Best Practices in Planning and Implementing BRT in China

Xianyuan Zhu, ITDP
Regional EGM on Policy Options for Sustainable Transport Development Meeting
27-29 Nov 2013, Incheon, Korea
BRT systems develop in China

- 20 cities implemented BRT;
- 2 BRT systems are under construction
- 5 cities are planning BRT.
The number of new BRT systems opened per year in China

8 BRT systems opened in 6 years

12 BRT systems opened in 3.5 years

Guangzhou BRT opened

5, Planned

Year

the number of cities
BRT systems develop in China

BRT has expanded and evolved in China since the first median bus lanes were introduced in Kunming in 1999.
Kunming was the first city to implement median bus lanes in China in 1999, solving the problem of bus-bicycle conflict at bus stops.
Beijing was in 2005 the first ‘full’ BRT system implemented in China, in the sense that it provided high capacity BRT buses, fare collection at stations rather than on buses, and dedicated bus lanes for most of its length.
4 corridors, but it doesn't connect to be a network.
Beijing BRT

BRT standard score (Gold, Silver, Bronze, non-BRT):

Year system commenced: 2004
corridors 2 & 3 August 2008; corridor 4 2012

Peak throughput (passengers/hr/direction): 2,750
South of Tiantan, N-S, PM peak, 24-Jan-13. Corridors 2-4 1,000-
1,500

City centre peak hour speed: 18-20 km/hr
Surveys Jan 2013

BRT system coverage (2-way roads) (1 fare): 79 km
Operational mode: trunk-only

Number of BRT stations: 78
18/20/21/19 corridors 1/2/3/4

Peak city centre buses/hr/direction: 40
South of Tiantan, N-S, PM peak, 24-Jan-13

Qualitative parameters

Segregated busways or bus-only roadways

Network of routes and corridors 3 lines, but no
interconnections

Enhanced station environment (more than just a bus shelter)

High peak period operational speed (>20km/hr) Not in corridors
2 and 3

Buses operating both inside and outside the busway corridor
Only 1 route in 4 corridors

Majority of bus passengers in corridors carried by BRT buses

Net time saving for bus passengers in corridor Unlikely in
corridor 1; not in corridors 2 or 3

Overtaking lanes at more than half of all stations

Actual peak ridership >10,000 passengers per hr per direction

Actual peak ridership >20,000 passengers per hr per direction

Carries more people than a mixed traffic lane (>3000 pphpd)

Pre-board fare collection and fare verification

Distinctive BRT buses Difficult to distinguish from many non-
BRT articulated buses

Distinctive marketing identity for system Beijing BRT

Quantitative parameters

Location of busway lanes: Centre of roadway Left of service lane in corridors
2, 3, 4

Stations with functioning passing lanes: 0

Longest BRT station: 75m
Shortest BRT station: 40m

Most station substop: 1

Fleet of special BRT buses: 187 corridors 1 & 4 only, 87 corridor 1; 100
(corridor 4

Fleet of integrated BRT feeder buses: 0

Average bus occupancy (peak hour & direction & point): 70

Total length of dedicated busway: 59 km 14/9.5/11/24.5km corridor 1/2/3/4

Length including mixed traffic portions: 79 km 16km/15km/23km/25km corridor
1/2/3/4

