Initiating Bus Rapid Transit in Jakarta, Indonesia

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On February 1, 2004, a 12.9-km (8-mi) bus rapid transit (BRT) line began revenue operation in Jakarta, Indonesia. The BRT line has incorporated most of the characteristics of BRT systems. The line was implemented in only 9 months at a cost of less than US$1 million/km ($1.6 million/mi). Two additional lines are scheduled to begin operation in 2005 and triple the size of the BRT. While design shortcomings for the road surface and terminals have impaired performance of the system, public reaction has been positive. Travel time over the whole corridor has been reduced by 59 min at peak hour. Average ridership is about 49,000/day at a flat fare of 30 cents. Furthermore, 20% of BRT riders have switched from private motorized modes, and private bus operators have been supportive of expanding Jakarta's BRT. Immediate improvements are needed in the areas of fiscal handling of revenues and reconfiguring of other bus routes. The TransJakarta BRT is reducing transport emissions for Jakarta and providing an alternative to congested streets. The BRT provides a tangible vision for an effective, viable, and sustainable public transportation system in Jakarta and elsewhere.

From 2002 to 2004, the Institute for Transportation and Development Policy (ITDP) provided technical assistance to the city of Jakarta, Indonesia, during its implementation of a bus rapid transit (BRT) system. This assistance included support to civil society (particularly nongovernment organizations and the media), private bus operators, and the government, primarily in the form of visits to the BRT systems in Bogota, Colombia, and Quito, Ecuador, and limited visits to Jakarta by key consultants who developed the Bogota system.

The assistance followed a 2001 review of BRT systems worldwide conducted for ITDP by Lloyd Wright. This paper provides an overview of the process of initiating the Jakarta BRT, key characteristics of the system, and some lessons learned.

BRT IN DEVELOPING COUNTRIES

BRT systems have gained prominence in recent years as a cost-effective method for providing urban mass transit. A review by Levinson et al. (*1*) attributes the earliest BRT concepts to several examples in the United States. However, the model for current BRT development in developing cities has emerged from Latin America. While many BRT systems are being built and operated in the more developed nations, the cities involved there frequently lack three critical characteristics more common to cities in developing countries:

1. High population densities,
2. Significant existing modal share of bus public transportation, and
3. Financial constraints providing a strong political impetus to reduce, eliminate, or prevent continuous subsidies for public transit operation.

These three characteristics combine to favor the development of financially self-sustaining BRT systems that can operate without government subsidy after initial government expenditures to reallocate road space and to provide infrastructure for a BRT system.

In Brazil, Curitiba's 1974 BRT implementation was cited for years as a model for a public transportation system that encouraged more sustainable development (*2*). However, the concept did not generate substantial interest until the emergence of BRT systems in other Latin American cities during the last several years. The BRT system that opened in 2000 in Bogota, Colombia, now stands as an example of the state of the art in BRT systems (*3*).

The arousal of worldwide interest in Bogota's BRT system, including in Jakarta, can be largely attributed to the efforts of Bogota's former mayor Enrique Penalosa, both through personal meetings with local politicians and in numerous articles and presentations (*4, 5*). Wright's (*6*) handbook on BRT systems identified "political will" as the most significant factor in the successful implementation of BRT systems. Penalosa provides a clear example of the political will and vision necessary to overcome political and institutional forces that inhibit the radical change needed to implement the Bogota system (*5*).

Of the BRT systems reviewed by Levinson et al. (*1*) in Europe, North America, and Latin America (they did not review any of the three systems then existing in Asia), three Latin American systems—in Curitiba, Quito, and Bogota—were the only ones that contained all of the key BRT characteristics they identified. Table 1 shows the primary characteristics of BRT systems identified by Levinson et al. (*1*), those identified by Wright (*6*), and the characteristics of Jakarta's new BRT system.

