak hour on more than 25% of buses on critical link in peak direction is > 5 m² | -5 |
| Passenger density during peak hour at one or more stations is > 3 m² | |
| Passengers unable to board buses or enter stations | |

DEDUCTIONS

# Poorly Maintained Busway, Buses, Stations, and Technology Systems

**-14 points maximum**

Even a BRT corridor that is well built and attractive can fall into disrepair. It is important that the busway, buses, stations, and technology systems be regularly maintained. A corridor can be penalized for each type of poor maintenance listed below for a total of -14 points.

| Maintenance of Busway | POINTS |
|---|---|
| Busway has significant wear, including potholes or warping, or debris such as trash or snow | -4 |

| Maintenance of Buses | POINTS |
|---|---|
| Buses have graffiti, litter, seats in disrepair, bus mechanisms (e.g., doors) not functioning properly | -2 |

| Maintenance of Stations | POINTS |
|---|---|
| Stations have graffiti, litter, occupancy by vagrants or vendors, or structural damage | -2 |

| Maintenance of Technology Systems | POINTS |
|---|---|
| Technology systems, including fare collection machines, are not functional, up-to-date, and/or accurate | -2 |

| Maintenance of Sidewalks on Corridor | POINTS |
|---|---|
| Sidewalks in disrepair | -2 |

| Maintenance of Bicycle Lanes on Corridor | POINTS |
|---|---|
| Bike lanes in disrepair | -2 |

# Conceptual Planning and Design in BRT Standard

DEDUCTIONS

## Low Peak Frequency

**-3 points maximum**

How often the bus comes during peak travel times such as rush hour is a good proxy for quality of service. For BRT to be truly competitive with alternative modes, like the private automobile, customers need to be confident that their wait times will be short and the next bus will arrive soon.

**Scoring Guidelines:** peak frequency is measured by the number of buses observed per hour for each route that passes the highest-demand segment on the corridor during the peak period. The peak frequency deduction is then allocated based on the percentage of routes that have a frequency of at least eight buses per hour in the peak period. If observations cannot be made, frequencies may be obtained through route schedules.

| % Routes With At Least 8 Buses per Hour | POINTS |
|---|---|
| 100% have at least 8 buses per hour | 0 |
| 75% have at least 8 buses per hour | -1 |
| 50% have at least 8 buses per hour | -2 |
| < 50% have at least 8 buses per hour | -3 |

## Low Off-Peak Frequency

**-2 points maximum**

As with peak frequency, how often the bus comes during off-peak travel times is a good proxy for quality of service.

**Scoring Guidelines:** off-peak frequency is measured by the buses per hour of each route passing through the highest-demand segment on the corridor during the off-peak (midday) period. The off-peak frequency score is then determined based on the percentage of all routes that have a frequency of at least four buses per hour during the off-peak period.

| % Routes with at Least 4 Buses per Hour | POINTS |
|---|---|
| 100% of all routes have at least 4 buses per hour | 0 |
| 60% of all routes have at least 4 buses per hour | -1 |
| < 60% of all routes have at least 4 buses per hour | -2 |

## Permitting Unsafe Bicycle Use

**-2 points maximum**

Bicycle use in busways is generally not encouraged, and is particularly dangerous in bus lanes with speed limits greater than 25 kilometers per hour (15 miles per hour) and/or bus lanes with widths less than 3.8 meters 12 feet). If cycling is observed in these conditions, a deduction should be made.

| Permitting Unsafe Bicycle Use | POINTS |
|---|---|
| Cycling permitted in bus lanes with speed limits greater than 25 kilometers per hour (15 miles per hour) and/or bus lanes with widths less than 3.8 meters (12 feet) | -2 |

DEDUCTIONS

## Lack of Traffic Safety Data

**-2 points maximum**

Traffic safety data is vital to ensuring that transportation systems operate safely and to evaluating efforts to improve safety. All cities should collect traffic safety data and make this information public so that progress can be tracked.

| Traffic Safety Data Not Collected | POINTS |
|---|---|
| Traffic safety data is not collected | -2 |

