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Trade-Offs in the Re-design of Public Transport Networks, Line Haul, Express and Transit Link Service Patterns.

Alison Anlezark,
Market Research Analyst,
State Transport Authority, SA

Brian Crouch,
Manager, Market Assessment,
State Transport Authority, SA

Graham V. Currie,
Manager, Victoria,
Travers Morgan Pty Ltd

Abstract:

This paper reviews experience with the re-design of public transport networks to replace traditional local stopping bus patterns with express or line haul bus and rail services. Such schemes have been purported to reinvigorate public transport systems by refocussing on faster and more frequent line haul passenger service aspects. There are also claims that, if properly designed, such services can reduce the size of operating resources invested in the public transport network resulting in reduced service costs. The paper draws on the experience of the STA in Adelaide in re-designing and operating 'Transit Link' bus and rail services and recent reviews of the 'Line Haul' service design concept in Brisbane. The paper explores the types and relative value of the trade-offs between the passenger benefits and dis-benefits that emerge, the relative passenger satisfaction levels that are demonstrated with actual experience and the financial impacts on public transport operators in terms of operating resources and costs. The paper concludes with an overall assessment of the line-haul/express service design concept and presents a series of recommendations for future service re-design which aim to appropriately balance the positive and negative impacts of this type of service change

Contact Author:

Graham Currie
Travers Morgan Pty Ltd
Suite 9, 214 Bay Street
BRIGHTON VIC 3186

Telephone: (03) 595-0228
Fax: (03) 596-2538

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1. INTRODUCTION

Some 1.1 Billion passenger journeys are made using public transport in Australian cities every year[1]. However this still only represents some 8% of urban journeys and while this proportion is now relatively stable (Industry Commission, 93) it is still far below the expectations of those seeking relief from traffic congestion and greater protection of our urban environment.

A profusion of suggested solutions to the 'urban transport problem' have emerged although those concentrating on the public transport industry have emphasised the importance of heavy rail and new light rail projects. This is despite the fact that bus services continue to dominate public transport in most of our cities (40% more urban public transport journeys are made by bus compared to rail[1]) and there is some evidence that urban bus travel has grown over the last 20 years (Cosgrave and Gargett, 92).

This paper looks at the use of express bus services as a means of improving the performance of the urban public transport system. It focuses on the trade-offs between the financial and resource effects of these services and the passenger benefits and dis-benefits that emerge. Examples are drawn from actual experience in the operation of these services including the development of the Transit Link express bus network in Adelaide and recent planning for Line Haul express bus patterns in Brisbane.

This paper is divided into four broad sections. The first outlines the various types of express bus services that are possible. This is followed by a brief description of the development of express services in Australia concentrating on the Transit Link services in Adelaide and the Line Haul project in Brisbane. The third section examines firstly passenger responses to and perceptions of these services and then financial and resource impacts. Finally a review and assessment of these effects is made focusing on the trade-offs and balances that are required in service design.

2. BACKGROUND TO THE EXPRESS BUS CONCEPT

The US Department of Transportation (84) defines an express bus service as:

> *"one which operates non-stop between a designated collection area and a downtown area of distribution"*

Figure 1 illustrates the types of bus patterns suggested for the family of express bus services and is loosely based on the US DOT research on the subject. Express patterns can be contrasted to the first pattern which is a traditional stopping service. The first express pattern, which we term the 'pure' express, involves the collection of passengers

