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GESTÃO DA MOBILIDADE URBANA

Responsible: Prof. Rosário Macário

Bus Rapid Transit (BRT)

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What is a Bus Rapid Transit?

Definition (ITDP, 2007)

BRT is a “high-quality bus based transit system that delivers fast, comfortable and cost-effective urban mobility through the provision of segregated right-of-way infrastructure, rapid and frequent operations, and excellence in marketing and customer service”

HOW CAN THIS BE ACHIEVED?
MAIN CHARACTERISTICS OF FULL BRT SYSTEMS (I)

Infrastructure

- Segregated lanes or busways

Sources: BRT Planning guide, ITDP, 2007 and Google image search
Main characteristics of full BRT systems (II)

- **Infrastructure**
  - Segregated lanes or busways

Source: BRT Planning guide, ITDP, 2007 and Google image search
MAIN CHARACTERISTICS OF FULL BRT SYSTEMS (III)

- Infrastructure

  - Most common layout

  Existence of an integrated “network” of routes and corridors

Source: BRT Planning guide, ITDP, 2007
Main characteristics of full BRT systems (IV)

- Infrastructure
  - High quality stations
    (convenient, comfortable, secure, weather-protected)

Source: Google image search
MAIN CHARACTERISTICS OF FULL BRT SYSTEMS (V)

- Infrastructure
  - Stations provide level access between the platform and vehicle floor

Source: Google image search
Main characteristics of full BRT systems (VI)

- Infrastructure
  - Special stations and terminals to facilitate easy physical integration between trunk routes, feeder services, and other mass transit systems
  - Improvements in surrounding public space

Source: BRT Planning guide, ITDP, 2007
Main characteristics of full BRT systems (VII)

- **Operation**
  - Frequent and rapid services between major origins and destinations
  - High capacity along corridors
  - Rapid boarding and alighting
  - Pre-board fare collection and fare verification
  - Fare-integration between routes, corridors, and feeder services

Source: Google image search
MAIN CHARACTERISTICS OF FULL BRT SYSTEMS (VIII)

Business and institutional structure

- Entry to system restricted to prescribed operators under a reformed business and administrative structure (i.e., “closed system”)
- Competitively-bid and wholly-transparent processes for awarding all contracts and concessions
- Efficient management resulting in the elimination or minimisation of public-sector subsidies towards system operations
- Independently operated and managed fare collection system
- Quality control oversight from an independent entity / agency
Main characteristics of full BRT systems (IX)

- Technology

  - Low-emission and low noise vehicles

<table>
<thead>
<tr>
<th>Vehicle type</th>
<th>Vehicle length (metres)</th>
<th>Capacity (passengers per vehicle)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bi-articulated</td>
<td>24</td>
<td>240 – 270</td>
</tr>
<tr>
<td>Articulated</td>
<td>18.5</td>
<td>120 – 170</td>
</tr>
<tr>
<td>Standard</td>
<td>12</td>
<td>60 – 80</td>
</tr>
<tr>
<td>Mini-bus</td>
<td>6</td>
<td>25 – 35</td>
</tr>
</tbody>
</table>

Source: BRT Planning guide, ITDP, 2007

Source: Google image search
Main characteristics of full BRT systems (IX)

Technology

- Automatic fare collection and fare verification technology
- System management through centralised control centre, utilising applications of Intelligent Transportation Systems (ITS) such as automatic vehicle location
- Signal priority or grade separation at intersections
Marketing and customer service

- Distinctive marketing identity for the BRT system

- Excellence in customer service and provision of key customer amenities

Source: Google image search
MAIN CHARACTERISTICS OF FULL BRT SYSTEMS (XI)

- **Integration and accessibility**
  - Ease of access between the system and other modes (including walking cycling)
  - Special provisions to ease access for physically disadvantaged groups, such as children, the elderly, and the physically disabled
  - Clear route maps, signage, and/or real-time information displays that are visibly placed within stations and/or vehicles