BACKGROUND ON JAKARTA

Jakarta, capital city of Indonesia, is a rapidly growing Asian mega-city. The United Nations (UN) lists Jakarta as the 16th largest urban agglomeration in the world, with not quite 10 million people. The UN projects Jakarta to be the fifth largest by 2015, with 21 million people (*7*). The greater Jakarta area, however, including those nearby cities that produce daily trips into Jakarta—Bogor, Depok, Tangerang,

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Transportation Research Record: Journal of the Transportation Research Board, No. 1903, Transportation Research Board of the National Academies, Washington, D.C., 2005, pp. 20–26.

TABLE 1 Characteristics of BRT Systems and Aspects Included in Jakarta's BRT

Characteristics		
Levinson et al. (*1*)	Wright (*6*)	Jakarta BRT
Dedicated running ways	Segregated busways	Yes
Distinctive easy to board vehicles	Rapid boarding and alighting; marketing identity	Yes
Attractive stations and bus stops	Clean, secure and comfortable stations and terminals	Yes
Off-vehicle fare collection	Efficient pre-board fare collection	Yes
Use of ITS technologies	Signage and real-time information displays; prioritization at intersections	Yes[a]
Frequent, all-day service	Excellence in customer service	Yes
	Effective licensing and regulatory regimes	No
	Modal integration at stations and terminals	No[b]
	Clean bus technologies	No

[a] On-board variable message sign for next station
[b] Some informal connecting services, such as bicycle taxis, have emerged at BRT stations; bus feeder services have been contracted but are as yet ineffective.

and Bekasi—was estimated at more than 21 million in 2000 (*8*). Traffic congestion and pollution from motorized vehicles have been significant problems for the last 20 years (*9*).

Chronic congestion on Jakarta's streets costs up to US$600 million annually. A do-nothing scenario for the year 2020 would result in this number increasing twelvefold. From 1985 to 2000, despite a significant reduction in car ownership after the 1987 economic crisis, travel time measured on four principal routes increased an average of 50% (*10*).

Furthermore, air pollution has far surpassed critical levels. For example, measurements in the 1980s reported total suspended particulate (TSP) measurements exceeding 600 mcg per m^3 (*9*); 35% to 40% of TSPs are estimated to come from the transportation sector (*11*).

Local public transit is overwhelmingly dependent on road-based modes of buses and paratransit. The modal split for three general income groups is shown in Figure 1.

Bus and paratransit services are offered primarily by the private sector, either companies or consortiums of individual owners that rent buses on a daily cash basis to individual operators. One public bus company operated 380 buses with government drivers in 2004. The route-licensing procedure is nontransparent. In addition, government and private-sector operatives collect both authorized and unauthorized fees from individual operators (H. Sager, unpublished data, 2000).

BRT CONCEPT DEVELOPMENT IN JAKARTA

Faced with an increasing share of private motor vehicle travel, Jakarta has made several attempts to improve mass transit. The corridor containing Sudirman and Thamrin Streets, the primary business center in Jakarta, has received particular attention. A metro rail line along the corridor has been in various planning stages for decades, and it is still included in current plans. A monorail system intersecting with the corridor is now under development. In the 1980s, a curbside bus-only lane was implemented on part of this corridor. However, enforcement was both difficult and lacking. While the signs for this lane still remain, it never produced significant results. The lane was not physically segregated, and there was no provision for rapid boarding or most of the other features associated with BRT systems.

In November 2001, Bogota's former mayor Penalosa visited Jakarta to present the Bogota TransMilenio BRT system. Then Vice Governor Budihardjo Sukmadi presided over the meeting and later relayed the information to Jakarta's Governor Sutiyoso. During