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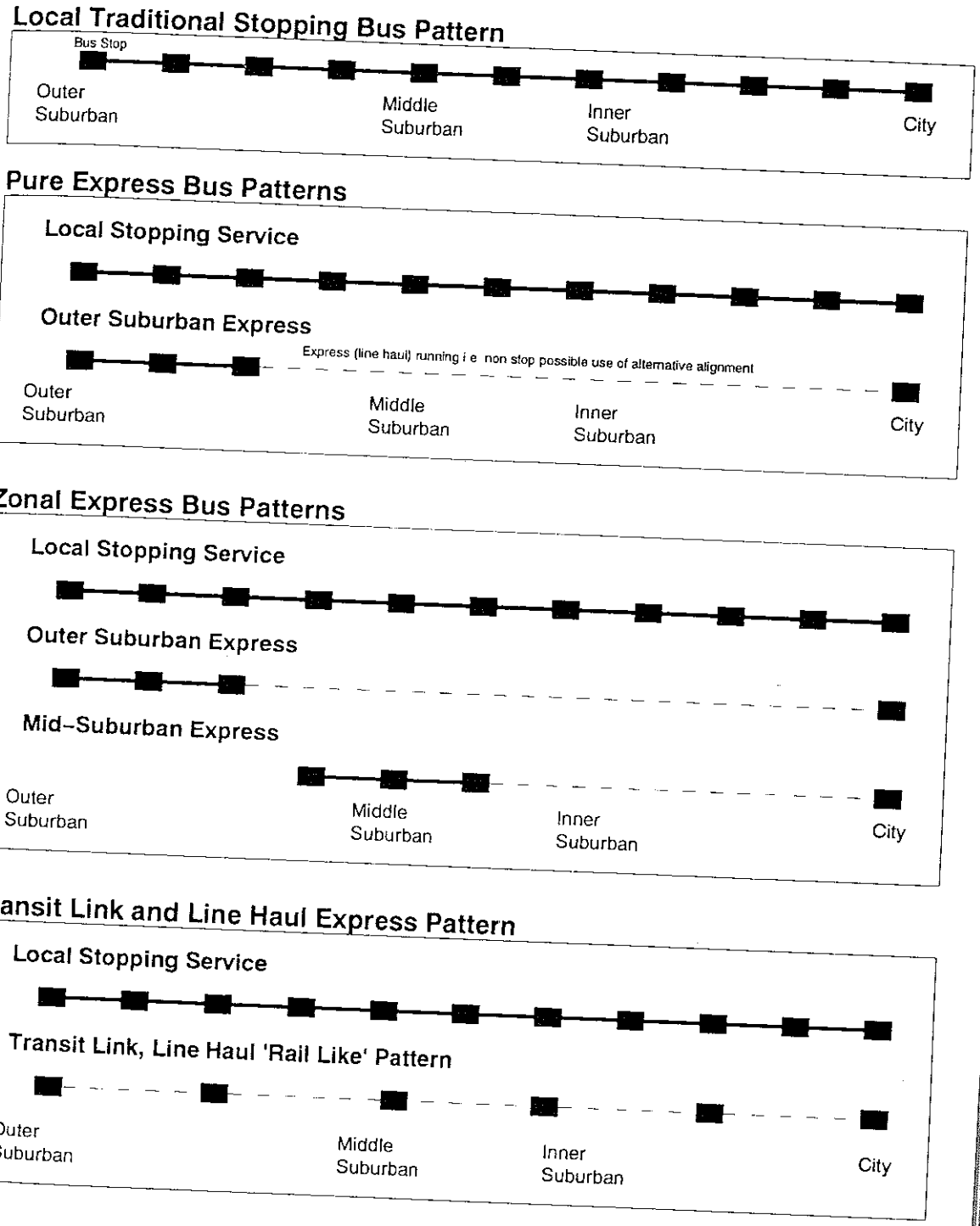
[1] Sources: Data for 1991/92 from Industry Commission (93) Travers Morgan (94), A C T A. (93) and various Annual Reports



Source: Based on US Department of Transportation (84) 'Operating Strategies for Major Radial Bus Routes Final Report' May 1984 DOT-1-84-27

Figure 1 : Types of Express Bus Patterns

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at outer suburban points and a single line haul run to the city. This pattern is run on top of local stopping services which cater for the travel needs of inner suburban passengers. The second pattern, the 'zonal express', is somewhat more complex since separate express services are provided to both outer and middle suburbs. Local services are still provided but the travel time benefits of express running are shared over a wider group of users (outer and mid-suburban passengers). The last pattern is the Transit Link and Line Haul pattern used in the Adelaide and Brisbane services. This pattern is very much a hybrid of other express family members but encapsulates the features of typical rail express service operating patterns into an express bus service i.e. stopping at designated stations with stop spacing much further apart than conventional bus routes.

Key features of express service design are:

- travel times faster than conventional stopping bus services via:
  - services which have fewer stops and hence less 'dead time' (this is time taken for vehicle deceleration/acceleration and boarding/alighting time at the bus stop while stationary).
  - potential to use a faster route/path over the non-stop segment.
- the need to identify trade-offs in the addition of extra bus stops on express routes since they:
  - permit more boarding/alighting and;
  - reduce general walk access distances to express buses, but also
  - slow the express service for through travelling passengers.
- the need to consider lower service frequencies for inner suburban passengers if some vehicle trips are operated express and consequently there are less services on inner suburban sections; alternatively express trips can be added on top of existing stopping bus services but this will involve the use of additional vehicle resources and hence higher costs.
- the possibility of charging premium fares for express (and hence higher quality) travel.

