TECHNICAL PAPER

LIGHT RAIL, IS NEW ZEALAND READY FOR LIGHT RAIL – WHAT IS NEEDED IN TERMS OF PATRONAGE, DENSITY AND URBAN FORM.

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ABSTRACT:

The paper is intended to reflect what patronage levels and urban form would be required to make light rail an effective travel demand management tool here in New Zealand. What is needed is a new form of public transport that can present a real alternative to the car. Close integration of light rail stations with where people live and where they want to go (shopping, cinema, hospitals, work, schools & universities, etc) is fundamental. With the right form of urban consolidation and increases in density along defined corridors, Light Rail has the ability to significantly change modal split within our cities towards public transport in the long term.

The issue of cost will be addressed with the author indicating, there is no reason why, in New Zealand, costs could not be kept down to around NZ $10 - 15 per km.

The paper will draw on the author's knowledge of Light Rail systems from undertaking a Churchill Fellowship world study tour of Light Rail, further research and from working in the UK, Australia, and North America on planning new light rail systems and associated urban forms.

INTRODUCTION

As our New Zealand cities continue to grow, so do the demands for faster and more efficient access. The days of building more approach roads into our cities and new city car parks with greater capacity maybe coming to an end. The public is demanding that our political leaders seek alternatives. Public transport is commonly voiced as an appropriate tool, yet its success in achieving significant modal shifts has been patchy. What is needed is a new form of public transport that can present a real alternative to the car. If New Zealand cities are to take advantage of the Light Rail revolution occurring in many North America, Australia & European cities and gaining growing popularity in Asia, then light rail as a concept must be sold to the people. There is a growing acceptance that a new tool is required to aid travel demand management in our cities. Light rail is being heralded, particularly in Europe & North America as just that tool, yet very few people here in New Zealand have ever heard of light rail and what it can do. Light rail thus needs to be sold to the people if it is to be an effective tool in travel demand management. Like any tool, certain right conditions need to prevail, for light rail to be effective there is a certain level of patronage and urban form required.

CHARACTERISTICS OF LIGHT RAIL

The success of light rail along defined corridors, particularly in Europe, can be attributed to its modern, often futuristic vehicles, perception of reliability, quietness, ease of access, climatic controls, and environmentally friendly nature. Basically, light rail appears a trendy new way to travel around our cities, compared to the car.

In Calgary, Canada, the southern LRT line has attracted 22% of its patrons as being previous car users[1], whilst in Paris 6% are former car users and 14% are new travellers[2] using the LRT for trips home for lunch, etc, not previously undertaken. These sorts of results, where quantified, help substantiate the real impacts LRT can have on travel patterns in our cities.

Technically light rail can be described as having the following attributes:

- It is rail based - vibration free track;
- Flexible up steep gradients - 10% on one section in Sheffield, UK (Lau, W);
- Can turn easily around corners (25 metre turning radius being common and in some cases less);
- Can travel along streets, run on an elevated track, share track with heavy rail and metro systems, and go underground;
- Basically it can go anywhere a track can be constructed;
- Uses clean, mainly over head, electric current 600/750 V (can run on dual current 750V/15KV as in Karlsruhe, Germany);
- Vehicle cars are very quiet, light, modern & futuristic;
- New vehicle cars are available now that run on low sulphur diesel, thus dispensing with overhead power (examples being in New Jersey, USA and Ottawa, Canada);

[1] Calgary Transit - Personal communication 2007
[2] Syndicat des Transports Parisiens - Personal communication Sept 95

- Carrying capacity per car can be up to 275 passengers when articulated;
- Low level floor entry cars are very common now for all new light rail vehicles;
- Light rail vehicles can be run in 2,3,4 or 5 car sets (pushing potential passenger capacity to over 1000, although normally a higher vehicle frequency would be used to achieve the same effect);
- Operates in town at around 25 km/h and up to 100 km/h outside;
- Headways (gaps between Super Trams) can be as low as one minute, although four to six minutes is more common today;
- Track is usually 1435mm Standard Gauge.

Overall, Light rail presents the flexibility to run easily in downtown congested urban areas and the switch immediately to operate like a fast heavy rail commuter system, when it is given its own right of way with priority.

A common question to arise when considering light rail is why not buses? Buses provide an important role in urban society to moving people along very flexible route structures and act as an ideal feeder service to rail based public transport operations. Where the key difference prevails between a bus and light rail system is in the public perception. Any rail based system is perceived to run on a fixed time schedule and not be subject to road delays. Light rail is seen as a more modern and cleaner travelling mode, whereas buses all too often suffer from past associations from aging bus fleets.