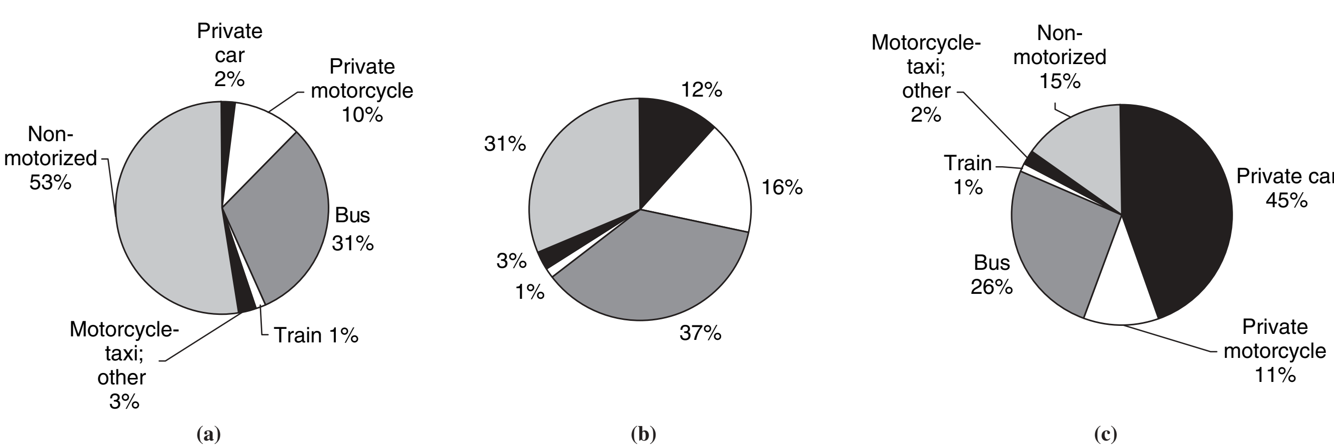

FIGURE 1 Modal split for each of three general income groups in Jakarta urban region: (*a*) low income, (*b*) middle income, and (*c*) high income (*10*).

2002, the governor decided to put a center-lane BRT system in the Sudirman–Thamrin corridor.

In 2003, two delegations from Jakarta visited Bogota and also Quito, to learn further about these BRT systems. In May 2003, after visiting Bogota, the governor formed a task force to implement the BRT system. This team officially consisted of five Jakarta agencies—Transportation, Public Works, Parks, Utilities, and Planning—plus the three affected local municipalities within Jakarta. (Jakarta is a special district incorporating several municipalities, each with a mayor. The district has roughly the status of a province and is headed by a governor.)

TRANSJAKARTA BRT FIRST CORRIDOR IMPLEMENTATION

Although discussion and preliminary planning occurred during 2002, the first Jakarta corridor was essentially planned and implemented during the 9-month period from May 2003 until January 2004. A 12.9-km (8-mi) initial closed-system BRT corridor began operation on January 15, 2004, on a trial basis, beginning revenue operation on February 1. Figure 2 shows a simplified map of the BRT line and other major transportation facilities.

This system, called the TransJakarta busway, includes the key elements of a BRT system, as shown previously in Table 1. A designated bus lane adjacent to the center island is physically separated from mixed traffic. Special TransJakarta stations collect the fare in advance and provide an elevated platform for rapid boarding and alighting. Figure 3 shows a TransJakarta bus at a station. In most cases, the stations are connected to the sidewalk by a pedestrian bridge and ramps suitable for wheelchairs. Buses are specially designed and identified—12-m (40-ft) buses with a single 1.8-m (5.9-ft) wide platform-level door on each side. A variable message sign at the front of the bus and audio, manually operated by the driver, announce the next stop in Indonesian and English. Service headway is 2 to 3 min at peak period and 3 to 4 min at off-peak period, with service hours from 5:00 a.m. until 10:00 p.m.

The system has an initial capacity of 3,250 passengers each direction per h, with 56 initial buses in operation. Increasing the number of buses, as done in 2004, will increase the system's capacity to a maximum 5,400 passengers each direction per h under the current design (P. Szasz, unpublished data, March 2004).

The Jakarta governor created a public managing company charged with running and planning the BRT system. This company, TransJakarta BP, contracts services as follows:

- Bus operation contracted to an operators' consortium made up of private and government operators,
- Ticketing operations to a private company,
- Revenue handling to a bank acting as trustee, and
- Feeder service operation to eight private bus operators.

