Bus Rapid Transit in Australasia: Performance, Lessons Learned and Futures

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Abstract

This paper presents a review of Bus Rapid Transit (BRT) systems in Australasia. It describes the major systems operating in Adelaide, Brisbane and Sydney, outlining their infrastructure, operations and development characteristics. The performance of these systems in terms of patronage, markets, operations and overall urban development impacts is described. Lessons learned in their implementation and operation is also reviewed. The paper concludes with an outline of future prospects for BRT development in Australasia and a discussion of the major findings of this review.

Introduction

Bus Rapid Transit (BRT) has been seen as a "creative, emerging public transit solution" (Levinson et al. 2003) which can be cost-effective in addressing urban congestion (U.S. General Accounting Office 2001). The development of new BRT systems in Australasian cities has been promoted as a cost-effective means of providing quality service for cities of low density (Fleming et al., 2001). Australasia has one of the oldest BRT systems—the Adelaide North East Busway (opened in 1986). It also has some of the world's newest systems: the Brisbane South East Busway, the Brisbane Inner Northern Busway, and the Sydney Liverpool-Parramatta Transitway (opened in 2001, 2004 and 2003).

This paper reviews the experiences of Australasian BRT systems by describing each system, measuring performance, and identifying lessons learned in implementation. The paper also describes future BRT development in Australasia.

Systems

There are four Australasian bus-based transit systems that qualify for BRT status:

- Adelaide North East Busway (ANEB)
- Brisbane South East Busway (BSEB)
- Brisbane Inner Northern Busway (BINB)
- Sydney Liverpool-Parramatta Transitway (SLPT)

Table 1 shows a summary of the key design features of each of these systems. Each system has unique and distinctive features and functions; even the two Brisbane systems have different functions. The Adelaide busway is a guided bus system using guide wheels on the side of buses to enable a smoother and faster ride along the busway. The other systems are unguided and operate as effective bus-only roads with different strategic functions:

- SLPT is a cross-corridor service linking two major sub-regional centres in Western Sydney. An interesting part of this arrangement is that the transitway termini, Liverpool and Parramatta, are already linked by a direct rail service. The transitway loops to the west of the direct rail service, linking suburbs to the west with both centres.
- BSEB performs a central CBD radial function from southeastern suburbs. It is a major radial corridor service stretching from the CBD to the edge of Brisbane's sprawling suburban development.
- BINB also is also radial but is short in length. Its major design rationale was to provide a traffic-free, fast, high-quality link to the CBD for the large number of northern corridor bus services. These services (like the South Eastern corridor routes) used to share congested inner city roads with traffic. Road bridges accessing the CBD were particularly difficult bottlenecks and had a significant impact on bus operating speeds and reliability. The busways considerably improve on this performance.

ANEB operates at a very high average speed (80 kph, including stopping time) and is potentially one of the fastest urban transit systems in the world. This is partly explained by the guided bus technology used in Adelaide, which results in high and safe operating speeds (with reasonable ride comfort) with maximum running speeds of up to 100 kph. ANEB has few stations reducing stop dwell time. With 5kms between stations, it is also possible for buses to reach a higher speed.

SLPT does not have the same quality of right-of-way separation that is exhibited in the other BRT system designs. This is partly explained by the nature of the development environment for each of these systems. SLPT was "built into" or "retro-fitted" into an area with much existing urban development using the alignment and reserve of the Sydney Water Pipeline corridor and also includes much on-street bus lane operation. This right-of-way had its limitations (Warrell, 2004), including the need for site access for the pipeline and adjoining properties, which required protection from noise. The other BRT systems have a very different development environment. The ANEB and Brisbane systems were built into a largely undeveloped right-of-way (parkland, a river valley, and a freeway reserve).

The nature of these development environments was part of the rationale for using BRT technology. BRT was seen as a "low impact mode in Adelaide; low noise and narrower track profile were key reasons for using BRT (Bray and Scrafton 2000). However, this system, like SLPT, was designed with the potential for future conversion to light rail (Warrell 2004).

The bus operating strategies of the Adelaide and Brisbane systems are similar:

- A trunk bus route operates along the full length of the busway (terminating in the city and at the suburban end of the busway).
- Services from a wider suburban catchment operate on-street and feed into the busway at its suburban terminus and also at selected stations as the busway nears the CBD. These services enter and operate on the busway for part of their length.
- Some services on the busway operate express, i.e., they do not call at each station.