3. EXPRESS BUS SERVICES IN AUSTRALIA

The Adelaide Transit Link Network

Transit Link is the generic term to describe the family of Adelaide express bus services introduced progressively since 1992 by the State Transport Authority (STA). There are now 10 radial Transit Link routes (see Figure 2)

Transit Link was one of several measures adopted by the STA to address patronage decline (at around 7% p.a. between 1991/92 and 1992/93). Bus travel dominates the Adelaide public transport system, therefore bus based solutions were required to address this decline (other public transport modes total less than 18% of overall patronage)

The emphasis of the Transit Link concept is on the provision of a higher standard of service and key features include:

- use of the newest vehicles in the fleet;
- services are concentrated in major volume corridors and during peak periods;

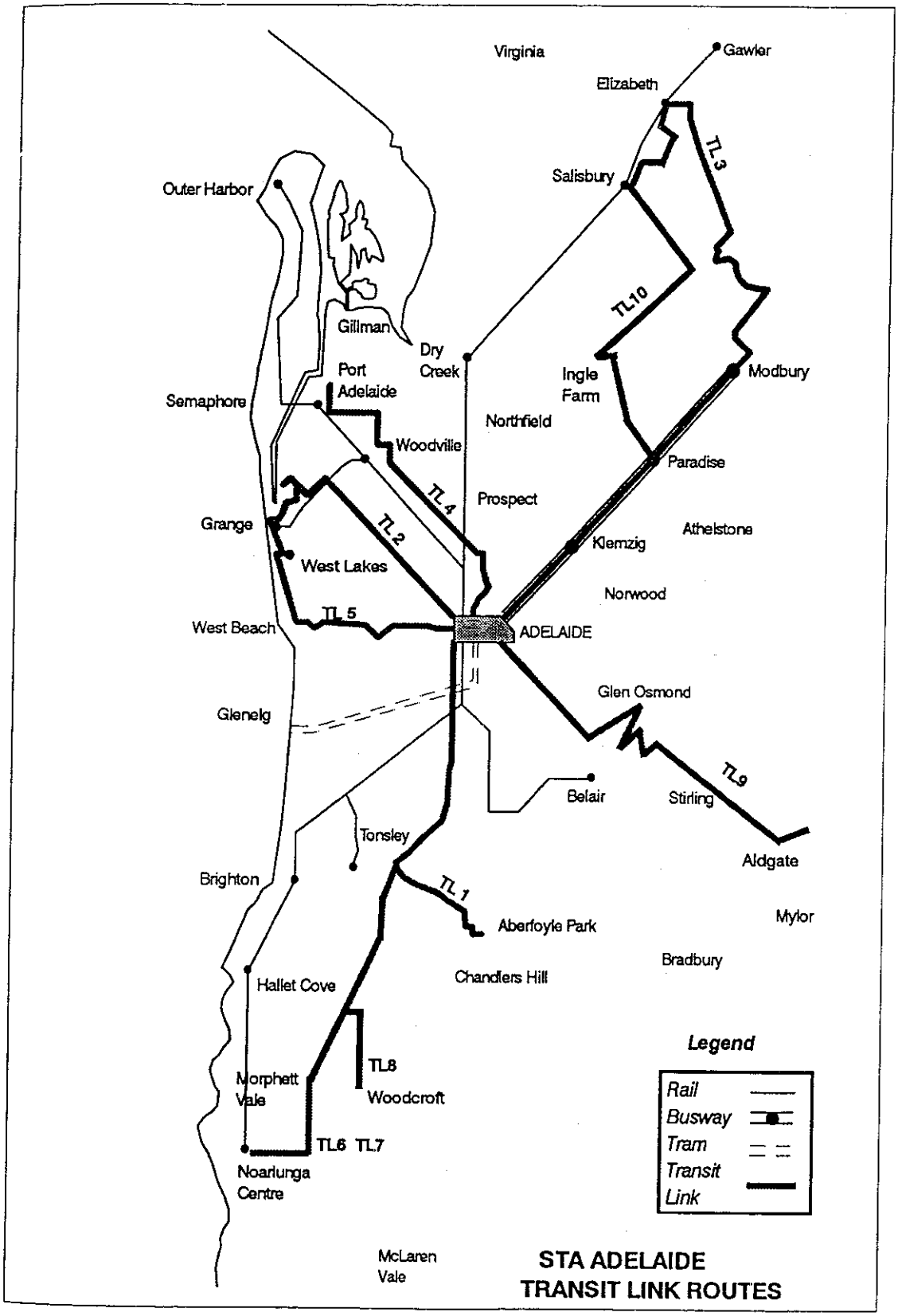

Figure 2: Adelaide Transit Link Express Bus Network

- stopping points are limited to selected important local centres;
- new styled stops called 'stations';
- local bus services feed into and are coordinated with Transit Link;
- bus priority strategies have been implemented to improve running times;
- the service is marketed separately from other public transport 'products'.

Another motivation for Transit Link was a general view that the STA's core business should concentrate on markets with higher volumes and density. In the longer term private companies or community transport operators could provide feeder services from low density suburbs to Transit Link services operated by the STA

In practice there have been two main types of Transit Link service introduced; 'overlay' services and 'balanced' services. The 'overlay' Transit Links have involved the introduction of new services without any reduction in existing services and hence a general increase in the amount of supply. The 'balanced' services were introduced as a package of measures where supply did not change substantially (or in some cases savings in resources were made). With 'balanced' service changes the new Transit Link service was generally provided as a replacement for some of the stopping bus services.