Average distance between stations: 940m 940m/790m/1000m corridor 1/2/3

Number of corridors: 4

Routes operating both inside & outside BRT roads: 1 B4A

Routes operating only in busway corridors: 5 2/1/1/1 in corridors 1/2/3/4

Fare type (flat, zonal, distance-based, other): flat fare

Station platform height: 35cm

Location of bus doorways: Right side left side in corridor 1

Number of BRT terminals: 4

Number of BRT depots: 2

Median cash fare (yuan): 1

Median smart card fare (yuan): 0.4 0.2 for smartphone

See www.chinaBRT.org for latest
One parking space, low capacity of station.
Pedestrian access tunnel to BRT station (with flash)
Pedestrian access tunnel to BRT station (without flash)
A typical open-air corridor 1 station, without slide door, non-protect.
Crush loading during peak periods
Better stations in outer part of corridor 2; overtaking mixed traffic; right-side doors
In all corridors the large majority of bus demand is outside the BRT, making an overall time saving benefit for bus passengers unlikely. Corr. 2&3 demand ~2,000 pphpd in BRT
Hangzhou’s BRT, which opened in 2006, features impressive BRT stations and buses, but has devolved from a BRT lane alongside a segregated bike lane (Line 1, 2006) to a predominantly kerbside bus lane (Line 2, 2009) to a series of stations without any bus priority lanes at all (Line 3, 2010).
Hangzhou’s BRT features impressive station architecture and BRT buses
Severe bus and mixed traffic congestion
BRT systems develop in China

- Beijing
- Hangzhou
- Chongqing
- Kunming
Non-BRT!
The corridor is only a 21 minute trip, but the Chongqing BRT bus has been designed like an intercity coach, with 39 large padded seats and little standing room.
Low demand, low frequency.
As well as the step to enter the bus, passengers have one additional step in bus doorway.
Produce from an adjacent field adorns a damaged BRT station sign on a pedestrian bridge
Symbol of the BRT systems in China to date?

- Low demand BRT lane,
- worse conditions for mixed traffic,
- and worse conditions for the large majority of bus users in the corridor.

All three systems had many positive features, but ultimately neither Kunming, Beijing nor Hangzhou presented a compelling case for replication in other cities.

Up to 2008, some BRT systems were still being planned and designed as closed systems, including Changzhou and Xiamen.
Direct-service systems greatly reduce the need for passenger transfers, and do not require transfer terminals and interchanges.
BRT systems develop in China

7 BRT systems developed in 2007-2009.
Changzhou’s two BRT lines, which opened in January 2008 and May 2009.

Changzhou’s BRT system features impressive stations and buses serving a network of routes and corridors.
Most stations are offset across intersections.
Stations located at the intersection already sometimes result in queues blocking the intersection and the pedestrian crossing, even with current relatively low bus volumes.
Even with current low demand, some stations are already experiencing overcrowding.
Changzhou's BRT stations are too narrow
Narrow stations mean that just a few people reading the information board is enough to block passage.
Refuge islands insufficiently wide to accommodate bicycles
None of the BRT systems so far have incorporated bike parking into any of the BRT designs, despite very high bicycle volumes in Beijing, Changzhou.
Xiamen, which in Sep 2008 opened a elevated busway consisting of three main corridors and 31 stations, including a 5.5km bridge and tunnel section with dedicated BRT lanes, is the first genuine ‘trunk and feeder’ BRT system.
Xiamen’s elevated busway is delivering strong results; with 7,400 pphpd it has the second-highest passenger flows of any BRT system in China.
Most demand below the elevated busway; shortage of access ramps
Severe overcrowding, even during off peak, has led to consideration of using 18m buses
Queuing at the Railway Station BRT station
Lots of stairs
BRT systems develop in China