Revenue and Expenses

The initial corridor cost an estimated US$1million/km ($1.6 million/mi) to implement—near or at the lowest cost of BRT systems

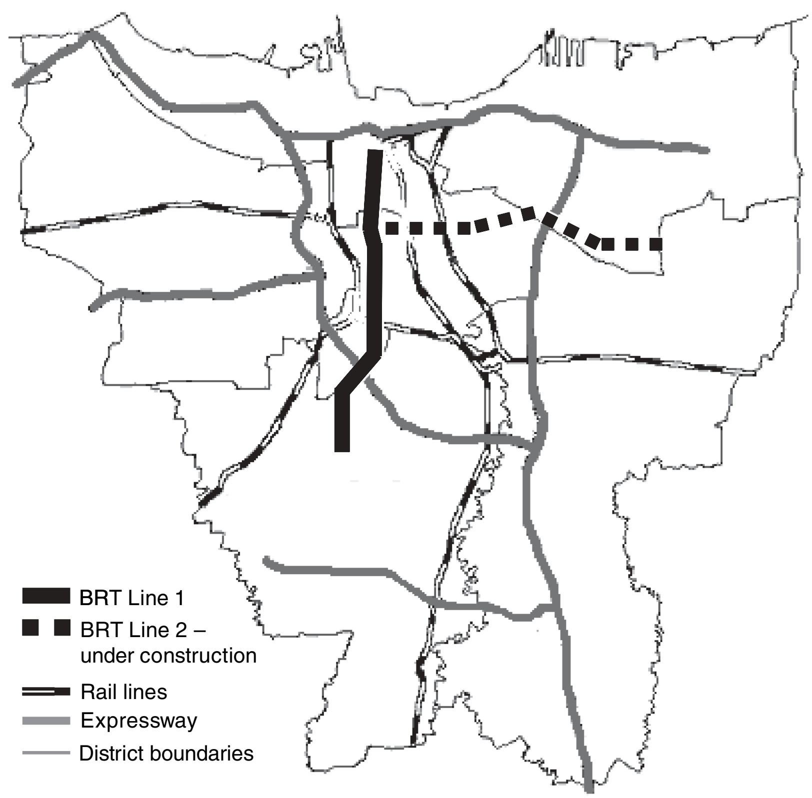

FIGURE 2 Map of Jakarta BRT line and other major transportation facilities (adapted from Jakarta Public Transit Users Association brochure, Pelangi, 2004).

FIGURE 3 TransJakarta bus at station during prerun trials in January 2004.

worldwide (*1, 6*). Direct cost comparisons are misleading, however, for this $12.9 million total cost includes approximately $5.5 million for acquisition of buses. As private investment in buses would have been possible in Jakarta, the actual cost is closer to $500,000 per km ($800,000/mi).

A cost comparison of the Jakarta BRT with other systems is complicated by the rapid implementation of the Jakarta BRT that resulted in the underbuilding of some infrastructure components—primarily the road surface of the busway lane itself and the terminals. This has resulted in subsequent high maintenance costs and some additional construction not included in the initial investment.

Government procurements for the buses, stations, turnstiles, and fare cards were generally obtained by direct appointment without competitive tender. While competitive procedures are required under law, the government used an exclusion for emergency procurements. Some aspects of the procurement are now under investigation.

The system uses a contactless fare card system. Cards are read only on entry to stations. Problems with the cards and readers have made their use unreliable, with bypass gates being used when a problem occurs. The current fare structure is a flat fare of 2,500 rupiahs (rp) (30 cents). A discounted flat fare of 1,500 rp (17 cents) is offered for trips from 5 to 6 a.m. The following table shows the Jakarta fares in comparison to fares of the major Latin American BRT systems (W. Hook, unpublished data, 2004).