SLPT has a different pattern; only a trunk service is operated. Regional bus services feed busway stations where passengers transfer between trunk services. An integrated network plan including through running of routes on the transitway was originally planned for (Levinson et al. 2003) but has not been implemented at this stage. This was due to problems with reorganising contracts with private bus companies in the region. These issues are now being addressed, and the full network concept is expected to be offered by 2007.

Table 1. Key Design Features of Existing Australasian BRT Systems

	Adelaide Busway (ANEB)	Sydney L-P Transitway (SLPT)	Brisbane South East Busway (BSEB)	Brisbane Inner Northern Busway (BINB)
Running Ways				
- Busway	Guided	Mixed un-guided busway and on-street bus lanes	Un-guided	
- Technology	Guide Rollers on front axle	Tyre on exclusive roadway	Tyre on exclusive roadway	
- Length (km)	12	31 20km bus only roads 10 km bus only lanes	16.5	2.8 (stage 1) 4.7 (full system)
- No. bus routes	18	1	117	14
- Top speed (kph)	100	80	80	
- Av. scheduled speed – busway sections	80 kph	29-34 kph	55-58 kph	Unknown
- Av. run time between busway start-end stations	9 mins	54-64mins	17-18mins	Unknown
- Busway grade-separation	Full 25 bridges, 8 pedestrian overpasses, 60m tunnel	None	Full 8 tunnels (1.6km) bridges/ viaducts (1.6km)	Full 6 tunnels, 7 stations, 1 viaduct, 4 bridges)
- Off busway operation of busway routes	Yes Suburban access, CBD access	No	Yes Suburban access, CBD access	
Stations				
- Number of stations	3	36	10	7 (full)
- Spacing (metres)	5,000	861	1,650	671
- Pedestrian crossing at grade	Yes	Yes (excl Prariewood Stn)	Most grade separated	
- Level boarding platforms	No	No	No	

Table 1. (cont.)

Distinctive Vehicles				
- Distinctive vehicles	No (Most articulated buses use the busway)	No	No	
- Fleet size	118	14-5 (est.)	475	
Off Vehicle Fare Collection[3]	None	Some (ticket machines at stations)	Some (ticket machines at stations)	
Intelligent Transport Systems				
Real time passenger information	No	Yes	Yes	
Active traffic light priority	Yes, off busway	Yes	Yes	
Frequent All Day Service (Busway Stations)				
Peak hour buses per hour	65	6	150	23 (stopping at stations)
Off peak buses per hour	12	3-4	133	11 (stopping at stations)
Weekday service span	5:59-24:35	5:10-23:05	5:00-23:50	5:00-23:25
Sunday service span	8:34-24:23	6:00-25:03	6:00-23:50	6:10-11:18
Construction Cost				
Total ($Aust, M)	$97.8/ $103.5[1]	$200.0/350.0[2]	$400.0/660.0[4]	$135.0
Cost/Km ($Aust, M)	$8.2/ 8.6	$6.5/11.3	$24.2/ 40.0	$28.7

Notes: [1]97.8 Levinson et al. (2003) $103.5 Bray and Scrafton (2000) in 1988 prices, $168M is 2005 prices

[2]$200M in Levinson et al. (2003), $350M in Australian Bus and Coach March 7 2005

[3]All systems have pre-paid ticket options. However, these are bought mainly at local shops.

[4]$400M in Levinson et al. (2003), $660M in Eppel Olsen (2003)

Source: Levinson et al. (2003), analysis of current (04/2005) schedules

An impressive feature of most of the Brisbane systems is high-quality station design. Almost all Brisbane busway stations have grade-separated pedestrian access between platforms using covered overpasses with lifts (Figure 1). The Adelaide and Sydney systems have less substantial stations (Prariewood Station on the SLPT is an exception).

The Brisbane and Sydney systems use low-floor, wheelchair-accessible buses for trunk services. This is not the case in Adelaide. Although platforms are provided in each system, none achieve level boarding entry onto buses. A boarding ramp is required in each case.

