Public Transport Mode Selection: A Review of International Practice

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Abstract

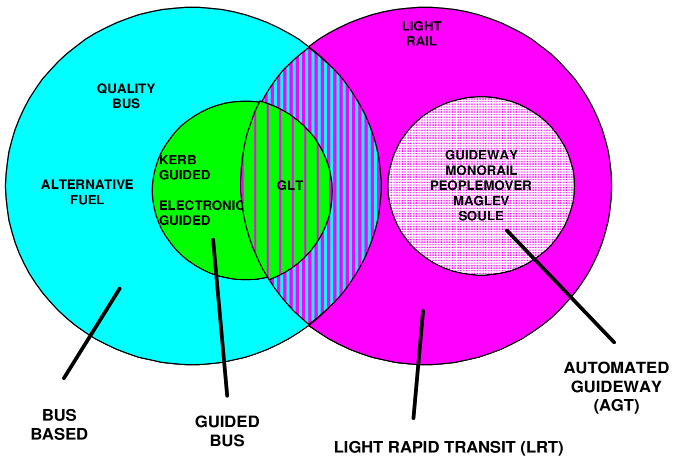
This paper will aim to address one of the ETC conference themes*: "Guidance for Option development in transport studies? How are particular mode solutions chosen?"*

The international policy context for particular public transport mode solutions will be examined [Europe, North America and Australasia] including the relative performance of a range of public transport mode options [from bus to light rapid transit].

1 Introduction

Over the last 25 years, many urban areas have adopted light rail as a potential intermediate public transport solution in low to medium density trafficked corridors. More recently, bus-based transitways have gathered interest as an alternative to light rail. This paper aims to compare some of the key features of both modes drawing on case studies to examine the relative strengths and weaknesses of these modes and identify how particular mode solutions are chosen.

2 Mode Options



Whilst Light rail and bus based systems have often been considered to offer different public transport solutions, there is increasingly a significant overlap in their characteristics as illustrated in the figure inset. This is particularly noticeable in the emergence of bus rapid transit operations and very high quality bus based vehicle technology.

2.1 Light Rail

According to the PTEG (2005) some of the main advantages of Light Rail include:

- ability to penetrate town and city centres with permanent, visible and acceptable infrastructure;
- delivery of predictable, regular and fast journey times, providing a high capacity service on simple and easily understood routes;
- high level of reliability due to segregation from other traffic, priority at junctions and contractual incentives to operators;
- accessible, well equipped and visible stops;
- a high ride quality throughout the entire journey;
- effective integration with new developments and park and ride facilities;
- opportunities to renew both the fabric of the urban areas it serves, and the image of those areas;
- permanence of infrastructure, vehicles and operations, creating confidence amongst individuals and business to make long term locational decisions that produce long-term patronage growth.

2.2 Bus Systems

Recent international improvements to bus systems include:

- Introduction of low-pollutant 'Euro IV' engine technology (requiring the use of low-sulphur diesel fuels).
- Reduced engine noise.
- Low floor chassis, to all but eliminate the height difference between kerb and floor.
- Much improved attention to passenger ambience, with quality upholstery, large windows etc

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Fuel cells are an emerging power source now being trialled in North America (Chicago and British Columbia) and elsewhere. This fuel source offers zero emissions, higher energy efficiency and quieter operations than conventional internal combustion engines. Fuel cell power plants have been retrofitted to existing buses and, as the technology improves, more conversions can be expected.

2.2.1 O-bahn

'O-Bahn' is a German term used to describe a propriety physical guidance system for buses. The longest operational O-Bahn system operates in Adelaide, Australia with some limited applications in Europe (Essen) and the UK (Leeds, Ipswich, Edinburgh). Standard buses are used on this operation, but with a small guide wheel protruding horizontally from the bus's steering gear on each side. Because the O-Bahn provides a bus-only, high -speed segregated operating environment, and also because of the excellent ride quality, the system has proved very popular and has attracted significant patronage increases since opening in Adelaide.

However, the O-Bahn does require long unbroken sections of parallel guidance kerb and so limits the scope for other traffic to cross the corridor.

2.2.2 Busway Rapid Transit (BRT)

According to the TCRP[1], BRT is as a flexible, rubber-tired rapid-transit mode that combines stations, vehicles, services, running ways, and Intelligent Transportation System (ITS) elements into an integrated system with a strong positive identity that evokes a unique image. BRT applications are designed to be appropriate to the market they serve and their physical surroundings, and they can be incrementally implemented in a variety of environments. In brief, BRT is an integrated system of facilities, services, and amenities that collectively improves the speed, reliability, and identity of bus transit. BRT, in many respects, is rubber-tired light-rail transit (LRT), but with greater operating flexibility and potentially lower capital and operating costs. Often, a relatively small investment in dedicated guideways (or "running ways") can provide regional rapid transit.

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[1] TCRP report 90 – Busway Rapid Transit

2.2.3 New Bus Based Vehicle Technology

Several bus manufacturers are developing and marketing very high quality 'light rail looking' vehicles. Examples include Translohr, CIVIS and the Ftr Streetcar.