SUPPORTING INFRASTRUCTURE

LRT needs good support infrastructure to ensure ease of use and to retain patronage.

- Good feeder bus services (70% of patrons in Calgary, Canada, arrive at LRT stations by bus[3]);
- Kiss & Ride facilities at all stations where the catchment has a number of car based patrons being dropped off by their partners, parents, etc;
- Park & Ride facilities. On Portland's LRT, approximately 25% of light rail users use the park & ride facilities. The western line extension provides 3,500 park & ride spaces.[4] In Grenoble, 1,000 park and ride space have been provide close to the alignment[5]. In Edmonton, Canada, 2200 parking bays are provided with an average occupancy of 80% during the University term.[6] In Sheffield, Meadowhall station provided 230 park & ride spaces for British Rail passengers. Prior to the arrival of the Supertram sharing the station, occupancy levels were only 30%. Since the arrival of Supertram the park & ride is frequently full (Goss,1995).

[3] Calgary Transit - Personal communication 2007
[4] Metro - Personal communication August 95
[5] Syndicat Mixte des Transport en Commun de l'Agglomeration Grenobloise - Information Brochure on the construction of the Grenoble City Tramway P10
[6] Edmonton Transit - Personal communication August 95

In Calgary, the 13,000 park & ride lots are almost always 100%full[7]. On Calgary's south line, 22% of travellers by LRT formerly used their cars for the entire journey.[8]

Hack (2002) refers to how in Strasbourg, park and ride station facilities built around its new light rail system increased patronage by 100 percent from residents living outside the metropolitan area during its second year of operation.

- Integrated ticket system with all public transport modes in the region. All systems visited managed to achieve full integration with other public transport systems in the city to allow patrons to use one ticket. Comments from some transit operators indicated that there is no point in introducing LRT without full integration or patrons will largely avoid using it.

- Clear fare information and simple instructions. In general, most fare information was difficult to follow, leaving the passenger unsure if the fare paid was correct.

- Clear passenger information systems showing time of next train, destination and any delays. The Docklands light rail system in the UK, has an excellent real time information displays on all station platforms.

- Ticket machines at all stations with easy to follow instructions. The French systems are good examples as they provided the ability to pay by credit card for weekly and monthly tickets. Some machines required the correct change, as not giving change or accepting notes is clearly very inconvenient.

- Low level floor platforms (dual levels when sharing stations with high floor vehicles i.e. old trams) where possible integrated with the footpath to avoid steep ramps, as in Strasbourg.

- Safety (fencing, stop plates, raised pavement borders). The Green Line stations in Los Angeles had the best examples of fencing to protect patrons, the use of stop plates at stations should someone or something fall on the track, and raised pavement borders along the platform edge to stop blind or near sighted persons falling on the track.

- Frequency of service is a fundamental issue to attract large numbers of people out of their cars. Most systems ranged from 4 to 6 minutes in the peak as an average and sometimes up to 10 minutes off peak.

- Well designed interchanges/stations. The standard of interchange design varied significantly. Issues such as protection from the weather, direction signage, seating, waiting areas, phones, cafes and architectural design, are so variable that between and across systems, the public never know what to expect. The most successful interchanges/stations in France have captured the concept of the station forming a public meeting place.

- Security to convince the inhabitants in LA that it would be safe using the 'tram', the system has its own police force and all the carriages are protected with bullet proof glass!

- Good Maintenance to keep operations effective. Edmonton Transit recommend 10 to 15% of fleet allowed in maintenance at any one time [9](this may in part be a reflection of the bad winter weather).

[7] Calgary Transit – Personal Communication 2007
[8] Calgary Transit - Personal Communication 2007
[9] Edmonton Transit - Personal communication August 95

- Access for the disabled and less able which is easy to use. France, in particular, leads the way with low level floor vehicles in all cities and platforms that are designed to ensure no vertical and minimum horizontal gaps. In Strasbourg and Grenoble in particular the station platforms form an integral part of the footpath.

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- Close integration with other modes of public transport - as in the case of Paris with many of its Metro stations being adjacent to LRT stations.

- Priority for LRT at road signals when sharing road space (a problem for cities such as Calgary where Downtown LRT vehicles stops at all signals).

- Free fare zone in busy downtown areas. One excellent idea was the introduction of a 'City Centre Free Zone'. This allowed people to hop on and off the 'Supertram' anywhere in Calgary & Edmonton centre at no cost, thus helping to reduce downtown road congestion and pollution. In Calgary 22,800 + people per day use the free zone downtown.[10]However, in Calgary this free zone's potential impact is reduced by the 'tram' stopping at road signals.