Overall, the majority of Transit Link services are 'overlay' services Three services, Transit Link's (TL's) 2, 4 and 5, were introduced as part of a 'balanced' package of service changes.

Line Haul Bus Service Development

Brisbane was one of the first cities to develop a clearly defined separate express bus service image and product with the introduction of the Cityxpress services in the early eighties (see DOT Brisbane City Council, 1984) However the development of this design into the Line Haul concept is somewhat more recent. The basic premise is that:

- for radial corridors of the city not served by rail, express buses should operate in a similar pattern to rail along the major artery;
- express or Line Haul buses operate with larger capacity vehicles in a separate livery to a few designated stops termed 'stations';
- local bus routes are redesigned to feed and coordinate at local 'stations';
- in most cases direct services to the city are cut to feed to local Line Haul express bus routes;
- the capacity saved by cutting long distance city based routes is redeployed to increase the density and frequency of buses feeding to Line Haul 'stations';
- a key aim of the design is to focus access on major regional activity centres where designated Line Haul 'stations' are located.

These design elements are very similar to Transit Link. Indeed a similar focus for public transport network redesign is shared with other cities; recently developed strategic goals for Public Transport in Melbourne have included the following:

> *"to develop and market a "line haul" public transport system comprising radial train, tram and bus services, major transport interchanges ("nodes"), and cross town bus services".* Victorian Transport Agencies (1993)

However a significant emphasis of the Brisbane Line Haul service design is 'balanced' service planning i.e. adopting a package of measures which do not significantly increase resources/costs.

The Line Haul concept in Brisbane is only in the development stage. Results of a recent design and service impacts review (Travers Morgan, 93b) are included as examples in this paper.

4. PASSENGER IMPACTS OF EXPRESS SERVICES

Market Size Impacts of Transit Link

Some 2.5 million journeys p.a. are made on Transit Link services. This represents 6% of the total Adelaide bus market. Of the 10 services, TL3 (Elizabeth via busway), TL4 (West Lakes) and TL10 (Elizabeth via Ingle Farm) account for just over half of all Transit Link demand.

A major travel market impact has been the attraction of new users; over 20% of the Transit Link market are new to public transport and of these the highest proportion are formerly car drivers. Table 1 compares the mode change behaviour of the Transit Link market with available data on the sensitivity of other new public transport initiatives. There is some variation between the market growth for individual Transit Link services with TL3 having the largest growth at 27% and TL5 the lowest at 12%. The data shows a significant trend towards higher growth from 'overlay' services (TL3) compared to 'balanced' services (TL's 2, 4 and 5). This may be expected given that the 'overlay' is a net overall increase in supply. What is somewhat more surprising is that there is also a demonstrated growth of the 'balanced' Transit Link services. The data suggests that market growth has occurred on these services despite the stable (or reduced) supply/resource input characteristics of 'balanced' services. These circumstances would clearly be attractive to the service provider from a cost recovery viewpoint although the effect on demand for all routes in the 'balanced' service change package must be considered.

There is some variation in performance when comparing the change in mode behaviour between Transit Link and other new public transport initiatives. Available data is a little 'patchy' on this issue (despite its obvious relevance/importance). Generally, heavy rail and light rail projects would tend to demonstrate higher mode diversion and patronage generation than bus based solutions including Transit Link. Ranges of market growth lie between 10% and 40%. Of the bus based solutions the 'overlay' Transit Link TL3, Brisbane Cityxpress and the larger Northeast Busway project in Adelaide show better market growth, mode diversion and trip generation performance (although TL3 clearly comes last of these). The performance of the 'balanced' Transit Link services is probably lower than that of all the other service types. However overall there is an inverse relationship between the market growth performance of different modes in Table 1 and the costs incurred in achieving that growth. The 'balanced' services are unlikely to incur any additional costs (and possibly make savings) but the data suggests that

growth is still achievable in these circumstances.

Table 1 Comparison of Mode Change Behaviour After The Introduction of Transit Link and Other New Public Transport Initiatives