Figure 1. Typical Stations on the Australian Busways

Distinctive bus vehicle design is a common feature of American BRTs (Levinson et al. 2003). None of the Australasian BRT systems use distinctive vehicles (although Adelaide does deploy its articulated buses on the ANEB).

All Australasian BRT systems have some off-vehicle ticket sales but also allow some on-vehicle sales. Intelligent Transport Systems are an important part of all systems; however, the newer systems use real-time information displays at stations (Adelaide does not have these). Active traffic light priority systems are a major feature of all systems, as is remote security monitoring.

All Australians BRT systems have high service levels including service spans and headways. BSEB is the largest system, with peak headways of 24 seconds. The scale of peak operations in Adelaide is broadly 40 percent of this volume, although a high volume of articulated buses are deployed (which will balance relative capacities). SLPT has relatively modest service levels (10-15-20 min) because only the trunk element of the service plan is provided.

BSEB has the highest construction costs of the systems ($24-$40M / km). ANEB appears to be the cheapest ($14M /km). BSEB costs are high due to quality station design. BINB also has much tunnelling, which has substantially increased costs.

Table 2 shows usage data for three of the systems (it is too close to the opening of the Inner Northern Busway for comparable data to be provided). BSEB, at 26M passengers per annum carries substantially more passengers than the Adelaide

Table 2. Market Data—Australasian BRT Systems

	Adelaide Busway (ANEB)	Sydney Transitway (SLPT)	Brisbane SE Busway (BSEB)
Ridership			
- Usage per annum	7.0M[1]	1.9M[2]	26.0M[7]
- Weekday average[3]	25,000	6,800	93,000
- Peak hour	4,500[4]	d/k	15,000[5]
Immediate Travel Impacts			
Direct corridor Ridership growth	24%[5]	56%[6] (47% new journeys)	56%[8] (17% new journeys)
% new pax who previously drove	40%[5]	9%[6]	26%[8]
Station Usage			
Board at stations	20%[4]	100%	66%[9]
Board off system	80%[4]	0%	39%[9]

Notes: [1]Based on 2003-4 financial year. Data courtesy of Office of Public Transport, Adelaide

[2]Jan-Dec 2005 data courtesy of Sydney RTA TransitWays

[3]Estimates using a year to weekday factor of 280 – a typical ratio in Australian cities

[4] Source: Passenger Transport Board (1999)

[5] Source: Peak hour peak direction estimate for 2004 made by Brisbane Transport (from a personal communication). Levinson et al. (2003) quoted 9,000/ hour

[6] Source: Parsons Brinckerhoff (2003)

[7] Source: Queensland Transport (2004)

[8] Source: McCormick Rankin Cagney (2002)

[9] Source: Queensland Transport (2003)

and Sydney systems put together. BSEB usage data probably exaggerate performance because many busway services follow the busway only for a short proportion of its length. The "core" South East Busway services carry 4M trips per annum (Queensland Transport 2004). The Adelaide Busway carried 7M passenger trips per annum (2003/4), and most of these trips would be travelling its full length. Hence, BSEB and ANEB are of comparable scale, depending on the measures used. BSEB has a much higher peak maximum load than ANEB. It is also clear that SLPT has usage substantially below the other busways.

Table 2 also shows contrasts in busway station behaviour; ANEB is mainly accessed "off system" (20% of passengers board at stations). In contrast, the Sydney Transitway is accessed entirely at station (because there no "off system" services). BSEB lies somewhat between these two extremes, with well over half of boardings occurring at stations.