City	*Fare (U.S. Currency)*
Curitiba	.55
Bogota	.40
Jakarta	.30
Quito	.25

While initial estimates predicted that the first corridor would not generate sufficient revenue to cover all operating costs with just the 12.9-km (8-mi) initial corridor, expansion of the system is predicted to allow capturing sufficient demand to cover operating costs. Doing so will require a change in some aspects of the implementation and operation of the present BRT (P. Custodio and P. Szasz, personal communication, July 27, 2004). A public transport demand model allowing more accurate prediction is currently in development.

The reliability of revenue and ridership figures from first corridor operation is questionable because of a current lack of control on ticket sales. Revenues are currently deposited to the government's general fund. Allocations for operating TransJakarta are currently provided through authorization of Jakarta's Parliament. Civil society has applied public pressure to fix the ticketing system and properly monitor revenues (*12*)

Based on rough estimates of demand (P. Szasz and P. Custodio, unpublished data, Nov. 2003), the first corridor was projected to capture an average of 2,500 passengers per h as maximum cross-demand per direction—or a total daily demand of 42,500. After 6 months of operation, passenger demand averaged 49,000 per day.

The current level of use generates approximate daily revenue of $13,000. Bus operation is contracted to a private consortium. The consortium is being paid 6,100 rp/bus-km ($1.10/mi). Initial operation during the first few months did not reduce the number of off-peak buses operating, resulting in some operating inefficiencies. Estimated daily operating costs, for the buses only, were approximately $8,900. By summer 2004, off-peak bus operations were reduced. These estimates do not include costs of ticketing and security personnel.

Relation to Existing Bus Services

With implementation of the first corridor, seven bus lines that operated along the full length of the corridor were identified for removal. More than 90 other bus lines operate on parts of the corridor. No existing bus routes have been rerouted to date.

Peak-period overcrowding on buses in Jakarta can be severe. Anecdotal evidence suggests this crowding has been reduced to more tolerable levels—100 or fewer passengers per bus—for buses operating along the corridor (P. Szasz, personal communication, July 27, 2004).

TransJakarta has contracted eight private bus operators whose existing bus routes cross the corridor, in an effort to establish feeder services for the BRT. A paper ticket offering integrated feeder and BRT service is sold. This effort has largely failed because of difficulties in getting the bus drivers, who must pay daily cash rental for the buses, to accept the printed tickets. The operators contracted by TransJakarta are the owners of the bus but do not operate the buses themselves, and as yet the paper tickets have not become acceptable as partial payment for the bus daily rental. This could be because of fears of counterfeiting.

Impacts on General Traffic

Congestion has increased for mixed traffic on the corridor. However, measurements are complicated by the implementation of demand management measures (described later). The limited extent of the BRT and lack of restructuring existing bus routes has meant that 95% of previous bus routes still operate on the corridor. This situation reduces the compensatory effect on congestion of having fewer buses operating in general traffic outside of the BRT lane.

In February and April 2004, P. Szasz analyzed traffic flow along the corridor and recommended several improvements to relieve bottlenecks. The bottlenecks are unrelated to the development of the BRT, concerned primarily with preexisting intersection and lane-merging designs (ITDP letter to Governor Sutiyoso with P. Szasz report, unpublished data, April 23, 2004).

Shortcomings of the BRT

Current shortcomings in the TransJakarta BRT system are as follows:

- Inadequate improvement of road surface for BRT lanes, particularly at stations, which has resulted in premature wear of the road surface. The surface is disrupted enough at some stops to interfere with the acceleration of a bus from the stop, resulting in increased wear, particularly on the clutch. In late 2004, the bus lane surfacing in front of the stops was being replaced with concrete.
- Terminal station capacities are far below current passenger demand levels, resulting in an informal system where passengers alight before the terminal station by using the emergency doors and exiting into the street. One terminal had additional platforms for alighting under construction in late 2004.
- Stations were designed to fit currently available median width with little reconfiguration of the road. This situation has resulted in some narrow stations and stations being located far from key transfer points, such as at Dukuh Atas commuter rail station.
- The design of one of the terminal stations requires doors on the opposite side of the bus from that used at all other stations. This requires all buses to be built with a platform-level door on both sides.
- Current bus design has only one platform-level door on the platform side, leading to uneven passenger distribution.
- Headway is not controlled in-route, leading to bunching of buses and occasional headways as long as 8 min (P. Szasz, personal communication, July 25, 2004).
- The current administrative structure of TransJakarta public company prevents the company from directly managing the BRT revenues and thus inhibits its ability both to provide fiscal controls and to have resources available for planning the system's expansion.