New Service	Previous Mode Used Before New Service Introduced (Proportions of New Service Market)						
	Car Driver	Car Passen-ger	Total Car (Diversion)	Did Not Travel (Generation)	Total Market Growth	Public Transport	Other
Transit Link (TL) Services							
2 West Lakes	10.2	4 4	14.6	6 0	20 6	77 5	1 9
3 Elizabeth	10 0	5 1	15.1	11.7	26.8	71.8	1 4
4 Port Road	6 9	3.8	10 7	5 8	16.5	82 2	1.3
5 Grange	3.9	3 7	7.6	4.2	11 8	87 3	1 0
T.L. Average	8 4	4.4	12 8	8 1	21.0	77 7	1.4
Other New Public Transport Initiatives							
Bus Based							
– Brisbane Cityxpress	11 6	11.6	23 2	11 6	35.0	65.0	–
– Adelaide Busway	13 3	5.7	19 0	9.0	[1]33.0	67 0	–
Light Rail							
– Manchester Metrolink	–	–	10.0	15 0	25 0	75 0	–
– US Light Rail	–	–	@33 0	–	–	–	–
Heavy Rail							
– New Rail Station (W.Yorks UK)	–	–	16 0	13 0	29 0	69 0	2.0
– New Rail Lines							
– Perth New Northern Suburbs Railway	23.0	1.1	24 5	9 9	34 4	63.6	0.7
– Birmingham (UK)	–	–	11.0	26 0	37.0	63 0	–
– Glasgow (UK)	–	–	15.0	15.0	30 0	70 0	–
– Merseyside (UK)	–	–	20.0	24.0	44.0	56.0	–

Notes: [1] Includes 4% other non-public transport modes

Sources: Alexander & Houghton (1993), Anlezark (93a, 93b), B C.C. (84), Cox & Love (91), Local Transport Today (94), Steer Davies & Gleave (90), Tordoff (93a, 93b), Wayte (91)

Impacts on Market Decline

Some 20% of the Transit Link market is new to public transport hence some half a

million passengers p.a. have been added to offset the general market decline. However for the 92/93 financial year the total market declined by some 2.8 million journeys. This decline would have been about 20% larger without Transit Link. There is clearly a long way to go before this type of initiative alone could completely offset the decline. At the same time a net increase in market size of over 2.8 million p.a. is a lot to ask of ten urban bus routes which carry 2.5 million passenger p.a.

Another way of gauging long term performance is to compare total market size in the vicinity of a new Transit Link service before and after its introduction i.e. including local stopping bus routes. Such analysis suggested a net growth in patronage for all corridors with Transit Link of 1%, compared to decline in other corridors over the same period of 5% i.e. a performance, net of market decline, in the region of 6%. 'Balanced' Transit Link services had performance very similar to market trends however the 'overlay' services showed a net market increase of some 8%.

'Overlay' Transit Link Performance Compared to Conventional Bus Service Initiatives

Since most Transit Link services are 'overlays', and hence require additions to fleet resources and costs, an important issue to address is the value for money for investment in new Transit Link services compared with the value obtained from deploying new vehicles in other, more conventional, ways. One way to assess this is to compare the service elasticity (i.e. the change in patronage caused by a given change in the amount of service provided) for new Transit Link services with that of other new types of service.

Overall the demonstrated service elasticity (with respect to vehicle kilometres) for the overlay' Transit Link routes is +0.55. Standard industry values (see TRRL, 1980) are generally lower than this at about +0.4 and +0.5. This suggests that new Transit Link services result in a better demand generation performance than may be expected by just increasing frequency on routes or by simply introducing new 'all stop' type services. Indeed typical industry service elasticities for the peak (around which Transit Link services are based) are often much lower (possibly as low as +0.3). The conclusion therefore is that demand growth performance of 'overlay' Transit Link services is better than for other more conventional types of new bus service initiative.

It is difficult to go further in establishing demand performance of Transit Link services since the cause and effects of various other service changes, population growth and the socio-economic characteristics in each of the Transit Link corridors all play a part. However it is not surprising that service elasticities indicate a better performance from 'overlay' Transit Link services. The attributes attracting passengers not only include the service effects from a higher frequency and supply, they also include the travel time reduction impacts of a faster service. In addition passenger perceptions of the new vehicles and their general image may all play a part.

Passenger Perceptions

Table 2 compares the results of market research for several 'Transit Link' services and that for the public transport market in Adelaide as a whole. This research concerns reasons for use of those services.

Table 2 **Comparison of Reasons for use of Transit Link and The Public Transport Market as a Whole**

Service	Reason for Use (%)				
	No Car Available	Car Parking Problems	Bus is Quicker	Bus is Cheaper	Other
Transit Link Service					
2 West Lakes	39.3	12.5	16.9	26.3	5.0
3 Elizabeth	37.0	6.7	22.0	24.6	9.6
4 Port Road	50.3	6.9	15.2	21.9	5.7
5 Grange	42.3	9.3	15.9	21.0	11.5
All Surveyed Transit Links	**42.2**	**8.9**	**17.5**	**23.5**	**8.0**
Total All Public Transport	**51.0**	**7.0**	**8.0**	**22.0**	**12.0**

Sources: Anlezark (93a, 93b, 94), Tordoff (93a, 93b).