Cities with BRT systems:
- Beijing
- Dalian
- Jinan
- Lanzhou
- Lianyungang
- Lanzhou
- Liyang
- Changzhou
- Xiamen
- Hangzhou
- Shaoxing
- Yancheng
- Changde
- Shangdong
- Yichun
- Yichun
- Chongqing
- Zaozhuang
- Kunming
- Hefei
- Shenzhen
- Urumqi
<table>
<thead>
<tr>
<th>City</th>
<th>Peak Throughput (passengers/hr/direction)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bogota</td>
<td>34,000 South of Calle 76 stn, 22-Jun-11 AM peak to south, 30,500, but North of station has more demand (Jun-11)</td>
</tr>
<tr>
<td>Guangzhou</td>
<td>29,900 30 May 2012, east of Shidajida station, AM peak east-west (Jun-12)</td>
</tr>
<tr>
<td>Istanbul</td>
<td>21,400 West of Mecidiyekoy station, W-E, AM peak, 2011.12.2 (Dec-11)</td>
</tr>
<tr>
<td>Lima</td>
<td>13,950 South of Uni station, N-S, AM peak, 2011.6.24. PM peak 9,700 Uni Stn S-N (Jul-11)</td>
</tr>
<tr>
<td>Mexico City</td>
<td>9,000 Approximate (Jun-11)</td>
</tr>
<tr>
<td>Seoul</td>
<td>8,400 2011.1.19, south of Hunsung Univ. Samseongyo station, north-south, AM peak (Jan-11)</td>
</tr>
<tr>
<td>Xiamen</td>
<td>8,360 West of Wolong Xiaocheng, east-west, AM peak, 10-May-12 (May-12)</td>
</tr>
<tr>
<td>Changzhou</td>
<td>7,400 Huaide Qiao, AM peak south to north, 2011.01.5 (Jan-11)</td>
</tr>
<tr>
<td>Urumqi</td>
<td>7,100 North-south, AM peak, 5-6 Jan 2012 north of Hongshan Stn (Jan-12)</td>
</tr>
<tr>
<td>Brisbane</td>
<td>6,500 Cultural Centre southward, 21-Oct-08, PM peak (Mar-12)</td>
</tr>
<tr>
<td>Hangzhou</td>
<td>6,300 10-Aug-11 AM peak Wulin Guangchang Bei, east to west (Aug-11)</td>
</tr>
<tr>
<td>Quito</td>
<td>6,000 In corridor 3. Corridors 1 and 2: 3,500 (October 2008) (Oct-08)</td>
</tr>
<tr>
<td>Delian</td>
<td>5,800 9-Sep-09, south of Cunliu station, into city, AM peak (Sep-09)</td>
</tr>
<tr>
<td>Zhengzhou</td>
<td>5,600 East of Jingwu Lu station, AM peak, 2011.1.5, west to east (Jan-11)</td>
</tr>
<tr>
<td>Beijing</td>
<td>3,800 South of Tiantan, N-S, PM peak, 10-Nov-10. Corridors 2&amp;3 ~2,000, Sept. 2008 (Nov-10)</td>
</tr>
<tr>
<td>Kunming</td>
<td>3,500 Jinmafang station, Jinbi Road, PM peak, W-E, 29-Mar-2011 (Apr-11)</td>
</tr>
<tr>
<td>Jakarta</td>
<td>3,400 15 May 2012, south of Tosari station (line 1), N-S (Mar-12)</td>
</tr>
<tr>
<td>Jinan</td>
<td>3,300 East of Lishan Lu station, 2011.3.25, east-west, PM peak (Apr-11)</td>
</tr>
<tr>
<td>Hefei</td>
<td>2,700 5-Aug-11 PM peak, west-east, east of Feifengjie (Aug-11)</td>
</tr>
<tr>
<td>Nantes</td>
<td>2,100 Duchesses Anne Chateau, March 2011. Source: TAN. ITDP surveys June 2010: 1,200 (Jul-11)</td>
</tr>
<tr>
<td>Yancheng</td>
<td>1,300 South of Daqing Lu station, PM peak, south-north, 4-Aug-2011 (Aug-11)</td>
</tr>
<tr>
<td>Bangkok</td>
<td>1,200 18-Oct-11, PM peak, north-south, south of Arkan Songkroh (Oct-11)</td>
</tr>
<tr>
<td>Amsterdam</td>
<td>960 East of Hoofddorp Station, east-west, PM peak, 2011.6.27 (Jul-11)</td>
</tr>
<tr>
<td>Nagoya</td>
<td>750 Approximate (Nov-10)</td>
</tr>
<tr>
<td>Zaozhuang</td>
<td>700 Railway station, west-east, PM peak, 8-Oct-2010 (Oct-10)</td>
</tr>
<tr>
<td>Chongqing</td>
<td>600 11-Mar-11, Lianfangyuan station (Mar-11)</td>
</tr>
</tbody>
</table>
Steps in the Guangzhou BRT planning process