Public Acceptance of First Corridor

During implementation of the first corridor, a heavy public outcry ensued in December 2003 when the first lane separators were installed and thus road capacity for mixed traffic was decreased by 20% to 25%. To combat the resulting surge in congestion, the governor extended the hours for the existing high-occupancy vehicle scheme, called three-in-one.

The three-in-one scheme in Jakarta had required three passengers per car during the morning peak period. With implementation of the BRT lanes, the governor extended this to include the afternoon peak period. This move proved unpopular, but it still continues. The morning three-in-one scheme had created a market for hired passengers (available for 12 cents a ride) along the primary routes entering the corridor. Because the corridor primarily contains office buildings, the ability to acquire additional passengers, hired or otherwise, is difficult over such a dispersed set of origins for the afternoon trip.

While the government has received some criticism, the BRT system has enjoyed favorable public opinion. During election campaigns in 2004, the BRT—unlike all other traffic modes—was allowed to operate freely by demonstrators. It became the only way to get quickly through the corridor; during that time, daily ridership measured more than 60,000.

PLANNING THE NEXT CORRIDORS

In 2004, a second and third corridor were planned. Both of these corridors began construction in late 2004 and are scheduled to enter service in 2005.

The second and third corridors run in an east–west direction perpendicular to the first corridor. The second corridor will extend the BRT system 11 km to the east from the first corridor and the third corridor will extend it 13 km to the west. The exact kilometer for the second corridor is only estimated, for the final route has not been determined. A portion of the second corridor was under construction in late 2004, as shown in Figure 2.

Development of the BRT system has occurred with limited estimation of public transportation demand. New public transit origin–destination surveys were being conducted in 2004 by ITDP in conjunction with the University of Indonesia for development of an improved public transit demand model.

ACCOMPLISHMENTS OF JAKARTA BRT

Reduction in Travel Time

The first corridor of the TransJakarta BRT reduces peak-period travel time for bus passengers, compared with bus travel before BRT implementation, by 59 min over the length of the corridor. (P. Szasz, unpublished data, 2004). This is equal to 4.6 min/km (7.3 min/mi).

Mode Shift and Emissions Reductions

According to a survey of 320 BRT passengers undertaken by the Japan International Cooperation Agency (JICA) in the first month of TransJakarta BRT operation, about 20% of BRT passengers previously used private motorized vehicles for the same trip. Figure 4 shows the previous mode used by busway passengers.

The BRT has reduced the emissions of pollutants from the transport sector. BRT systems have the potential to reduce emissions in a variety of ways (*6*). Table 2 shows the reduction in pollutants attributable only to modal shift to the BRT. These calculations are based on the JICA survey, an average of 49,000 total daily trips on the BRT, an assumed 8-km average BRT trip distance, and average passenger loading assumptions shown in the table.