The prototype Translohr was unveiled in mid- 2000, and may best be described as looking like a light rail vehicle, but running on road with rubber tyres. The CIVIS (like the Translohr) may also be described as a light rail-looking vehicle, but running on road with rubber tyres. It, too, is a guided system that also allows for manual steering. The biggest difference between these two systems is the approach taken to vehicle guidance. With the CIVIS, guidance is provided by a digital camera mounted inside the vehicle and facing forwards. The Ftr is a high quality bus based technology currently under examination in several locations in the UK with operations planned for York, Swansea and Leeds.

2.3 Comparisons

Transport for London have identified the following characteristics of the main public transport modes focusing on capacity, capital cost, operating cost, average speed, reliability, roadspace allocation and land use integration. TfL acknowledge that bus based rapid transit and light rail have an important role to play in urban public transport where full segregation for an alignment is not required (or always available) and shared running with traffic management is feasible. Such public transport solutions also have a key advantage in costing only about 10% of an Underground line (per km) but potentially delivering 30% of the capacity over relatively short to medium distances.

Modal Characteristics	Bus	Maximum Bus Priority	Busway	Tram	Light Rail	Heavy Rail
Maximum capacity	**2,500 pphpd**	**4,000 pphpd**	**6,000 pphpd**	**12,000 pphpd**	**18,000 pphpd**	**30,000 + pphpd**
Capital cost per route km	**< £1m**	**£1m - £2m**	**£1m - £20m**	**£15m - £20m**	**£10m - £45m**	**£45m - £250m**
Operating cost per passenger place km	**3.8 p – 8.8 p**	**2.5 p – 5.8 p**	**2.5 p – 5 p**	**1 p – 2.1 p**	**1 p – 1.4 p**	**1.5 p – 1.8 p**
Average speed	**10–14 km/hr**	**14–18 km/hr**	**15 – 22 km/hr**	**15 – 22 km/hr**	**18- 40 km/hr**	**18- 40 km/hr**
Reliability	**Improving**	**Medium**	**Good**	**Medium to Good**	**Good**	**Very Good**
Roadspace Allocation	**Mixed running with traffic**	**Mixed running and on-road bus lanes**	**Totally segregated alignment required**	**Mixed running and on-road tram lanes and totally segregated where available**	**Very largely on segregated alignments**	**Totally segregated**
Theoretical Land Use 'best fit'	**Best suited to lower density dispersed urban form**	**Best suited to lower density dispersed urban form**	**Best suited to high demand corridors in medium to low density areas**	**Higher densities of development, or connecting denser urban centres**	**Higher densities of development, or connecting denser urban centres**	**Very high density urban development**

Source: Transport for London

2.4 Case Studies: United Kingdom

2.4.1 Perspectives

The UK Government's Transport Strategy published in 2000 envisaged 25 new light rail lines by 2010. This has not happened due to difficulties with cost escalation, risk and associated premiums, lengthy planning processes and differences between patronage forecasting and actual ridership. This has seen greater interest in the role of bus based systems to deliver local transport solutions. Within this context this paper examines the rationale for the selection of a bus based transitway and a light rail solution in two very different urban areas.

2.4.2 Luton – Dunstable [Bus Rapid Transit]

Translink is planned as a fast, frequent and reliable high-quality service linking Houghton Regis, Dunstable and Luton. The service will be provided by special buses capable of running both on their own track and on the public roads. This will maximise the flexibility of Translink services so they can serve a large number of destinations in the area, connecting the main housing areas of the conurbation with the main industrial areas, the three town centres, the main line rail stations in Luton, and London Luton airport. Almost 85,000 people live within a 400 metre walking distance of stops on the proposed network. Service frequency is planned to be an average of 12 services per hour although in some areas this could be as high as 38 services per hour.

The scheme would involve the construction of approximately 12 km of guided busway, the majority of which would run along its own dedicated track following the route of the disused Luton-Dunstable railway. Translink buses would join and leave the busway at selected points, enabling them to serve the Luton-Dunstable-Houghton Regis conurbation.

Various studies evaluated the performance of re-introducing other public transport services as alternatives to the proposed guided busway, namely:

- Extension to Dunstable of the heavy rail 'Thameslink' services
- A diesel shuttle service between Dunstable and Luton, with intermediate stations,
- A light rail service between Dunstable and Luton, including a possible extension to London Luton Airport

The Translink guided busway was preferred when compared with the other options because it provides:

- a flexibility of transport routes that can serve a greater number of people living in Luton, Dunstable, and Houghton Regis
- a positive return on investment costs, as indicated by the Benefit: Cost ratio and the positive Net Present Value
- greater patronage of public transport services, resulting in more scheme benefits for the local travelling public.

Overall the key determinant was a public transport solution that could capture the largest potential customer market.