Lack of a car is the most significant reason for use of all services, however it is less important to the Transit Link market; more users are 'Choice' users (i.e. they have a car available) but chose to use bus as an alternative. There are clear correlations between the lower dependence on car travel for Transit Link users and the high proportions of new Transit Link travellers who previously used cars for travel.

Another significant trend is the much greater appreciation for the faster service speed attributes of Transit Link; at least double the proportion of Transit Link users cited this as a reason for use compared to the public transport market as a whole (including bus and rail). Overall however the service speed attribute was not as important as the low cost of public transport services generally.

Table 3 shows comparative passenger satisfaction levels for Transit Link services and STA services a whole. Transit Link users are significantly more satisfied with their service than public transport users generally; over double the proportion of Transit Link users rate the service above average compared to public transport users as a whole. All Transit Link services are very highly rated although the 'overlay' services (TL3 in Table 3) are possibly more highly rated.

Table 3 **Comparative Passenger Satisfaction Levels: Transit Link Services & Total Public Transport Market**

Service	Rated Satisfaction Level		
	Below Average Satisfaction (Very Poor/Poor Rating)	Average Satisfaction (Neutral)	Above Average Satisfaction (Good, Very Good)
Transit Link Service			
2 West Lakes	2.6	5.1	92.4
3 Elizabeth	2.2	5.7	92.1
4 Port Road	4.7	13.2	82.1
5 Grange	5.5	8.0	86.9
All Surveyed Transit Links	**3.8**	**8.0**	**88.4**
Total All Public Transport Services	**19.0**	**38.0**	**43.0**

Sources: Anlezark (93a, 93b, 94), Reark Research (94), Tordoff (93a, 93b)

Customer preferences were further investigated in surveys where passengers were asked to rate the performance of various specific service attributes (Reark Research, 93). This indicated higher average performance ratings for Transit Link services compared with public transport generally in respect to:

- speed of service
- vehicle cleanliness
- passenger security
- lack of graffiti
- standard of stations/shelter
- access to parking at terminals/stops.

Nature and Size of User Benefit/Disbenefits

In practice the user effects of express services depend on the type of service being introduced, the detailed configuration of the service change and the impacts of these on individual trip patterns. For 'overlay' services there will only be positive passenger effects since the express is provided on top of existing routes. Benefits will result from higher service levels and faster journey times from express running. Benefits are therefore a combination of frequency increases, wait time reductions and travel time reductions.

For 'balanced' services the trade-offs are more complex since some elements of existing services are removed and used to operate the express service. To assess the overall (net)

effect a detailed knowledge of individual trip patterns is required. The number of those who benefit and the size of their benefit must be known and compared against the number who have a slightly worse service and the relative size of their disbenefit.

A major part of the assessment of the 'balanced' express designs for the Brisbane Line Haul service (Travers Morgan, 93b) was modelling of the effects of the possible express and feeder bus patterns on a detailed database of passenger volumes and trip origin/destination (OD) movements (see Crouch, Currie and Wallis, 92 for a description of methodology). Table 4 (top) shows a summary of travel time impacts of a typical package evaluated in the study, these are expressed as average travel time changes in minutes of journey time.

Table 4 Summary of User Travel Time Impacts – Typical 'Balanced' Line Haul Service Package – A.M. Peak

Changes In AVERAGE Passenger Journey Times

Journey Component	Average Passenger Time(Min)	Percent Total Impact
• In vehicle travel time	-0.61	-28.4%
• Waiting time at bus stops	-1.68	-78.1%
• Access/egress walk time	-0.09	-4.2%
• Transfer time	+0.24	+11.2%
Total Impact	-2.14	100.0%

Overall Distribution and Scale of Benefits/Disbenefits

	No. of Journeys	Average Real Journey Time Change (Mins.)
Trips unaffected by service changes	1,944	0.0
Trips with improved service	3,274	-9.6
Trips with lower service	1,662	+8.9
Generated (new trips)	404	-
Total Trips	7,284	-2.1

Sources: Travers Morgan (1993b)

Overall an average net saving of about 2 minutes of travel time per passenger were forecast (although this was distributed unevenly throughout the market with some winners and some losers). Significantly most benefits (about 80%) result from waiting

time reductions at bus stops rather than the in-vehicle travel time reductions that may be expected from express services. Waiting time benefits resulted from :

- the redistributive effects that result from concentrating vehicles on higher volume corridors (more passengers benefit from the higher frequency in these high density corridors than those that 'lose out' from lower frequency in lower density suburbs).
- many local routes operating directly from suburban areas to the city were cut to feed to Line Haul service stops (or stations). The new feeder service was usually operated at a higher frequency hence reducing waiting times.

Overall access/egress times from homes/work to and from bus stops showed a small net improvement. This is somewhat contrary to what one may expect from an express service design which focuses service on a limited number of stops. In practice access/egress times were slightly reduced overall via:

- improved area coverage of feeder buses, and;
- the concentration of Line Haul services on more important stops (around which passengers live in higher density groups).