Performance

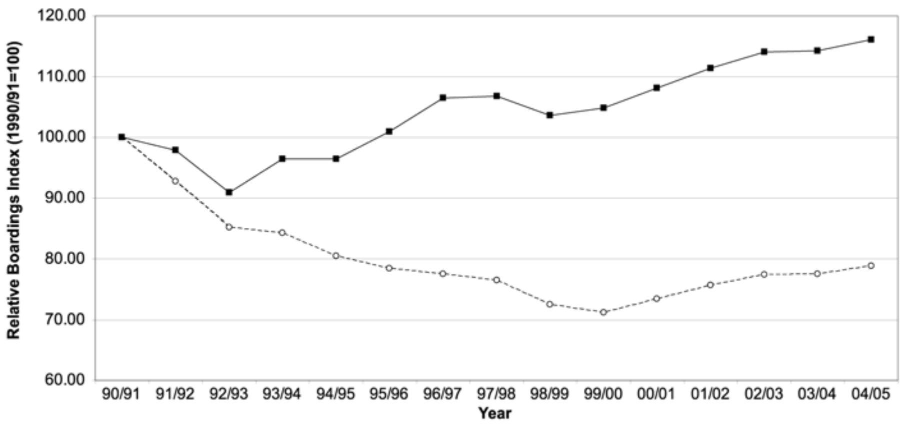
Travel and Market Impacts

All systems generated high corridor ridership growth (Table 2). The newer systems have increased usage by over 50 percent. The nature of growth has been different in each case. A high share of the ANEB ridership growth (40%) came from car drivers (Levinson et al. 2003). In Sydney most growth in transit ridership came from new journeys. A smaller share of car drivers took to using the transitway (9 percent) (Parsons Brinckerhoff 2003). SLPT caters for cross-corridor demand, which is low in volume and highly dispersed. This is a difficult market to compete with the car. In Brisbane, growth of 56 percent included 26 percent who previously drove (McCormick Rankin Cagney 2002). Both the Brisbane and Adelaide systems perform a CBD radial function and compete with congested road markets. Their high car usage impact is due to the competitiveness of the busways in terms of travel time/ cost and the associated parking issues within associated CBD's.

SLPT is operating considerably below patronage forecasts. A prediction of 18,000 per weekday was identified in Levinson et al. (2003); however, actual is 5,100 (Table 2). The difference is explained by the difference between the service levels planned and those actually operated. Only the trunk service is being operated, while a far more comprehensive multi-operator network was envisaged in forecasts. In addition, integrated ticketing and redevelopment of Parramatta interchange is yet to occur, but both assumptions also were included in the original forecasts. Forecasts based on the current (less developed) system were around 1,700 per weekday, and current usage is well above this expectation.

ANEB has an impressive long-term market performance (Figure 2). The busway has demonstrated consistent patronage trends above the norm for other bus, tram and rail services. Current ridership is 16 percent larger than in 1990/91. For other corridors, patronage is more than 21 percent lower than in 1990/91.

Figure 2. Relative Patronage Change of Busway Compared to Other City Public Transport—Adelaide Busway



Note: 1990/91 patronage = 100, annual patronage is indexed relative to the 1990/91 value. 1990/91 is a year after the final extension of the busway and, hence, allows for "ramp up" market growth associated with new system introduction.

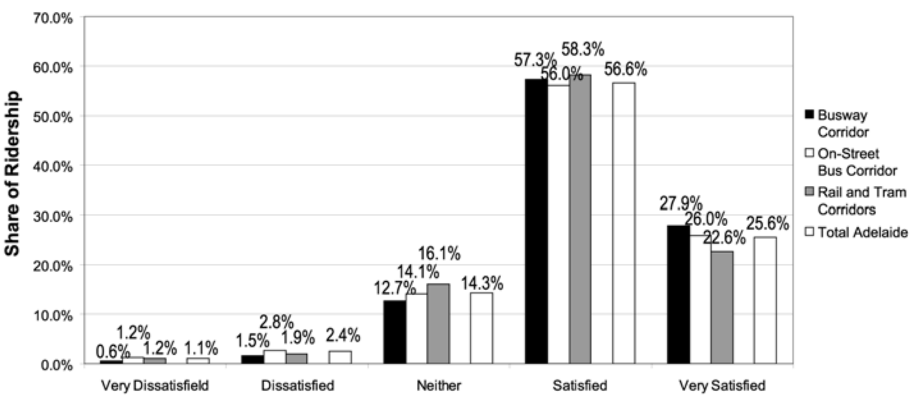
Since 2002-3 (a year after completion) ridership on the core BSEB routes had increased by 8 percent to 2003-4 (Queensland Transport 2004), while patronage for most of the remaining Brisbane bus services has increased by only 2 percent (Brisbane Transport 2003, 2004). This suggests that growth is four times higher for busway-related services.