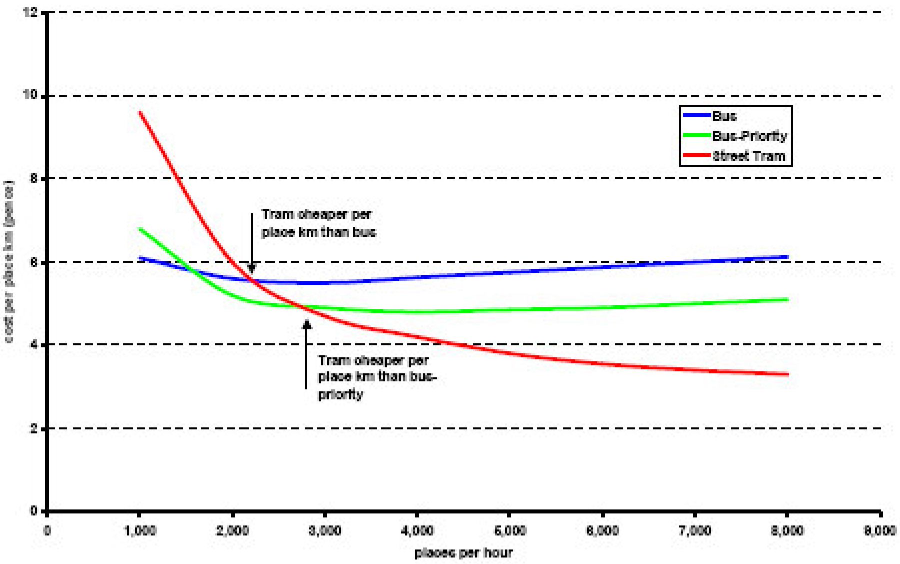
2.4.3 London [Light Rail]

Transport for London consider up to 7 criteria in the determination of the most appropriate public transport mode for a given application.

- Criteria 1 - Capacity
- Criteria 2 - Reliability
- Criteria 3 - Modal Efficiency
- Criteria 4 - Mode Share
- Criteria 5 - Regeneration
- Criteria 6 - Deliverability
- Criteria 7 - Value for Money

TfL recognize that buses can carry high passenger volumes, but operating costs increase severely at higher volumes and service quality worsens as service speeds and reliability decline because of increased frequency - leading to 'platooning' (this is true of all modes) and this also increases costs.

The figure below shows the change in operating cost per place km versus capacity for an illustrative urban corridor for three public transport modes.



Source: TfL

It is also important to recognize in the London environment that the maximum public transport vehicle flow through junctions that can currently be accommodated within the Urban Traffic Control system to obtain good priority is quite limited.

Therefore to move very large numbers of people can require larger vehicles with more entrances, in order to achieve junction priority, reduce boarding delays, raise operating speed and reliability and contain operating costs. In some corridors this could necessitate the provision of light rail to meet forecast passenger demand.

TfL is taking a whole corridor management approach to try and identify and distribute optimally roadspace between all of the competing uses on and around the highway.

(i) Cross River Tram

Cross River Tram is a proposal for a 16.5km tramway through the centre of London and has two principal roles to fulfil:

- Supporting regeneration in the most deprived parts of inner south London
- Providing increased transport capacity between Waterloo and Euston to relieve London Underground crowding.

It is due to this mixture of regeneration and transport benefits that the scheme is being promoted both by the Cross River Partnership – a body comprised of local boroughs and business interests – and TfL.

The key benefits of the CRT scheme include

- Relief of crowding on public transport services between Euston and Waterloo and cater for predicted population and employment growth along the route
- Catering for 66 million passengers a year and with interchange with 12 London Underground stations and four major rail stations, including the future international terminal at King's Cross
- Improved access to education, health and job opportunities, particularly within the 50 local areas served by CRT which are classified as deprived or very deprived
- An environmentally friendly link to the centre of London as a real alternative to cars for trips into and around town
- A commercially-attractive spur to greater investment as well as linking regeneration along its route
- Focus attention on London with an eye-catching asset to tourism
- Halve journey times into central London for some sections of the route
- Part of the Oystercard system so passengers can "hop on and off"

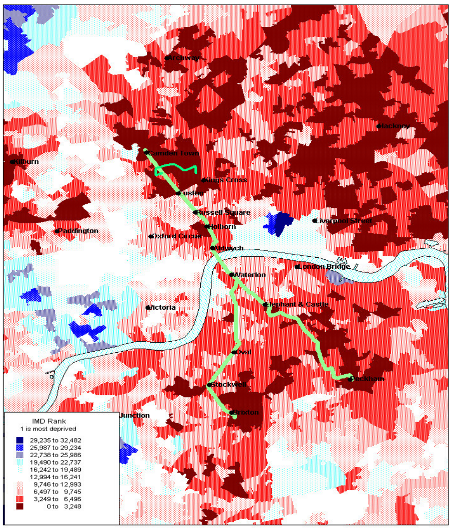


Figure 2.3: 2004 Indices of Deprivation (source OFDPM)

The areas of Deprivation served by Cross River Tram are shown in the figure opposite:

- 72% of the "Super Output Areas" within the corridor are in 20% most deprived areas in the UK
- 30% are in the 10% most deprived in the UK

Key:

Dark red	*= most deprived,*
Dark blue	*= least deprived*
Green	*= CRT*

Earlier work undertaken by TfL (2000) assessed the relative performance of a range of public transport mode options on the route which included

- Tram
- Trolley bus

- High Priority High Frequency (best bus) – operating Euro III diesel double decker bus service on the CRT alignment in conjunction with "maximum practical" priority for public transport

This work showed that the passenger demands exceeded those that could reasonably supplied by bus or trolleybus and that the tram option was the most appropriate mode.