Not all components of travel were forecast to show a net improvement. Disbenefits arise from the increased transfer requirements at key feeder points and Line Haul interchanges. The cutting of direct local buses to the city to feed to Line Haul 'stations' means that through travellers have to weigh any travel time and wait time benefits against a forced transfer onto the Line Haul service. Overall average travel benefits are reduced by 11% as a result of forced transfers.

Table 4 (bottom) also shows the total effects of the service change on the market as a whole expressed in terms of those who have a better or a worse service. Some 45% of passengers have a better service with real travel times savings (mostly waiting time reductions) of about 10 minutes. This is balanced against about half this proportion that disbenefit by around 9 minutes each in real terms. The overall net improvement in service is forecast to generate a net growth in the market of around 6%

While the results in Table 4 are specific to the area and package evaluated, the following can be concluded about the user effects of 'balanced' express services generally:

- there are trade-offs to be made between passengers with a better and passengers with a worse service;
- benefits can be generated from local frequency effects as well as the travel time reductions associated with express service;
- passenger transfers generated from the package are significant disbenefits.

5. OPERATING RESOURCE AND FINANCIAL IMPACTS

Net passenger growth demonstrated by the Transit Link and the Line Haul service increase overall fare revenues. However for 'overlay' services this does not improve cost

recovery since costs are increased by a larger margin with the introduction of additional vehicle resources. In its favour the service elasticity analysis noted above indicates a better overall patronage growth for 'overlay' services compared to simply increasing frequencies or operating new conventional bus routes.

The financial situation is far more favourable for 'balanced' service changes, however the returns on patronage growth, passenger satisfaction levels and overall user benefits are less. The key financial impact of 'balanced' service changes is the trade-offs between these factors and the cost reductions resulting from the savings in vehicle resources.

Table 5 shows how these trade-offs appeared in the Brisbane Line Haul project evaluation. The existing services were provided with a fleet of 80 vehicles. An assessment of the initial plan for the project suggested that this would increase to over 100 vehicles. As may be expected this generated a high market growth, high user benefits and a large proportion of winning passengers (passengers with a better service). However the initial plan also a generated a high volume of losers; a very unattractive proposition when traded-off against the large fleet size (and cost) increase.

Table 5 Trade-Offs Between Passenger & Operating Resource Impacts - Brisbane Line Haul Project, A.M. Peak

Service Package	Demand Impacts				Supply Impacts
	Passenger Journeys (No.)	Net User[1] Benefits ($/Peak)	Pax. with Better Service (No.)	Pax. with worse service (No.)	Number of Buses Required
BASE (Current Network)	6,880	–	–	–	80.5
Initial Line Haul Draft Design Plan	7,330 +519	$3,086	3,542	1,695	101.3 +20.8
Optimised Package A (Resource Saving Strategy)	7,284 +404	$2,372	3,274	1,662	79.1 -1.4
Optimised Package B (Trade-Off Strategy)	7,413 +533	$3,112	3,339	1,269	84.2 +3.7

Notes: [1] Net travel time benefits are weighted and converted to $ terms using a value of time of $4.20/hr.
Source: Travers Morgan (1993b)

Two optimised service change packages were developed from a detailed analysis of each of the component parts of the initial Line Haul plan. They represent opposite ends of a spectrum with resource saving a priority at one end (The Resource Saving Strategy) and maximising user benefits (within a resource constraint) at the other (The Trade-Off Strategy). The key trade-offs that emerged included:

- with the Resource Saving Strategy a net saving of vehicles (and costs) result. The trade-off to achieve this is that while demand growth, net benefits and the number of winners is still high, it is less than that demonstrated in the initial Line Haul plan.
- The Trade-Off Strategy slightly increases vehicle resources, however patronage growth, net user benefits and the number of winners is higher than the initial plan. Also the number of losers is lower than the other plans.

Interestingly the Resource Saving Strategy has less losers (passengers with a worse service) compared with the initial plan, even though 22 less vehicles are used. This is indicative of the benefits of a detailed assessment of the service redesign package using good passenger data.

The optimisation process used to define the Resource Saving and Trade-Off service change packages included the following key elements to improve performance:

- balancing of local stopping service frequencies with Line Haul expresses in inner suburban areas;
- reducing the catchment area for cutting direct local to city services to feed to the Line Haul 'stations';
- careful consideration of city centre alignments for passenger distribution.

The critical difference between the two strategies was the degree to which transfering was 'forced' upon passengers. With resource saving a more 'heavy handed' use of service cutting and feeding to Line Haul terminals was used. This saved buses but generated transfers. With the Trade-Off Strategy routes were diverted to Line Haul 'stations' making transfers discretionary; however the feeding route was not cut at the 'station'. In this way passengers can transfer if they desire i.e. if they can benefit. Those that do not wish to transfer are not forced, hence they do not generate disbenefits. The cost of this trade-off is less saved vehicles.