This table does not include emissions reductions from the shift of 66% of BRT passengers from regular buses. Emission reductions for these trips can be expected from (*a*) the improved drive cycle of the BRT buses over buses previously caught in congestion and (*b*) the lower emissions of the new BRT buses compared with those of the old

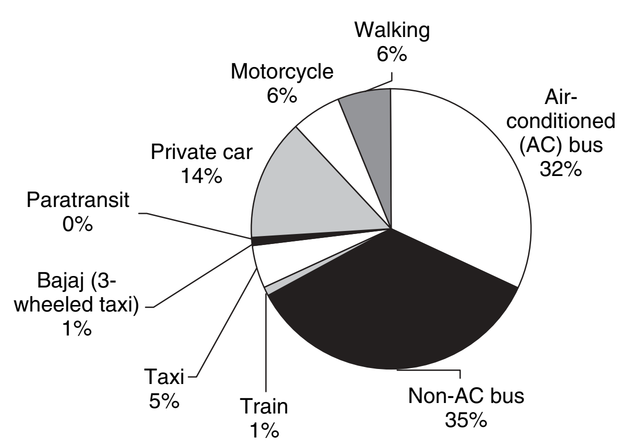

FIGURE 4 Previous mode used by Jakarta BRT passengers.

TABLE 2 Emissions Reductions from Modal Shift to the Jakarta BRT

Mode	Emissions (g/km) (*9*) Nitrogen Oxide	Emissions (g/km) (*9*) Particulate Matter 10	Passengers per Vehicle	Daily Pass-km Shifted to BRT	Emissions per Day (kg) Nitrogen Oxide	Emissions per Day (kg) Particulate Matter 10
Private car	2.7	0.2	1.2	54,900	120	9
Motorcycle	0.07	0.5	1.2	23,500	1.4	10
Taxi	2.7	0.2	0.5	19,600	110	8
3-wheeled taxi	0.07	0.5	0.5	3,900	0.5	4
Totals				101,900	232	31
BRT	13	0.68	65	101,900	20	1.1
Emission reductions attributable to modal shift					212	30

buses operating in Jakarta. Insufficient data exist to quantify this emissions reduction. Further, these reductions will not be optimized until the BRT is expanded sufficiently to allow rerouting of the normal bus routes to complement the BRT system. Jakarta's current public transport demand exceeds supply, so rerouting of existing bus routes should benefit both passengers and bus operators.

Protection of BRT Right-of-Way

The governor of Jakarta has adamantly defended the reserved right-of-way for the TransJakarta BRT. For example, the governor publicly criticized the vice president of Indonesia for using the BRT lane for his motorcade in February 2004. Indonesian civic organizations also protested the vice president's action. Subsequently, the vice president apologized and promised not to repeat the violation (*13*). Although some incursions occur by vehicles at roundabouts, the overall right-of-way has been protected and thus rapid travel times have been assured.

Other Positive Outcomes

There have been additional positive aspects of the TransJakarta BRT. Among them are the following:

- The TransJakarta BRT system was implemented rapidly, is being expanded rapidly, and is providing a tangible example to Jakarta's citizens that public transit travel can be affordable, clean, comfortable, safe, and fast.
- Bus operators have supported the TransJakarta BRT concept, and they have officially expressed their willingness not only to operate the BRT buses but also to pay for the full cost of purchase and operation of future buses.
- The city is making efforts to improve sidewalks to better accommodate pedestrians in the BRT corridor.

CHALLENGES FOR THE FUTURE

In considering the Jakarta BRT from a broad perspective, the following challenges still need to be addressed.

Revenue Control

A revenue control system needs to be established, chiefly to improve the reliability of the fare cards and card readers, as well as to implement auditing control of ticket sales and revenues. At the moment, the BRT is vulnerable, for the amount of operating subsidy (if any) is not known. Strengthening the legal status of TransJakarta is likely to be a prerequisite to meet this challenge.

First Corridor Flow Improvements

While the current configuration can handle current demand, when the second and third corridors open, improvements will be needed to increase the capacity of the first corridor. One essential improvement will be for higher capacity in ticketing, passenger boarding, and alighting at the two terminals. Improvements in station and bus design, plus overtaking lanes at bus stops to allow limited-stop bus services, will be needed to increase capacity (P. Szasz and P. Custodio, personal communication, July 27, 2004).