- 2003-2004 preliminary BRT planning
- ITDP MOU with Construction Commission of Guangzhou, Apr. 2005
- GMTDC / GMEDRI work with ITDP since that time

2005:
- Conceptual plan, demand analysis & corridor comparison

2006:
- Phase II planning; further traffic, operational and design planning & demand analysis for phase I

2007-2008:
- Implementation planning & design. Final station & operational design, BRT authority, architecture, engineering design, metro integration, NMT integration

2009:
- BRT construction, regulatory set-up, refinement of operational plan, promotion & outreach, vehicle procurement

2010:
- Feb. BRT operation
Guangzhou’s city government was considering 3 options for BRT when the planning started in 2005. The main options were the low-demand, low-risk Fangcun Avenue, or the high demand Zhongshan Avenue.
In Guangzhou’s ‘direct-service’ BRT system, BRT buses can run outside the corridor. The graphic above shows the 31 BRT routes, with the main concentration along the 23km BRT corridor, but a total of 273km of roads covered
Before BRT, in the BRT corridor. Bus stop congestion – bad for all modes
A typical scene at Gangding bus stop before the BRT implementation.
Gangding BRT station, after the BRT implementation
Selected BRT Station layouts

1-module configurations
(offset, at grade)

1-module configurations
(offset, footbridge)

2-module configurations
(facing, at grade crossing)
Shangshe BRT station in the morning peak. Highest demand stations include escalators.
New high density development lines the BRT corridor. Shipaiqiao station includes a metro connection and a connection into the adjoining shopping mall.
Chebei intersection – change from 4-phase (before BRT) to 2-phase (with BRT)
Tianfu Lu intersection before and after BRT
Bike sharing: 5,000 bikes at 113 stations. Contact: shanshan@itdp-china.org
The first BRT system in China with more than one BRT operator
Lanzhou

Western China. Capital of Gansu Province
Population around 4 million
ADB loan funded BRT project
Opened in Dec 2012.
Stations from Peili Guangchang to the east are ‘split’ and allow use by buses with doors in only the right side of the bus (current buses). Stations west of Peili Guangchang have a single central platform (‘island’) which requires buses to have doors in the left side (new BRT buses). For initial BRT operation Lanzhou has only 50 new 12m BRT buses and more 20 18m buses were put into the operation after BRT opened one month.
Bus Volumes
The east of Xingfuxiang station: 6193 passengers per hour per direction in March, E-W, PM
Underground shopping mall along BRT corridor
New Developers along BRT Corridor
Shijidadao station
Lessons learned (1)

Guangzhou BRT: metro-level capacity delivered by buses. This provides new options for rapidly growing Asian cities.

Many critical aspects to BRT project success:
- corridor selection
- data collection & analysis
- operational design
- institutions & regulation
- communications and outreach
- control centre & ITS
- stations (placement relative to intersections, configuration, length, width, spacing, and architecture)
- fare collection
- vehicles, traffic engineering & management
- intersection design & signal phases
- modal integration (metro, bicycle, pedestrians)
- ancillary measures such as parking & urban design.
Lessons learned (2)

- The first BRT corridor should serve high demand, congested locations, including the city centre.
- The infrastructure has to be correctly planned and designed together with an operational plan that in turn meets passenger demand.
- BRT stations should be designed to meet passenger demand levels.
- There are many advantages to having multiple BRT operators.
- Intermodal integration is often neglected during BRT planning, to the detriment of the BRT systems involved.
- A successful BRT corridor should be a beautiful urban corridor with high quality public spaces especially around station areas.
- Supervision during implementation.
- Consultants.
Thank You

More information:
www.itdp-china.org
www.chinabrt.org
www.transportphoto.net
www.publicbike.net

www.sitevisits.net