6. REVIEW AND ASSESSMENT

This paper has reviewed the experience of express bus service patterns in Australia, focusing on the Adelaide Transit Link and Brisbane Line Haul projects. Express services are not new to Australia although the Transit Link and Line Haul services are marketed as separate products with an original design. The Transit Link services have demonstrated:

- patronage growth higher than would be expected by conventional service level increases;
- high diversion of car demand to public transport. While this diversion is lower

than that for new rail projects, the costs associated with new express buses are well below those of new rail services;

- a very satisfactory impact on a declining market trend, although the scale of the Transit Link initiative is well below that required to reverse these trends;
- very high passenger satisfaction levels compared to other public transport services.

'Overlay' services have better demand performance compared to 'balanced' service changes. However the cost effectiveness implications of 'balanced' service changes are attractive given the overall financial constraints and cost recovery performance of public transport.

Detailed assessments of user benefits/disbenefits of express services have shown that 'overlay' services will always generate benefits mainly from frequency increases and faster journey times. This must be traded-off against increased costs. With 'balanced' services, savings in vehicles are possible while demand performance assessment suggests that:

- net benefits can still be generated;
- benefits can come from frequency increases resulting from a redistribution of vehicle capacities;
- transfers are a significant problem with 'balanced' service designs;
- the transfer problem can be eased via sensitive handling of service design at interchange points, in particular by reducing 'forced' transfering.

It is possible to generate net user benefits and also reduce, or at least maintain, existing resources using a 'balanced' service planning approach. However:

- more sensitive handling of the 'forced' transfer issue will require a trade-off against resource savings; and
- there will always be some losers, however they are usually a minority and overall the market will grow.

Overall it is clear that the Transit Link and Line Haul products are an attractive addition to Public Transport; they have very satisfactory demand performance and are popular. They are a good means for governments to be seen to be doing something about the 'urban transport problem' where a bus based approach is the only practical solution available. However it is important to recognise that they are only one of many possible initiatives to attract people from private car use; the scope for the introduction of such service is limited; they cannot solve all urban transport problems on their own.

The scope for financial improvements with 'balanced' service changes is another attractive feature. There is also scope to consider fare supplements for such services (although this option is not widely considered in Australia). The emphasis which these express patterns place on regional and local urban centres as Line Haul stops/'stations' also works to reinforce a nodal sub-regional urban structure. This can be an attractive urban planning feature.

Unfortunately it is unclear if the recent trend towards regulatory reform and

contestability for service provision will act for the promotion of the further Transit Link/Line Haul type express service initiatives. A network wide perspective is required for effective planning considering many routes, operating catchments and (in some cases) operators. 'Overlay' services may be easier to implement since they do not change the operating arrangements for existing routes (or operators or contracts). However there will always be concerns that they are abstracting passengers (and revenue) from other operators routes. With 'balanced' service designs the trade-offs become more complex when the effects on different bus operators is concerned; delicate decisions about which operator should have more or less service than at present will be required. Furthermore contracting structures can tend to further complicate express planning; it is difficult to adapt a corridor wide plan if the service catchment covers many separate contract areas and contract periods. If there are defined contract areas, boundary problems for through running routes will present difficulties as will considerations about the continuity of agreed contract periods should different periods prevail in the same corridor. Overall these issues may be in the 'too hard basket' for many urban transport regulators who are concerned to be seen to be fair to all operating companies and providing a 'level playing field'.

It is possible to review the experience of the Transit Link and Line Haul services to consider best practice criteria for future design of these services. For Service Design key recommendations are:

- the need for a detailed knowledge of passenger OD trip patterns in order to minimise negative impacts and also to emphasise positive design effects
- a sensitive handling of transfer provision in reorganising route and service structure;

Service Marketing should emphasise:

- that the service is different from other public transport;
- frequency and operating speed advantages, comfort, reliability, safety and cleanliness;
- a market targeting towards the peak, adult car driving market segment

A good Implementation Strategy would foster a positive image for the service via:

- the initial development of 'overlay' services, with 'balanced' services implemented once a good service image is established;
- targeting corridors with the greatest travel time saving benefits for the first services;
- marketing the service as a city wide network from the first service, i.e. making it clear that passengers in all corridors will get a service eventually

Finally it is worth emphasising that bus service enhancement projects, such as the express patterns described, are very important elements of a wider strategy to reduce urban congestion problems. Currently bus based initiatives are not as fashionable as light and heavy rail projects; however they relate to the public transport mode used by the majority of Australians and in many (if not most) cases, bus based initiatives will be the only new public transport alternative physically, structurally, environmentally and financially possible.

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