There is also evidence that the type of people using busways is different from traditional on-street bus service markets. ANEB displays a lower share of ridership who have no car available for their trip than on-street bus services (Currie 2005). It also has a considerably higher share of "choice" passengers, i.e., those who have a car available but choose to use transit, and also those on high incomes compared to other corridors. Overall, the busway displays income and user "choice" characteristics, which are more similar to rail markets than traditional on-street bus markets (Currie 2005).

These characteristics are consistent with the high patronage growth impacts identified earlier, particularly those associated with reduced auto use. There is also consistency in BRT market characteristics for all Australasian systems (Parsons Brinckerhoff 2003; McCormick Rankin Cagney 2002).

All Australasian BRT systems have had a positive impact on customer satisfaction (as may be expected after a significant investment in service). In Adelaide this impact has been sustained in the long term. Figure 3 shows the results of a 2001 customer satisfaction survey of the Adelaide busway corridor compared to on-street bus and rail/tram corridors. The busway shows consistently higher satisfaction than on-street bus and rail corridors and lower dissatisfaction rates. The share of very satisfied customers on the busway corridor is over 5 percent larger than those in the on-street bus corridors some 12 years after it was fully opened.

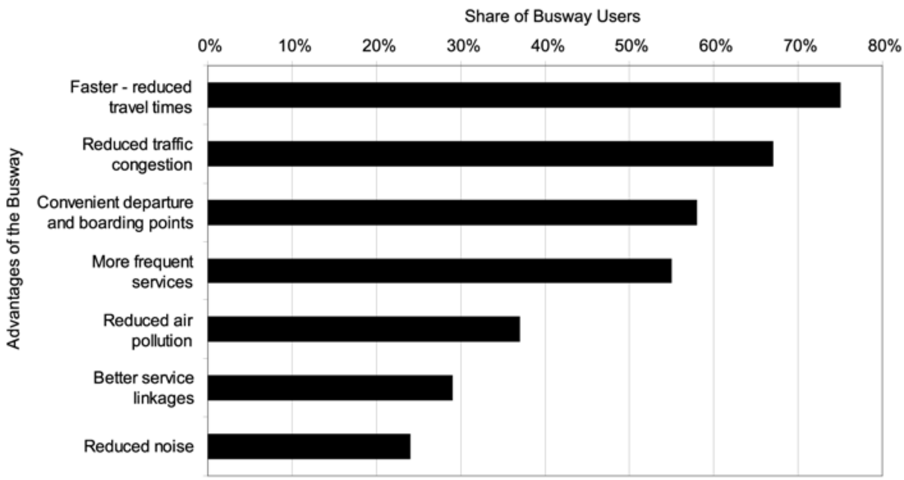
Figure 3. Public Transport Customer Satisfaction— Adelaide BRT, On-Street Bus and Rail Corridors



Source: Market Equity (2001)

Figure 4 shows user-perceived busway advantages for the BSEB. Faster travel times, reduced traffic congestion, convenient stops, and frequent service were the main benefits identified.

Figure 4. User Perceived Advantages of the Brisbane South East Busway



Source: McKormick Rankin Cagney (2002)

Urban Development Impacts

Urban development impacts for ANEB and BSEB were identified by Levinson et al. (2003) (see Table 3). Property value growth of up to 20 percent was identified in the region of BSEB, a higher growth than in other Brisbane corridors. Although urban development associated with Tea Tree Plaza has been associated with ANEB, in practice little development has occurred around the remaining stations. As a senior planner in Adelaide put it, there is “no evidence of the busway having encouraged additional urban development” (Currie 2005). The same source notes the very high park and ride access behaviour to most Adelaide busway stations (over 50% of boardings are from via car acces). Park-and-ride and urban development at stations are not well matched due to the extensive parking area required and the poor environmental quality associated with car access (Dittmar and Ohland 2004). This problem is exacerbated by BRT since the very high frequencies provided are very attractive boarding points for park-and-ride travellers.

Table 3. Land Use Benefits of Selected Australian BRT Systems

System	Land Development Benefits
Adelaide Busway	Tea Tree Gully area becoming an urban village
Brisbane South East Busway	Up to 20% gain in property values near the busway. Property values in area within 6 miles of station grew 2 to 3 times faster than those at greater distance.