- Regular ticket checks to stop fare evasion. Most of the LRT systems visited worked on the honour principle of obtaining a ticket for the trip with occasional ticket checkers rooming the stations and Supertrams. Unfortunately fare evasion is a mounting issue for most LRT operators. In Paris 16 - 17% of passenger do not pay. [11]

PATRONAGE LEVELS

Just how effective light rail has been in influencing travel patterns in the cities can be seen from figure 1:

Table 1: Patronage Levels in Europe and North America

JOURNEYS PER DAY	LINE(S)/SYSTEM	LENGTH	JOURNEYS PER DAY PER KM
82,000	Croydon	27.0 kms	3,050
248,000	Calgary system	44.9 kms	5,520
230,000	Grenoble	34.2 kms	6,760
288,000	Rouen	43.3 kms	6,650
62,700	Denver	56.3 kms	1,113
41,300	Salt Lake City	30.5 kms	1,355
42,000	Edmonton line	12.6 kms	3,415
107,600	Portland	71.0 kms	1,515

Sources: Calgary Transit 2006; Grenoble Transit 2008; Tri Met Portland 2009; City of Edmonton 2009; Rouen Municipal Public Transport (TCAR) 2009

What is important to note out of this table is that Calgary has a city population of just 1 million people, Edmonton with a city population of 730,000, Grenoble with a city population of 531,000, and Rouen with a city region population of 400,000 are in the top four cities in terms of patronage per kilometer of track. Population levels are in themselves not a reflection of potential patronage, but rather urban consolidation and increases in density along defined corridors.

[10] Calgary Transit - 2009

[11] Syndicat des Transport Parisiens - Personal communication Sept 95

Using Calgary, Canada, as an example with a city population of 1 million and 248,000 average week day trips, this equates to around 1/8 of the whole city's population taking a return trip on the Calgary C train each weekday.

Another important trend that is starting to emerge in North America is that the transport planners are under estimating the patronage forecasts for new light rail systems. Since the launch of the Phoenix system in late December 2008, "the region's new Metro light rail transit (LRT) system has been significantly exceeding its predicted weekday ridership forecasts. Between January and April 2009, the new system's average weekday ridership exceeded projections by 32.6 percent" (Arizona Republic, June 29th, 2009).

COST OF CONSTRUCTION & OPERATING COSTS

Costs very significantly between countries, for example:

Table 2: Comparison of Light Rail Building Costs

Line	Cost in Millions	Length in kms	Cost Converted in NZD Millions Per km
Phoenix	USD 1,400	32.0	$62.5
Salt Lake City	USD 1,130	30.5	$52.8
Denver	USD 880	30.6	$41.1
Portland	USD 3,000	129.3	$33.0
Edmonton	CAN $344	12.6	$32.0
Croydon	GBP 230	28.0	$20.5
Calgary	CAN $548	49.9	$14.0

Sources: Calgary Transit 2009; Portland Tri Met 2009; Edmonton Transit System 2009; Denver Light Rail Now Project Team 2007; Croydon Tram Link 2009; Phoenix - Light Rail Now Web Site April 2008

Significant variations in land acquisition & labour costs are a major factor behind the cost differential in the above cities. LRT vehicles costs can also vary significantly, anything from NZ $4.0 to $8.0 million per car set. The cost of LRT vehicle provision can, however, be significantly reduced if second-hand rolling stock is used to initially establish the network.
With good planning, minimal land acquisition, at grade running of vehicles and the partial use of existing heavy rail tracks (used or disused), there is no reason why, in New Zealand, costs could not be kept down to around NZ $10 - 15 per km, over lengths in excess of 20 Kms (including rolling stock). Clearly it is not cheap to introduce LRT into our built up environments, but if we are serious about travel demand management and the environment, these Supertrams can move people en masse efficiently.

The cost of operating any public transport system is expensive, with daily operating expenses (variable costs) being covered, in part, by the fare box, and the rest through government subsidies. Light rail, however, has the potential to effectively cover 100% of the costs of operating the system.

Quite often fare levels are kept low as part of the general policy to encourage patrons out of their cars and improve travel demand management in that city. In Paris, for example, 33% of operating costs is funded through the fare box, a further 33% from a local tax on employers employing more than 10 people, the remainder coming mainly from central government.[12]

[12] Syndicat des Transports Parisiens - Personal communication Sept 95

This fare level in Paris is set by the Ile de France region to encourage public transport use in Paris.