Source: Google image search
<table>
<thead>
<tr>
<th>Informal transit service</th>
<th>Conventional bus services</th>
<th>Basic busways</th>
<th>BRT-lite</th>
<th>BRT</th>
<th>Full BRT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-regulated operators</td>
<td>Segregated busway / single corridor services</td>
<td>Segregated busway</td>
<td>Metro-quality service</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Taxi-like services</td>
<td>On-board fare collection</td>
<td>Typically pre-board fare payment / verification</td>
<td>Integrated network of routes and corridors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Poor customer service</td>
<td>Basic bus shelters</td>
<td>Higher quality stations</td>
<td>Closed, high-quality stations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Relatively unsafe / insecure</td>
<td>Standard bus vehicles</td>
<td>Clean vehicle technology</td>
<td>Pre-board fare collection / verification</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Very old, smaller vehicles</td>
<td></td>
<td>Marketing identity</td>
<td>Frequent and rapid service</td>
<td></td>
</tr>
</tbody>
</table>

Source: BRT Planning guide, ITDP, 2007
ITDP’s BRT Standard

- Evaluates BRT corridors based on a wide range of features
  - Basic Features, ex: dedicated right-of-way, off-board fare collection, platform-level boarding
  - Service Planning, ex: multiple routes, differentiated services, hours of operations, multi-corridor network
  - Infrastructure, ex: passing lanes at stations, stations set back from intersections, center stations
  - Stations, ex: distances between stations, number of doors on bus
  - Communications, ex: branding, passenger information
  - Access and Integration, ex: universal access, integration with other PT, pedestrian access, bike lanes

- Points can be added (“good” features like passing lanes at stations) or deducted (“bad” features like low off-peak frequency)

- Recognizes particularly high-quality corridors with either Bronze, Silver, or Gold rankings

Brief history (I)

- Since early 1930s - Several plans to modernize PT (Chicago and other US cities)

- 1960s - Bus lane concept developed in New York, Paris and other cities

- 1972 - Oxford st, London converted into the first bus-only street

- Early 70s - Curitiba implements the first full BRT, followed by other Brazilian (mid 1970s) and world cities (late 1970s, 1980s)
Bus Rapid Transit

(Vídeo BRT Curitiba)

http://www.streetfilms.org/curitibas-brt/
http://www.youtube.com/watch?v=z-MtqyWQj7g
1975 – World Bank recognises the potential of busways in its Transport Policy Paper

Early 1980s – First guided busway (Essen, Germany), followed by other cities (Adelaide, Australia; Nagoya, Japan; several other UK cities)

Late 1990s – Decline in “normal” bus ridership in South America increases interest in BRT - Quito, Ecuador; this is followed by interest for BRT systems in Asia (China, India, etc)
• Late 1990s – Technological development in France of bus systems that mimic LRT systems (e.g. TEOR System, Rouen)

• Dec 2000 – TransMilenio, in Bogota (Colombia) shows it is possible to deliver high performance BRT systems to compete with metro (aprox 45000 passengers / hour / direction)

  Other measures for success of TransMilenio: new cycleways and pedestrian areas, improved public space, closing of 120km of roadways on sundays, car restriction measures

• Since early 2000s – Increased interest for BRT in developed countries’ cities in Europe and in North America
Bus Rapid Transit

(Videó BRT TransMilenio)

http://www.streetfilms.org/bus-rapid-transit-bogota/
BRIEF HISTORY (IV)

- Evolution of cities with BRT systems

Cities with BRT/Bus Corridors

- Guangzhou, Hefei, Yancheng, Zaozhuang - China
- Jaipur - India; Palembang, Gorontalo, Surakata - Indonesia
- Bangkok - Thailand; East London Transit - UK
- João Pessoa - Brazil; Barranquilla, Bucaramanga - Colombia
- Estado México - México; Lima - Perú; Brampton - Canada

Curitiba

Bogotá TransMilenio,
Los Angeles Metrorapid

Source: Bus rapid transit systems and beyond Exploring the limits of a popular and rapidly growing urban transport system (MSc. Thesis), David Sorg, IVT, 2011
PEAK RIDERSHIP IN SELECTED BRT SYSTEMS