Source: Levinson et al (2003)

Park and ride and its impact on urban development around stations is less of an issue for the other BRT systems. Only 13 percent of the BSEB users drove a car (McKormick Rankin Cagney 2002), and less than 1 percent for SLPT (Parsons Brinckerhoff 2003).

There is little information on urban development associated with the SLPT, mainly due to its fairly recent opening. The low density suburban context of SLPT has been recognised as a difficult development environment (Warrell 2004). Also, initial low service levels on SLPT present a poor offering. Nevertheless, a pro-active approach to design development opportunities around major stations has been taken, notably at Prariewood (Faber 2004).

Operational Impacts

Travel time savings were a key feature of user perceived benefits of the BSEB (see Figure 4) and SLPT (fast travel time was rated as very important by 73% transitway passengers) (Parsons Brinckerhoff 2003). Travel time savings were:

- SLPT – up to 60-minutes (Levinson et al. 2003) for a complex feeder bus, rail, feeder bus trip, but generally lower for other (more common) trip types
- BSEB – a 60-minute motorway trip from Eight Miles Plains to the CBD has been reduced to 18 mins (a 42-min travel time saving) (Deutscher and Pasieczny 2003)
- ANEB – travel times from suburbs to CBD reduced from 40 to 25 minutes (minus 15 minutes), (Levinson et al. 2003).

Although reliability improvements are likely, little monitoring has occurred. Operational challenges associated with crowd handling and frequent vehicle movements at inner stations on the BSEB have been identified (Pasieczny 2003).

Management of these issues has required careful segregation and deployment of vehicles and passengers to separate platform sections.

Safety issues in using driver "line of sight" as a means to separate fast-moving buses were identified on the ANEB (Bray and Scrafton 2000). Following a rear-end accident, flashing lights were installed on buses to indicate they are stopped. A special vehicle also was designed to recover broken down buses on the guided busway. This is virtually never used. A strong safety record for the guided busway is evident (Bray and Scrafton 2000).

"Tire scrubbing" was another operational lesson of ANEB. Tire wear on curved sections of the guided busway occurred. This was addressed via speed reduction at these points.

ANEB planners were concerned about the dwell time delays resulting from on-vehicle ticket sales. Multi-door ticket validators and mandatory off-vehicle ticket sales would clearly assist but have not been implemented. The benefits of better boarding time need to be balanced against the potential to increase fare evasion. This concern has led to limited off-vehicle sales in Australasian BRT systems.

Lessons Learned

This section is based on interviews with BRT system planners and operators.

Sydney Liverpool-Parramatta Transitway

The lack of coordination between the opening of the transitway and the resolution of bus contract issues is the major issue affecting performance. In addition Parramatta interchange development and integrated ticketing has lagged behind transitway opening. Clearly, better coordination would have improved performance.

Initial marketing of the SLPT also has been a concern. Creating the "T-Way" brand was emphasised over providing practical details about how to use the system.

The use of at-grade pedestrian crossings seems to have been effective from both a safety and cost view. SLPT operators suggested a 2-minute headway threshold should be used to determine whether crossings should be grade separated. This view contrasts with the design of the ANEB, where at-grade pedestrian crossings are provided at headways much shorter than 2 minutes. No pedestrian safety issues have been identified with either designs to date.

Some concerns with station design features are noted:

- Stations are not close enough to major trip generators.
- Sound barriers, safety concerns and cost issues have limited access paths from trip generators to stations.
- Stations are considered "over-designed" to be distinctive and attractive. Originality was considered to overly dominate cost and practicality issues.
- Too much glass was used. This is expensive and generated vandalism issues. Less glass with be used in the next T-Way system.
- "Lush" landscaping is expensive and can trap litter and garbage.

As a result of these lessons, stations on the next T-Way system will be 20 percent cheaper.

An interesting viewpoint also was expressed regarding the use of real-time passenger information (RTPI) systems. Planners expressed the view that the benefits of RTPI systems are small when frequent services are provided. Although RTPI is popular, it does not necessarily mean it is cost-effective.

Adelaide Busway

ANEB planners found the frequency advantage of busway stations makes them very attractive. Park and ride access was heavily under-estimated in original plans (e.g., Paradise Interchange had 160 parks on opening and now has 550). During the first 5-10 years, station parking lots were heavily over-subscribed, with much illegal parking.