# Conceptual Planning and Design in BRT Standard

DEDUCTIONS

## Buses Running Parallel to BRT Corridor

**-6 points maximum**

Bus corridors should be designed to capture as much of the public transportation demand on a corridor to maximize the utility of dedicated transit infrastructure. A significant number of full-sized public buses operating outside of the busway results in difficult transfers, undermines the financial sustainability of the BRT corridor, and leads to less frequent service on the corridor.

| Buses Running Parallel to BRT Corridor | POINTS |
|---|---|
| < 60% of buses operating on corridor use busway | -2 |
| < 40% of buses operating on corridor use busway | -4 |
| < 20% of buses operating on corridor use busway | -6 |

## Bus Bunching

**-4 points maximum**

Bus reliability is critical to improving BRT performance. Bus bunching—when the distance between buses becomes highly uneven—reduces reliability, increases wait times, and contributes to crowding conditions, deteriorating the quality and speed of service.

**Scoring Guidelines:** bus bunching deductions will be made when two buses are seen traveling in the same direction on the same route, one directly behind the other. Observation for this deduction are to be made during the peak hour at the highest demand segment on the corridor.

| Bus Bunching | POINTS |
|---|---|
| Bus bunching observed on corridor | -2 |
| Multiple instances of bus bunching are observed on corridor within an hour | -4 |

# BRT Standard Scorecard

| CATEGORY | MAX SCORE |
|---|---|
| **BRT Basics** (pp. 26–37) | **38 (TOTAL)** |
| Dedicated Right-of-Way | 8 |
| Busway Alignment | 8 |
| Off-Board Fare Collection | 8 |
| Intersection Treatments | 7 |
| Platform-level Boarding | 7 |
| **Service Planning** (pp. 38–44) | **19** |
| Multiple Routes | 4 |
| Express, Limited-Stop, and Local Service | 3 |
| Control Center | 3 |
| Located in Top Ten Corridors | 2 |
| Demand Profile | 3 |
| Hours of Operations | 2 |
| Multi-Corridor Network | 2 |
| **Infrastructure** (pp. 45–52) | **13** |
| Passing Lanes at Stations | 3 |
| Minimizing Bus Emissions | 3 |
| Stations Set Back from Intersections | 3 |
| Center Stations | 2 |
| Pavement Quality | 2 |
| **Stations** (pp. 53–57) | **10** |
| Distances Between Stations | 2 |
| Safe and Comfortable Stations | 3 |
| Number of Doors on Bus | 3 |
| Docking Bays and Sub-stops | 1 |
| Sliding Doors in BRT Stations | 1 |

**Minimum Requirements for a Corridor to be Considered BRT**

1. At least 3 kilometers (1.9 miles) in length with dedicated lanes
2. Score 4 or more points in dedicated right-of-way element
3. Score 4 or more points in busway alignment element
4. Score 20 or more total points across all five BRT basics elements

| CATEGORY | MAX SCORE |
|---|---|
| **Communications** (pp. 58–59) | **5** |
| Branding | 3 |
| Passenger Information | 2 |
| **Access and Integration** (pp. 60–65) | **15** |
| Universal Access | 3 |
| Integration with Other Public Transport | 3 |
| Pedestrian Access and Safety | 4 |
| Secure Bicycle Parking | 2 |
| Bicycle Lanes | 2 |
| Bicycle-Sharing Integration | 1 |
| **Operations Deductions** (pp. 66–72) | **-63** |
| Commercial Speeds | -10 |
| Peak Passengers per Hour per Direction (pphpd) Below 1,000 | -5 |
| Lack of Enforcement of Right-of-Way | -5 |
| Significant Gap Between Bus Floor and Station Platform | -5 |
| Overcrowding | -5 |
| Poorly Maintained Infrastructure | -14 |
| Low Peak Frequency | -3 |
| Low Off-Peak Frequency | -2 |
| Permitting Unsafe Bicycle Use | -2 |
| Lack of Traffic Safety Data | -2 |
| Buses Running Parallel to BRT Corridor | -6 |
| Bus Bunching | -4 |

BRONZE 55–69.9 points

SILVER 70–84.9 points

GOLD 85–100 points

## Case Study