Sessão 6: Bus Rapid Transit (BRT)

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What is a BRT?

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 service 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)

正式启动和机构体系结构

- 进入系统受到指定运营商的限制，即在改革后的企业和行政体系结构下（即，“封闭系统”）。
- 竞争性投标和完全透明的程序用于授予所有合同和特许权。
- 高效的管理导致对系统运营的公共部门补贴的消除或最小化。
- 独立运营和管理的票价收集系统。
- 质量控制监督由独立实体/机构提供。
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
Main characteristics of full BRT systems (X)

- 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)

Marketing and customer service

- 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
### RANGE OF TYPES OF BRT SYSTEMS

<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>- Non-regulated operators</td>
<td>- Segregated busway / single corridor services</td>
<td>- Segregated busway</td>
<td>- Segregated busway</td>
<td>- Segregated busway</td>
<td>- Segregated busway</td>
</tr>
<tr>
<td>- Taxi-like services</td>
<td>- On-board fare collection</td>
<td>- Typically pre-board fare payment / verification</td>
<td>- Higher quality stations</td>
<td>- Higher quality stations</td>
<td>- Higher quality stations</td>
</tr>
<tr>
<td>- Poor customer service</td>
<td>- Basic bus shelters</td>
<td>- Clean vehicle technology</td>
<td>- Clean vehicle technology</td>
<td>- Clean vehicle technology</td>
<td>- Clean vehicle technology</td>
</tr>
<tr>
<td>- Relatively unsafe / insecure</td>
<td>- Standard bus vehicles</td>
<td>- Marketing identity</td>
<td>- Marketing identity</td>
<td>- Marketing identity</td>
<td>- Marketing identity</td>
</tr>
<tr>
<td>- Very old, smaller vehicles</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

- Publicly or privately operated
- Often subsidised
- On-board fare collection
- Stops with posts or basic shelters
- Poor customer service
- Standard bus vehicles

- Some form of bus priority but not full segregated busways
- Improved travel times
- Higher quality shelters
- Clean vehicle technology
- Marketing identity

- Metro-quality service
- Integrated network of routes and corridors
- Closed, high-quality stations
- Pre-board fare collection / verification
- Frequent and rapid service
- Modern, clean vehicles
- Marketing identity
- Superior customer service

Source: BRT Planning guide, ITDP, 2007
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 is converted into the first bus-only street

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

http://www.streetfilms.org/curitibas-brt/
http://www.youtube.com/watch?v=z-MtqyWOj7g
Brief history (II)

- 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 and several other cities in the UK)

- 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)

Source: Google image search
- 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 cicleways 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 nation cities Europe, North America
(Video BRT TransMilenio)

http://www.streetfilms.org/bus-rapid-transit-bogota/
Evolution of cities with BRT systems

Cities with BRT/Bus Corridors

- Guangzhou, Hefei, Yancheng, Zaozhuang - China
- Jaipur - India; Pelembang, 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

BRT CAPACITY COMPARISON WITH OTHER MODES

Source: BRT Planning guide, ITDP, 2007
# 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
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
Before BRT

Source: Google image search

After BRT

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

- Contracting (open vs. closed system)

- Land use oriented measures

Source: BRT Planning guide, ITDP, 2007
# 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 rail systems | High to very high passenger demand (30,000 to 80,000 pphpd) | • Superior image for city  
• High commercial speeds (28–35 kph)  
• Attracts discretionary public transport riders  
• Uses relatively little public space  
• Low local air emissions | • Very high infrastructure costs (US$45 million to US$350 million per km)  
• May require operational subsidies  
• Poor revenue recovery during non-peak periods  
• Long development and construction times  
• Complex integration with feeder services |
| Light rail transit (LRT)    | Moderate passenger demand (5,000 to 12,000 pphpd) | • Provides good image for city  
• Attracts discretionary public transport riders  
• Quiet ride performance  
• Can be fitted to narrow streets  
• Low local air emissions | • Moderately high infrastructure costs (US$15 million to US$45 million)  
• May require operational subsidies  
• Limitations with respect to passenger capacity |
| Bus rapid transit (BRT)     | Low to high passenger demand (3,000 to 45,000 pphpd) | • Relatively low infrastructure costs (US$0.5 million to US$14 million)  
• Often does not require operational subsidies  
• Good average commercial speeds (20–30 kph)  
• Ease of integration with feeder services  
• Moderately good image for city | • Can carry with it the negative stigma of bus technology  
• Relatively unknown to many decision makers |
| Conventional bus services   | Low passenger demand (500 to 5,000 pphpd)        | • Low infrastructure costs  
• Relatively low operating costs  
• Appropriate for small cities with low demand | • Poor service image  
• Often lacking in basic customer amenities and comfort  
• Regularly loses mode share to private vehicles |

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

MAIN ADVANTAGES / DISADVANTAGES OF BRT SYSTEMS

(+)

☐ Lower construction and operating costs (vs. rail)

☐ Lower development times (vs. rail)

☐ Higher capacity (vs. standard bus services)

☐ Network flexibility (vs. rail)
CONCLUSIONS (II)

MAIN ADVANTAGES / DISADVANTAGES OF BRT SYSTEMS

(-)

- High occupancy of surface space and barrier effect inside cities (vs. metro)

- Low attractiveness for discretionary riders (vs. rail)

- Lower capacity to induce increases in land value (vs. rail)

- Not feasible for all urban environments (e.g. historical neighbourhoods)
GUANGZHOU (CHINA) BRT – A SUCCESSFULL 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 – Accross Latitudes and Cultures
  http://www.brt.cl/
- China BRT
  http://www.chinabrt.org/
- National BRT institute (US)
  http://www.nbrti.org/
- Global BRT Data
  http://www.brtdata.org/
- Institute for Transportation and Development Policy (ITDP)
  http://www.itdp.org
MEC   MUOT   MPOT

DISCIPLINA: GESTÃO DA MOBILIDADE URBANA

Prof.ª Responsável: Rosário Macário

END

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