Overall as well as regeneration and social inclusion benefits, Cross River Tram has a strong business case with significant benefits relating to revenue, user benefits (travel time savings) and avoided bus costs.

2.5 Case Studies: Australia

2.5.1 Perspectives

In the last 30-40 years the development of Australian cities has predominantly been built around the concept of the private car as the main means of transport. Beyond the city centres the result has been sprawling, low-density development with segregated single-purpose land use zones and dispersed trip destinations. These circumstances present significant challenges for public transport to attract sufficient patronage to ensure viability. And although levels of car ownership are high, there are significant parts of society without access to a vehicle. These parts of society experience considerable travel disadvantage.

In low-density, dispersed areas of Australian cities that have grown up away from radial heavy rail routes the concept of bus rapid transit has emerged as perhaps the most appropriate form of public transport provision due to relatively low demand concentrations, dispersed trip patterns and relative construction costs.

Typically a successful high quality public transport system will need to:

- deliver frequent services according to a reliable timetable;
- provide direct travel routes;
- offer a single ticketing system across different modes;
- provide an integrated network of services;
- define a system-wide identity; and
- develop excellent passenger interchanges.

In fast developing Australian cities and in the face of growing car dependence, such a public transport system must both respond to the travel environment and be capable of implementation over a short period of time.

Population density is a fundamental consideration. For a 20 kilometre trunk route, residential densities of some 36 people / hectare or above may justify a minimum cost light rail system sharing road space with other users (Pushkarev and Zupan 1980). Far from reaching these conditions, low-density Australian urban areas display the dispersed travel patterns and corridor flows able to be served most economically by high frequency services when these are operated by vehicles of lower carrying capacity than heavy or light rail. When rapid busways have been selected, the choice of mode has been based on patronage demand assessment, route definition and the identification of operating characteristics appropriate to travel needs.

Perhaps the most valuable benefit of a rapid busway system relates to the critical factor of interchange. It has long been known that transfers are a major constraint on the use of public transport (Horowitz & Zlosel 1981). With a bus-based network, the access and trunk modes are the same. The use of a rapid busway system therefore has the advantage of allowing local buses – which can reach beyond the busway into adjacent residential areas – to join dedicated roadway facilities and provide, in peak periods at least, an express service without requiring passenger interchange.

Outside of Melbourne light rail is perceived to offer less opportunity as a line haul mode and has often been predicated in terms of providing a CBD distribution function (i.e. Sydney and Brisbane).

Details of recent developments in rapid busways and light rail are discussed below.

2.5.2 Adelaide [Bus Rapid Transit]

Adelaide is the capital city of the state of South Australia, with a population of some 1.1 million. It is a city with a high reliance on motor vehicle use, with public transport catering for about 5 percent of all passenger trips in the metropolitan area, and 20 percent of CBD-bound trips. The Adelaide O-Bahn was completed in 1989 as a guided busway running 12 kilometres from the Adelaide central business district (CBD) to the city's outer north-eastern suburb. Adelaide's O-Bahn has been successful in cost-effectively attracting and maintaining public transport patronage. The reasons for selecting O-Bahn Busway over light rail included (1) significantly lower cost (2) reduced need for passenger interchange and (3) avoidance of street track or subway construction in the CBD (TRB, 2002).

The majority of buses – and passengers – using the O-Bahn begin their journey in suburban areas and travel about one third of their distance in this environment before joining the guideway for travel to the CBD. These buses perform collection, express, and distribution functions – without the need for passengers to transfer. A major benefit of this operational approach is that only 10 to 15 percent of passengers using the O-Bahn need to interchange. This is a significant achievement in a low-density area where the majority of potential users live beyond a reasonable walking distance from stations.

Weekday patronage is approximately 20,000 passenger trips, with peak flows of about 4500 passengers per hour. The capacity of the O-Bahn has been estimated at 18,000 passengers / hour in each direction, using articulated buses operating at 20-second headways.

Bray and Scrafton (2000) identified a number of key findings with regard to the performance of the O-Bahn, after its first 10 years of operation. Some of the key findings include:

- Public transport patronage in the corridor rose by 22.2 percent between the period immediately prior to the opening of the O-Bahn (1985) and completion of stage 2 (1989).
- 14 percent of users had previously been car drivers and 10 percent were generated trips.
- Patronage rose by 10.6 percent per annum between 1985 and 1991. Compared to other areas where while population grew at a similar rate to the O-Bahn catchment, public transport patronage grew at only 1.4 percent per annum.
- Patronage on bus services that use the O-Bahn has remained broadly constant since 1991, while it has declined on the remainder of the public transport system.
- The cost of carrying passengers on the O-Bahn is less than would have been the case using a light rail system.

Adelaide has shown that over a long period of time a flexible, rapid-bus public transport system can cost-effectively attract and sustain patronage in a low-density environment.

2.5.3 Brisbane [Bus Rapid Transit and Light Rail]

Brisbane, the capital city of Queensland, is located in the fastest-growing region in Australia. Forecasts predict that during the 20-year period from 1992 to 2011 population in the region will increase by 60 percent. Over this period total daily person trips are expected to increase by 70 percent and vehicle kilometres by over 100 percent.