### COMPARISON OF PEAK RIDERSHIP IN SELECTED BRT AND MASS RAIL TRANSIT SYSTEMS

<table>
<thead>
<tr>
<th>Line</th>
<th>Type</th>
<th>Ridership (passengers/hour/direction)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hong Kong Subway</td>
<td>Metro</td>
<td>80,000</td>
</tr>
<tr>
<td>São Paulo Line 1</td>
<td>Metro</td>
<td>60,000</td>
</tr>
<tr>
<td>Mexico City Line B</td>
<td>Metro</td>
<td>39,300</td>
</tr>
<tr>
<td>Santiago La Moneda</td>
<td>Metro</td>
<td>36,000</td>
</tr>
<tr>
<td>London Victoria Line</td>
<td>Metro</td>
<td>25,000</td>
</tr>
<tr>
<td>Buenos Aires Line D</td>
<td>Metro</td>
<td>20,000</td>
</tr>
<tr>
<td>Bogotá TransMilenio</td>
<td>BRT</td>
<td>45,000</td>
</tr>
<tr>
<td>São Paulo 9 de julho</td>
<td>BRT</td>
<td>34,910</td>
</tr>
<tr>
<td>Porto Alegre Assis Brasil</td>
<td>BRT</td>
<td>28,000</td>
</tr>
<tr>
<td>Belo Horizonte Cristiano Machado</td>
<td>BRT</td>
<td>21,100</td>
</tr>
<tr>
<td>Curitiba Eixo Sul</td>
<td>BRT</td>
<td>10,640</td>
</tr>
<tr>
<td>Manila MRT-3</td>
<td>Elevated rail</td>
<td>26,000</td>
</tr>
<tr>
<td>Bangkok SkyTrain</td>
<td>Elevated rail</td>
<td>22,000</td>
</tr>
<tr>
<td>Kuala Lumpur Monorail</td>
<td>Monorail</td>
<td>3,000</td>
</tr>
<tr>
<td>Tunis</td>
<td>LRT</td>
<td>13,400</td>
</tr>
</tbody>
</table>

Source: BRT Planning guide, ITDP, 2007
BRT capacity comparison with other modes

Source: BRT Planning guide, ITDP, 2007
COMPARISON OF INFRASTRUCTURE COSTS BETWEEN BRT AND OTHER SYSTEMS

Assumptions and information:
Total investment: US$1 billion to each system

- Bangkok BRT costs (proj.): US$2.34M/km
- Hypothetical LRT system (est.): US$25M/km
- Bangkok Skytrain costs (rep.): US$72.5M/km
- Bangkok subway costs (rep): US$142.9M/km

Source: BRT Planning guide, ITDP, 2007
Cost and capacity ranges

Source: BRT Planning guide, ITDP, 2007
AVERAGE COMMERCIAL SPEED COMPARISON
(BRT AND OTHER SYSTEMS)

Source: Providing a Choice for Gold Coast Transport Options, presentation to Gold Coast City Council –21-05-07,
Prof. Graham Currie
Other important issues of BRT systems (I)

- **Corridor selection**
  (demand analysis, network feasibility, road characteristics, space availability, costs, etc)

![Guangzhou, China](image1.jpg) Before BRT

![After BRT](image2.jpg)

Source: Google image search
Other important issues of BRT systems (II)

Corridor selection (2)

Source: BRT Planning guide, ITDP, 2007
Other important issues of BRT systems (III)

- Stakeholders’ involvement, public hearings

Source: BRT Planning guide, ITDP, 2007

- Contracting (open vs. closed system)