Pedestrian Aspects

While pedestrian facilities have not been ignored, much more could be done to improve the design of these facilities. Station width has been set by the existing median width, without regard to predicted passenger flows. Neglect of passenger flows is especially evident at the two terminals. Long ramps to allow wheelchairs to access the busway add significant travel time for all passengers, without the option of shorter stairways. At-grade crossings would be suitable in parts of the first corridor where there are already traffic signals every 400 m (440 yards). The current use of overpasses at these sites adds about 3 min of walking to the total trip time (P. Szasz, personal communication, July 27, 2004).

The importance of walking in Indonesian cities has been neglected by planners for decades (*14*). Nevertheless, civil society has been playing a key role in pushing for improvements in pedestrian facilities. In addition, the possibility of encouraging bicycle trips to BRT stations has not yet been explored.

Public Transit Integration and Reform

Thus far, only a handful of bus routes—those that extend along the whole corridor—have been eliminated following implementation of the BRT. Changes in bus routes could reduce routes that compete with the BRT on the corridor and improve the ability of routes to act as feeders. Doing so will have the benefits of increasing demand for the BRT and improving mixed traffic flow on the BRT corridors.

Efforts are under way to better integrate the BRT with commuter rail. Fare integration with other transit modes, particularly with bus feeder routes, will be a crucial part of this effort. ITDP is currently working with the University of Indonesia to improve the public transport demand model to provide more accurate estimation of demand for various BRT and bus route scenarios.

CONCLUSIONS

The TransJakarta BRT provides a tangible vision for an effective, viable public transportation system in Jakarta. The BRT has captured the public's imagination. Clean new buses stopping at clean new stations, the presence of security personnel, and a protected right-of-way immediately elevate the status of this form of transportation. That is true even when operation has not been optimized and system inefficiencies are evident.

From a review of Jakarta's experience so far in implementing the BRT system, the following lessons can be drawn:

- Civil society is playing a critical role in pressuring the government to respond to the needs of public transport passengers and in following good governance.
- Private-sector bus operators physically visiting an existing successful BRT private operator—in this case the Si99 company in Bogota—provided a rapid transfer of knowledge. That did much to gain the general support of this politically important group, whereas gaining such support has been highly contentious in other cities.
- Incrementally implemented systems not accompanied by a restructuring of bus routes are likely to cause significant traffic disruptions. In an ideal situation, reduction of the buses in mixed traffic can compensate for the removal of lane space for the BRT. Lacking this situation, political will and strength are vital ingredients. The leadership of Jakarta's Governor Sutiyoso has been essential to pushing through implementation.
- Transfer of knowledge to local planners with no experience with BRT systems is complex and requires consideration of institutional obstacles.
- The strong public acceptance of the BRT (despite a reduction in general traffic capacity) in an Asian megacity with no successful history of prioritizing public transportation opens the opportunity for duplicating Jakarta's initiative throughout Asia.

ACKNOWLEDGMENTS

Governor Sutiyoso and the other leaders and staff of the Jakarta government implemented the new BRT in a difficult regulatory environment. Enrique Penalosa, former mayor of Bogota, through his own charisma and dedication, helped persuade Jakarta to embark on the effort to implement the BRT. Technical expertise and guidance were provided by Paulo Custodio, Pedro Szasz, and Remi Jeanneret. Jarko Vlasak provided early guidance on management steps and logistical arrangements for a tour of Bogota. In Bogota, the city government, TransMilenio, Si99 S.A., and Ciudad Humana generously gave of their advice and time. Contributors to this project include IDTP personnel Oscar Diaz, Lloyd Wright, Paul White, Lisa Peterson, and especially Walter Hook. Contributors in Indonesia were Bambang Susantono, Fatimah Sari Nasution, Darmaningtyas, Arthur Szasz, and ITDP's partners—the University of Indonesia Center for Transportation Studies, Pelangi, and Instrans. The W. Alton Jones Foundation provided initial support for ITDP's BRT work. The U.S. Agency for International Development supported ITDP's technical assistance to Jakarta.

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The Bus Transit Systems Committee sponsored publication of this paper.