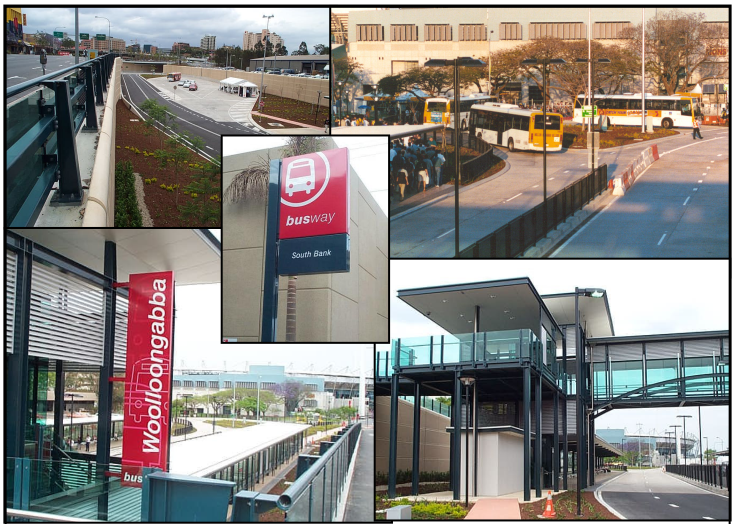
The south-east Queensland region's Integrated Regional Transport Plan (IRTP) (Queensland Government 1997) aims to modify rather than attempt to satisfy unrestrained traffic growth. The IRTP provides a framework for the ongoing planning and funding of transport infrastructure throughout the region.

Public transport mode share has been declining across the region. It is currently approximately five percent, down from 7.5 percent in 1992 (Queensland Government 1997). Public transport caters for about 30 percent of trips to the Brisbane CBD, which itself accounts for about 15 percent of jobs in the Brisbane metropolitan area.

(i) Brisbane Busways

In 1997, the Queensland Government incorporated Brisbane City Council's busway strategy as a central feature of its IRTP and identified an ultimate 75 kilometre network of largely segregated rapid busways radiating out from the CBD. The south-east busway is the first line to be developed, having opened in April 2001.

The figure inset shows the very strong identity that has been established for the busway network, including distinctive station designs and a consistent approach to the presentation of vehicles and information.



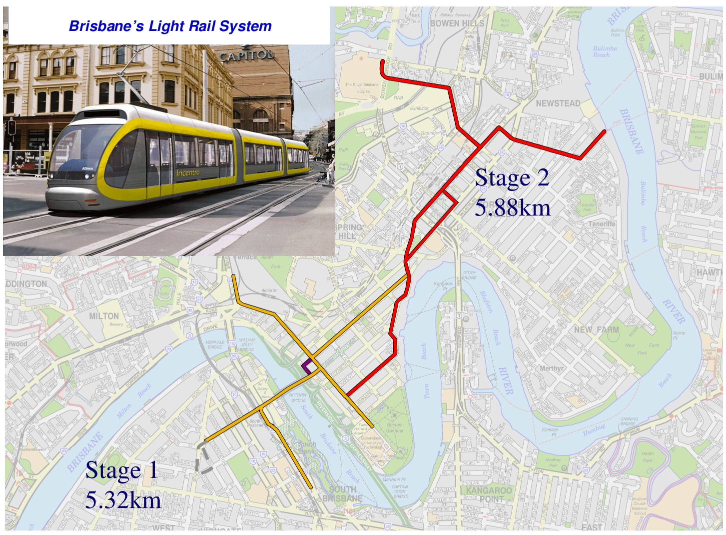
South East Busway (*Turner*)

The 15.6 kilometre south-east busway is a fully grade-separated, two-lane roadway with 12 on-line stations. The nature of its environment (parallel to a motorway), plus the inclusion of a number of significant structures and high-quality stations, has contributed to the relatively high cost of the infrastructure at AUD$400 million (AUD25M/km).

A 4.7 kilometre inner northern busway is under construction which will extend the south-east busway through the CBD into Brisbane's inner northern suburbs, where it will intercept five northern and western bus corridors and serve a major university, high schools and the Royal Brisbane Hospital. This section will also have a high unit cost similar to the south-east busway.

The full benefits of the south-east busway may only be realised when the planned system is operating as a whole. At that time, cross-regional trips – the major portion of the overall travel market – will be able to be comprehensively targeted by the bus network.