- Land use oriented measures
COMMON PROBLEMS IN BRT SYSTEMS PLANNING

1. System designed around a technology and not the customer
2. System designed around the existing operators and not the customer
3. Too little investment in the planning process
4. No competitive tendering of planning consultants
5. Too few full-time staff dedicated to planning the system
6. First phase is too limited in scope
7. No re-organisation of existing bus routes
8. No re-organisation of existing regulatory structures
9. Allowing all existing bus operators to use busway infrastructure, resulting in severe busway congestion
10. No competitive tendering of bus operators
11. No independent concession for fare collection
12. Public sector procurement of vehicles (instead of private sector procurement)
13. No provision for feeder services or direct services into residential areas
14. System built on low-demand corridor(s) to make construction easier
15. No provision of safe and quality access for pedestrians to stations
16. No provision for integration with other transport modes (e.g., bicycle parking, taxi stands, park and ride facilities)
17. No integration of BRT plan with land-use planning or provisions for transit-oriented development (TOD)
18. Under sizing vehicles and/or infrastructure for the given demand
19. Too few doorways in vehicles/station to facilitate rapid boarding and alighting
20. No communications plan, marketing campaign, or system branding to explain or promote the new system

Source: BRT Planning guide, ITDP, 2007
### BRT vs. Other Systems

<table>
<thead>
<tr>
<th>Technology</th>
<th>Demand requirements</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| Metro rail / elevated | High to very high passenger demand (30,000 to 80,000     | Superior image for city  
| rail systems          | pphpd)                                                   | High commercial speeds (28–35 kph)  
|                       |                                                          | Attracts discretionary public transport riders  
|                       |                                                          | Uses relatively little public space  
|                       |                                                          | Low local air emissions                                                                               |
| Light rail transit    | Moderate passenger demand (5,000 to 12,000 pphpd)       | Provides good image for city  
| (LRT)                 |                                                          | Attracts discretionary public transport riders  
|                       |                                                          | Quiet ride performance  
|                       |                                                          | Can be fitted to narrow streets  
|                       |                                                          | Low local air emissions                                                                               |
| Bus rapid transit     | Low to high passenger demand (3,000 to 45,000 pphpd)    | Relatively low infrastructure costs (US$0.5 million to US$14 million)  
| (BRT)                 |                                                          | Often does not require operational subsidies  
|                       |                                                          | Good average commercial speeds (20–30 kph)  
|                       |                                                          | Ease of integration with feeder services  
|                       |                                                          | Moderately good image for city                                                                                 |
| Conventional bus      | Low passenger demand (500 to 5,000 pphpd)               | Low infrastructure costs  
| services              |                                                          | Relatively low operating costs  
|                       |                                                          | Appropriate for small cities with low demand                                                                             |
|                       |                                                          | Can carry with it the negative stigma of bus technology  
|                       |                                                          | Relatively unknown to many decision makers                                                                                |
|                       |                                                          | Poor service image  
|                       |                                                          | Often lacking in basic customer amenities and comfort  
|                       |                                                          | Regularly loses mode share to private vehicles                                                                        |

Source: BRT Planning guide, ITDP, 2007
CONCLUSION (I)

MAIN ADVANTAGES / DISADVANTAGES OF BRT SYSTEMS

(+)

☑ Lower construction and operating costs (vs. rail)

☑ Lower development time (vs. rail)

☑ Higher capacity (vs. conventional bus services)

☑ Network flexibility (vs. rail)
Conclusion (II)

Main advantages / disadvantages of BRT systems

(-)

- High occupancy of surface space and barrier effect inside cities (vs. metro)
- Low attractivity for discretionary riders (vs. rail)
- Lower capacity to induce increases in land value (vs. rail)
- Not feasible for all urban environments (e.g. historical areas)
GUANGZHOU (CHINA) BRT – A SUCCESSFUL BRT

(Video BRT Guangzhou – Winner of ITDP’s 2011 Sustainable Transport Award)
http://www.streetfilms.org/guangzhou-china-brt/
Other information sources on BRT

- BRT – Across Latitudes and Cultures
  http://www.brt.cl/
- China BRT
  http://www.chinabrt.org/
- National BRT Institute (US)
  http://www.nbrii.org/
- Global BRT Data
  http://www.brtdata.org/
- Institute for Transportation and Development Policy (ITDP)
  http://www.itdp.org
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END

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