Initial ANEB service levels were considered low due to funding limitations. Starting with high service levels is recommended. This point is reflected in the SLPT experience.

ANEB planners emphasize how the busway has substantially built ridership. The transfer free operation of buses from suburbs to downtown is considered a major advantage, compared to rail and light rail alternatives.

Brisbane Busways

In identifying areas where planning could have been better, the only major concern was the linking of busway station design into adjacent urban development. BSEB is a difficult environment for development integration since its location, adjacent to a freeway, was not an attractive one for TOD. The freeway corridor considerably reduced the walk on catchments and acts to dilute the quality of station environments (due to high traffic volume and noise). Good design has acted to partly reduce impacts.

Brisbane planners shared the views of those involved with the SLPT that RTPI systems were of limited value in an environment where high frequency services were offered.

BSEB has faced operational issues associated with platform crowding and managing large numbers of bus movements in inner stations. There also are concerns about capacity. Overloading on vehicles is an emerging issue. Short term plans for refurbishing inner stations have addressed many of these concerns. Use of higher-capacity buses is being considered.

Capacity concerns are clearly linked to the success of BSEB. Success was a commonly used word in describing lessons learned. This has been evidenced by popularity with users and the ongoing commitment Brisbane authorities have made to new BRT systems.

Futures

There are two new fully committed BRT systems under construction in Australasia: the Sydney North West Transitway (SNWT) and the Auckland Northern Busway (ANB).

Table 4 shows some of the key features of these systems. In total, an investment of around $Aust700M is expected within the next 2 years. New systems will increase Australasian BRT system size by around 47 percent (of busway route kms). SNWT will follow the concept of the SLPT and will link in to the SLPT at Parramatta.

ANB incorporates a one-direction busway using tidal flow operations nearer Auckland CBD. This design is a compromise between constrained right-of-way width, particularly over the Auckland Harbour Bridge and other road demands. ANB also uses freeway shoulders as a right-of-way in outer suburban sections, as well as a more traditional two way “bus only road” busway design (much like BSEB) between these two sections.

Table 4. Key Design Features of Committed New Australasian BRT Systems

	Sydney North West Transitway[1]	Auckland Northern Busway[2]
Year of Opening	2007	Late 2006
Running Ways		
- Busway	Un-guided	Un-guided
- Technology	Tire on mixed exclusive and bus lanes. 10 bridges, 2 underpasses and 10 new signalised intersections	Tire on exclusive roadway Mixed freeway shoulder, 2 way busway and single lane busway (tidal flow). Some sections may also use HOV lanes
- Length (km)	21	9
- Right-of-way	Mixed	Mainly side of freeway reserve
- Busway grade-separation	Limited	Yes
- Off busway operation of busway routes	Yes	Yes
Stations		
- Number of stations	27	5
- Spacing (metres)	777	1,800
- Pedestrian crossing at grade	Yes (some exceptions possible)	Most station designs appear so
- Level boarding platforms	No	No
Distinctive Vehicles		
- Distinctive vehicles	No	No
Off Vehicle Fare Collection[3]	Some (Ticket machines at Station)	No
Intelligent Transport Systems		
Real time passenger information	Yes	Yes

Table 4. (con't)

Frequent All Day Service (Busway Stations)		
Peak hour Buses per hour	10	10
Off peak Buses per hour	15-30	10
Construction Cost		
Total ($Aust, M)	$Aust 524M	$NZ 266M
Cost/Km ($Aust, M)	25.0M	$NZ 29.6M

Notes: [1]NSW Minister of Transport Media Release, 4th Dec 2004

[2] *http://www.busway.co.nz/*

In terms of existing systems development, expansion is proposed for each of the Brisbane BRT's:

- $Aust 460M—New Busway Station on the BINB (completed by 2015)
- $Aust 25M—extension of the BSEB to Springwood (completed by 2009) (Queensland Government 2005)

The expansion of the existing SLPT is also a significant project in term of existing systems development. Bus operator contracting issues have considerably limited the initial operations. In addition, the redevelopment of Parramatta interchange and the introduction of integrated ticketing have lagged but should be fully addressed by the end of 2006. Much improvement in the performance of the SLPT is expected.