(ii) Brisbane Light Rail



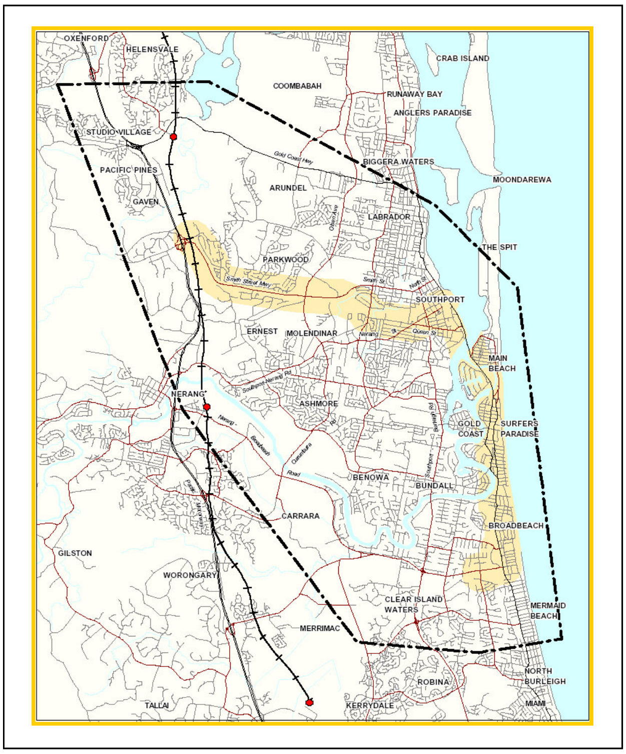
In the past 15 years there have been three separate light rail systems proposed for Brisbane. The first proposal in 1992 had an urban renewal project as a catalyst for it's generation. In its final form light rail was promoted as an inner city distribution system for the busway (see busways above). A CBD loop structure was conceived and in the 12.5 km of track, there were 6 terminii.

The Government was committed to busways and the light rail was promoted as supporting that mode in order to gain BCC support. However the project lost transport functionality. Although the project was tendered for design, build and operation, the private sector considered that the patronage risk was very high and priced their bids accordingly. This made the cost to government unacceptable and the project was abandoned.

2.5.4 Gold Coast

The Gold Coast is arguably Australia's premier tourist destination especially for the south east Asian market. It is growing rapidly and of the 1.65 million trips currently made per day in the Gold Coast area, only 15%, or 250,000, are work related trips. The remaining 1.4 million trips are made up of education, tourism and other trip purposes, many of which are made outside peak periods which provides unique travel characteristics and real potential for high patronage on public transport throughout the day. Also uniquely for an Australian urban area the coastal strip has very high-density development. For example at 80 storeys the Q1 Tower is the world's tallest residential apartment block.

It is essential that the Gold Coast has sufficient and appropriate transport infrastructure to support this growth. While traffic volumes continue to increase and land for more roads is becoming harder to acquire, it is recognised that providing more and more roads is not sustainable. A sustainable public transport solution is needed to manage road congestion, preserve travel times, and reduce adverse tourism, environmental, social and economic impacts. Improved public transport will add to the city's image and its liveability whilst increasing transport choices and helping to influence the form of development.
A feasibility study has been completed, jointly funded by the State and Commonwealth Government and jointly managed by the State and Local Government (Gold Coast City Council).

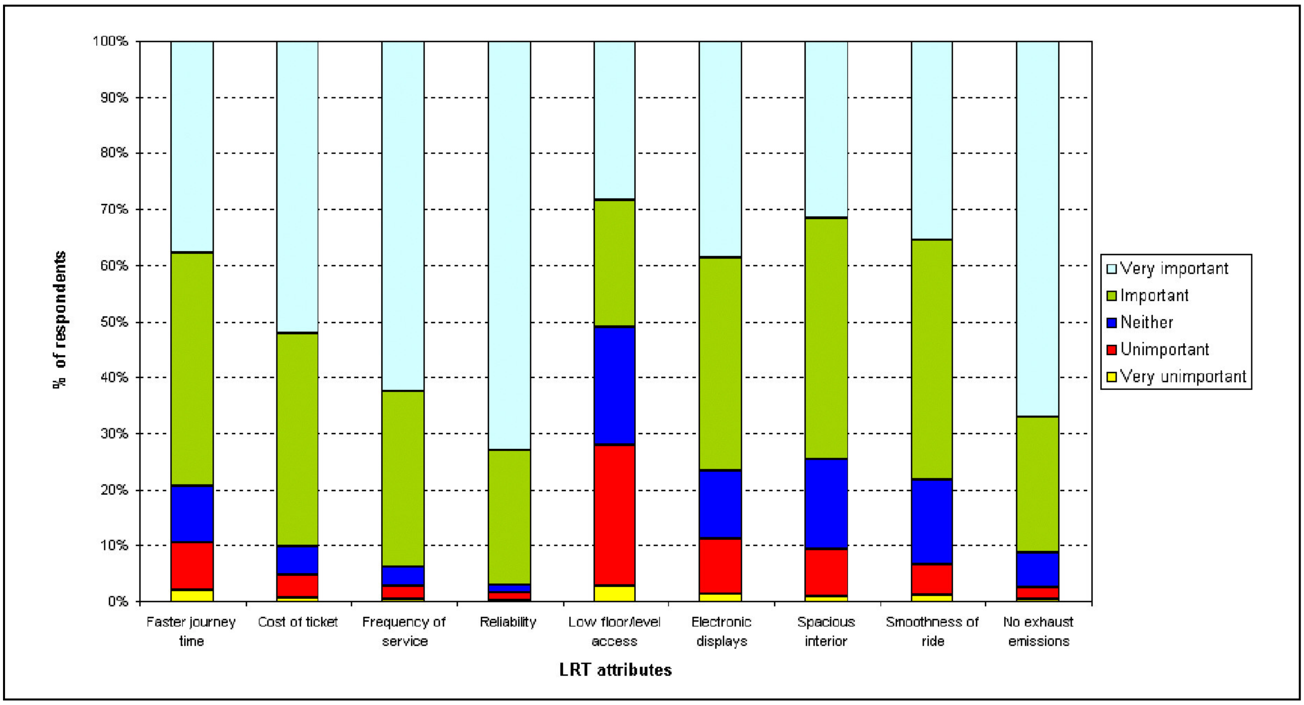


The study has identified a preferred corridor and alignment options for light rail. The corridor contains some major trip generators including:

- Mainline rail station
- Theme park
- Regional hospital
- University
- Surfers Paradise CBD with high density development (including the Q1 building) and local centres
- Surf Beaches
- A major shopping centre
- Casino

It could be argued that in this context a light rail transport system in the city could be highly successful.

Importantly the system is being examined within the context of a regional transport strategy and urban development strategy. And the system is being examined to meet a number of objectives and not just for transport functionality. These objectives include social, environmental and economic objectives. And in particular the ability of a system to integrate with the urban fabric and to focus land use development is seen as critical factors.
Stated preference surveys were undertaken as part of the initial work which identified some of the key attributes of light rail for members of the travelling public and these are shown below.



2.5.5 Sydney [Bus Rapid Transit]

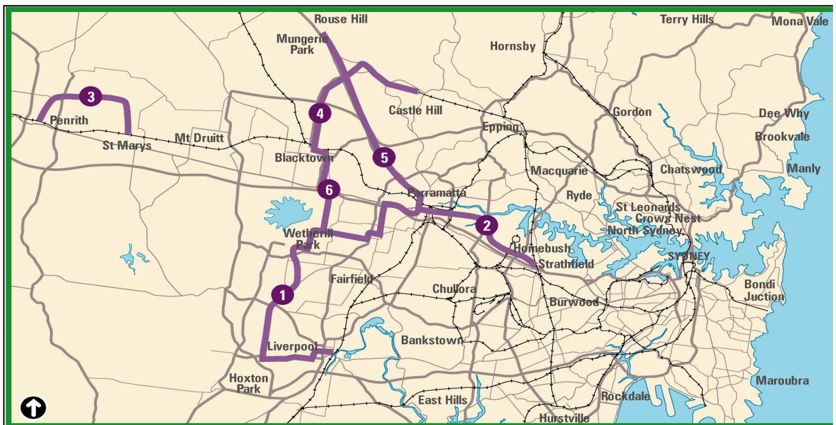
Sydney's public transport system is very much the product of its evolution from a late 18th-century convict settlement clinging to the edges of Sydney Harbour to Australia's largest metropolis, stretching nearly 40 kilometres north and south and up to 60 kilometres to the west.

Sydney faces some critical challenges on a wider scale. Population is growing at over one percent annually, putting pressure on land supplies and creating environmental problems and up to 500,000 new homes will be required over the next 20 to 30 years. The NSW Government has set a target of zero growth in vehicle kilometres travelled by 2021. This target integrates with an urban strategy for containing the outward expansion of Sydney, increasing densities and encouraging the use of public transport.

(i) Sydney Transitways (T-way)

A central element of the NSW Government transport plan is the development of rapid busway public transport corridors in western Sydney. Western Sydney is further characterized by dispersed, low-density employment areas outside centres, with very low levels of public transport use. The corridors proposed as rapid bus-only Transitways are designed to address the transport needs of the western Sydney region by linking centres, employment areas and other major destinations at the same time as strengthening links to the trunk rail system. The principal focus of the proposed Transitway network is Parramatta, designated as the second CBD for Sydney (Fleming 2000).

The challenge for the delivery of the western Sydney transitway network is to quickly develop a public transport alternative that meets existing needs, forms a framework for ongoing urban development, and provides an attractive alternative to car use.



1. Liverpool to Parramatta
2. Parramatta to Strathfield
3. St Marys to Penrith
4. Blacktown to Castle Hill
5. Parramatta to Mungerie Park
6. Blacktown to Wetherill Park

The proposed Transitway network is shown inset and would extend at full development for about 100 kilometres and, under current plans, would include over 100 stations. The first link in the network, from Parramatta to the regional centre of Liverpool (about 30 kilometres), opened in early 2003.

The focal point of the Transitway network will be its stations. Over time it is envisaged that these stations will provide focal opportunities – in some of Sydney's newest suburbs – for relatively high-density, public transport-oriented development. A common Transitway station identity is being developed, through architectural design. Stations are planned to be located on trunk Transitway corridors at intervals of approximately 800 metres. Grade-separated pedestrian crossings will be included at stations in major centres or at a significant destination such as a regional hospital, or where urban form enables this to be the preferred treatment. Comprehensive, real time and static passenger information will be available at all stations. Security cameras will be provided, while stations will be shaped in line with the guiding principle of enhancing security through design (Fleming 2000). Consequently capital costs are relatively high at between AUD10-20M/km.

Over half of the Transitway network has been designed as exclusive bus-only roadway. The Transitway network has also been designed to allow for future conversion to light rail.

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.