There are a very large number of planned systems (i.e., not fully developed or committed), which would represent more than a tripling of total Australasian BRT system size.

Networks of linked BRT systems are planned for in both Brisbane and Sydney. The recent Infrastructure Plan for South East Queensland (Queensland Government 2005) has identified a staged program for a further $Aust 1.2B investment in new busway development.

The new Brisbane busways will involve more on-street bus lane operations than the existing busways (following the concept of the SLPT). This is because Brisbane has used available corridors for fully grade-separated busways. There is little opportunity left for using river, park corridors or space next to freeway reserves. New transit systems will have to be retro-fitted into existing urban areas-a more challenging task to implement effectively.

An interesting inter-modal development as part of the expansion of busways in Brisbane is the redevelopment of platforms at Roma Street Railway Station. Two rail platforms will become busway stations within a major rail station complex including mostly commuter and long distance rail platforms.

Auckland has a similar set of extensive network development concepts associated with rapid transit corridors, although transit modes for these corridors are undecided at this stage.

Canberra, Australia's capital, also has plans for the Belconnen to Civic Busway. This is a 10 km corridor where a combination of bus-only roads and bus lanes are envisaged.

Discussion

Based on the findings of this review, a few conclusions can be drawn regarding four important questions associated with BRT.

Has BRT system development increased in Australasia? Yes. Despite early interest with the Adelaide busway, no large-scale systems were developed for over a decade. However, the last 3 years, and certainly the next 2, will see substantial growth. Around $Aust 2 Billion in investment in BRT system has occurred or will occur.

How have BRT systems performed relative to expectations? In interviews with staff from both Adelaide and Brisbane busways, it is clear that performance has been well beyond expectations. In Brisbane, long term maximum peak hour (peak direction) demand of 10,000 per hour was forecast. Current use is 15,000 per hour after only 5 years. The Sydney transitway is well below performance due to contracting problems. In effect, the service planned was not provided; hence, planned performance did not eventuate.

Has BRT replaced heavy and light rail as a mode of choice in Australasia? No. There are several heavy rail and some (small) light rail development projects. BRT has not replaced rail but it has become a viable option to examine alongside the alternatives. BRT's flexibility to expand to rail at a future date is a part of the justification for choice of BRT in most cases.

Has BRT become a more attractive mode choice than rail in Australasia? A qualified yes. The $Aust 2 Billion investment in recent Australasian BRT systems is at least as large as the rail investment made over the same period. This demonstrates BRT's effectiveness in the difficult choice governments face in the quality, cost and funding availability trade-off. It is clear that more transit systems can be provided with BRT than with rail for the equivalent dollar. However, decisions to invest in rail are still being made. Clearly, rail is seen to be more appropriate in certain situations; governments are demonstrating their right to pay for a higher quality and more expensive systems if they wish. BRT has not proven a ubiquitous answer to all of urban transit problems. Rather, it is a powerful additional tool to be used in appropriate circumstances.

An important perspective on the BRT systems identified is the large range of technologies and characteristics employed. There are more contrasts than similarities between systems.

The relatively poor initial performance of the SLPT suggest the larger-scale, grade-separated busway models are more appropriate. However, this view is simplistic. It fails to understand the problems Sydney faced in implementation. It also fails to recognise the different challenges and objectives being addressed by different types of system. SLPT is retro-fitting a new mass transit system into an existing suburban area, while the other busways are using largely undeveloped urban corridors with parks, rivers, or freeway rights-of-way. Retro-fitting is a more difficult challenge. Yet it is a challenge worth making since there are far more opportunities and a greater need for retro-fitting within suburban development than there are opportunities and needs for developing BRT systems in available river/park or freeway reserves. This is demonstrated by the new Brisbane Northern and Eastern Busway projects. These will follow the suburban retro-fit model due to a lack of available rights-of-way.

Conclusions

This paper has presented a review of BRT system in Australasia. Four major systems have been developed with varying characteristics and performance. All have achieved attractive patronage impacts and are well valued by customers. Within the next 2 years, Australasian BRT systems will increase by around 50 percent. Longer term expansion of BRT systems are being planned, including new systems in Canberra. Brisbane has plans for $Aust 1.2B in busway development by 2026.

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