2.5.6 Comparisons

Some recent market data examined for australasian BRT systems (Currie, 2006) has highlighted the success of BRT. Of particular interest is statistics which demonstrate the potential capacity of BRT, the ability of BRT to stimulate growth in public transport use and the ability of BRT to encourage mode shift from private car.

	Adelaide	**Sydney**	**Brisbane**
Ridership			
Annual	7m	1.9m	26m
Weekday	25,000	6,800	93,000
Peak Hour	4,500	n/a	15,000
Immediate Travel Impacts			
Corridor Ridership Growth	24%	56% [47% new journeys]	56% [17% new journeys]
% new pax who previously drove	40%	9%	26%
Stations			
Board at stations	20%	100%	66%
Board off busway	80%	0%	34%

2.6 Case Studies: North America

2.6.1 Perspectives

The Federal Transit Administration (FTA 2006) acknowledges that Communities seeking to improve their quality of life may want to carefully consider Bus Rapid Transit. FTA sponsored BRT programs are underway in US urban areas including: Boston, Los Angeles, Miami, Cleveland, Hartford, Honolulu, Santa Clara, Albany, Chicago, and Pittsburgh. In North America BRT is recognized as being able to provide an innovative, cost effective alternative to more costly fixed rail transit systems, one that can be built and improved incrementally and is flexible enough to serve both highly developed urban areas as well as lower density suburbs

2.6.2 Ottawa [Bus Rapid Transit]

Ottawa, with a metropolitan population of 650,000 persons, has the most successful extensive busway system in North America. Due to an anticipated increase in the metropolitan population, employment and increase in the transit ridership, the transit operating agency developed a rapid transit plan for the region. The strategy entailed building the rapid transit lines from the outside relying initially on surface street operations in the central area. The downtown segment was the most expensive to construct and was therefore deferred in favour of less costly construction in the corridor leading to the downtown.

The choice of a specific technology was therefore limited to systems that could operate at-grade on downtown streets. This produced two viable options, a busway or a light rail system.

These alternatives were compared using criteria including capital and operating costs, level of service, staging flexibility, and environmental impact. Based on annual costs the busway using articulated buses proved to be the least expensive. The lower operating costs of the busway alternative were due to its close demand/capacity relationship and savings from the interlining of buses between routes on the busway. With the rail system, the opportunity to short turn trains was limited so that the train capacity exceeds the demand except in the downtown area. In the case of the busway, the use of many different bus routes produces a greater opportunity to adjust the overall system capacity to match the demand as it varied along the transitway. The lower operating cost of the best busway to the best LRT alternative reflects the possibility that busway alternatives can, in the right circumstances, achieve a better match between demand and capacity (Florida IU, 1998).

3 Conclusions

Public transport mode choice is primarily driven by socio-economic criteria in all of international regions examined. This in turn is dependant on the potential passenger market for public transport and the trip patterns of prospective users. Particularly in Australasia and North America, land use development over the past 30-40 years has resulted in very low density, single use development with dispersed trip patterns not well served by traditional line-haul public transport. Consequently the concept of bus rapid transit has developed to serve this land use development. In the case of Brisbane and Adelaide the systems have performed significantly better than expectations.

No true bus rapid transit system has been implemented in the UK or continental Europe. Arguably the main barriers to this have been related to the deliverability of the full package of bus rapid transit features on any particular corridor. Light rail has demonstrated its ability to deliver the full package of complementary measures although barriers still exist in some locations (e.g. integrated bus / light rail services outside of London and Nottingham in the UK). Overall, in the right circumstances, many of the advantages of light rail can be claimed by bus rapid transit (public transport growth, mode shift and development gain).

Ultimately the right choice of public transport solution is governed by local circumstances requiring comprehensive examination of alternatives on an objective basis.

4 Bibliography

Bray DJ and D Scrafton (2000) *The Adelaide O-Bahn: Ten Years On*, in 8th Joint TRB/APTA Conference on Light Rail Transit Proceedings. CD-Rom Paper K-31 pp 1-16, Dallas, November.

Connell Wagner et al (2000), South East Busway and Inner Northern Busway, Development of Operational Plan. Brisbane (unpublished)

Currie, G. (2006) Bus Rapid Transit in Australasia: Performance, Lessons Learned and Futures, Monash University

Federal Transit Administration (2006), www.fta.dot.gov

Fleming D (2000), Public Transport for low density cities, UITP, London

Florida International University (1998), At-grade Busway Planning Guide

Hass-Klau, C., Crampton, G., Weidauer, M. and Deutsch, V. (2000) Bus or Light Rail: Making the Right Choice, Environmental & Transport Planning, Brighton.

Horowitz, A. and Zlosel, D. (1981) Transfer Penalties: Another Look at Transit Rider's Reluctance to Transfer, Transportation, 10, 279-282.

PTEG (2005) What Light Rail Can Do for Cities

Queensland Government (1997), Integrated Regional Transport Plan

Pushkarev, B. and Zupan, J. (1980) Urban Rail in America: An Exploration of Criteria for Fixed-Guideway Transit, Urban Mass Transit Administration, Washington, DC.

Transport Research Board (2000) BRT Case Studies, TRB

Transport Research Board (2002), O-Bahn Busway, Adelaide's Experience

Transport for London (2000), Cross River Transit – Summary Report