The option to determine the amount of operating costs that the fare box should cover is clearly a political decision, but one that allows for significant flexibility.

LAND USE/TRANSPORT INTEGRATION

Close integration of light rail stations with where people live and where they want to go (shopping, cinema, hospitals, work, schools & universities, etc) is fundamental. Here the European systems are well ahead**.** In North America the general thrust was to use former disused heavy rail tracks for significant sections of each system. Unfortunately, these disused, or former heavy rail tracks are generally associated with industry, poor housing and urban decline, and are not where people want to live today. Consequently, people bus or drive to the station from nearby suburbs. What was needed in these cities was for the LRT tracks to have gone into the suburbs where the people live, rather than relying on bus or car transfers.

If LRT is to work well, the system must go as close as possible to where people live and then take them as close as possible to where they wish to travel. After all, light rail is designed to go easily down streets, turn corners, and yet be quiet and not pollute the urban environment.

Cervero (1995) refers to earlier works of his in 1994 which theorize that in the US, land use impacts along LRT lines have been minimal because these transit systems commonly follow old abandoned rail lines and have consequently emerged to rely on Park & Rides to access land uses further a field. It is interesting to note that the North American systems have tended to largely follow former heavy rail freight tracks which historically have attracted industry and little housing. New Zealand cities have a clear advantage in that much of the existing and disused track infrastructure goes through or very close to major generators or attactors in these urban areas.

There would appear to be a certain population threshold below which light rail would not function effectively. Many of the cities are major urban conglomerations such as Los Angeles with 9.5 million in LA County alone, while other cities, such as Grenoble, has only 530,000 inhabitants, yet both have an LRT system. If light rail is to be considered, it is necessary for a city to have a population base around 200,000 upwards. The actual population level alone, however, is not the critical issue, but rather the density of population distributed along the LRT corridor.

In Grenoble, France both 20% of the city's population and 27% of the job market[13] are within 400 metres of an LRT station. As a general rule of thumb, within 400 metres walking distance of any LRT station is where the density of population and employment is critical, if residents and workers are to easily access the LRT system. It is, thus, the density of population (and jobs) close to the LRT stations that makes LRT work so effectively in Grenoble, rather than some predetermined population threshold.

Urban Consolidation and Density

As a travel demand management tool, urban consolidation and increases in density have the ability to significantly change modal split towards public transport in the long term. Urban consolidation and increases in density drive the supply side of land use integration.

[13] Syndicat Mixte des Transport en Commun de l'Agglomeration Grenobloise - Information brochure on the construction of the Grenoble City Tramway P5. Job sector figures averaged across the two lines

Some researchers see intensive redevelopment around rail stations as an ideal means of obtaining urban consolidation. Greenpeace state that if the population was doubled around 90 Sydney stations, an infill of 900,000 people could be achieved. In Canberra's Gunghalin, Canberra Land Pty proposes densities of 100 persons per hectare as achievable based on the urban village concept focused around a new light rail system, Glazebrook (1993).

Smith (1984) found that as density rose around transit catchments from 7 to 16 dwellings per acre, transit trips rose sharply in six major US cities. In Greater New York, this density increase related to an increase in transit trips from 0.2 to 0.6 persons per typical weekday. Where densities in New York achieved 100 dwellings per acre, this related to one transit trip per day.

Australian Urban & Regional Development Review (1995) comment that a net density of 25 dwellings per hectare configured as a 'Public Transport Sensitive Design' (PTSD) of urban form, is required to support a transit system, whilst reducing the public infrastructure costs associated with lower density urban sprawl. The 'Public Transport Sensitive Design (PTSD) represents a form of development which is focused on, and designed around, a transit system and which features a high level of street pattern connection.' Based on its study of fringe development costs along the Brisbane - Gold Coast growth corridor, it suggests that to achieve a net density of 25 du/ha, the following mix of housing type, as shown in Figure 3, should prevail:

Table 3: Suggested Mix of Housing Types in a Development to Promote Public Transport Usage

Type	***Site Area***	***Occupancy Rate***	***% at 25du/ha***
Separate Hse	650 sq m	3.4	5
Separate Hse	500 sq m	3.4	10
Separate Hse	350 sq m	3.1	35
Semi-detached, etc	200 sq m	2.09	25
Flats, apartments or cluster	150 sq m	1.88	25
Percentage roads + open space	27		
Net Dwelling Density (du/ha)	25		

Source: Australian Urban & Regional Development Review (1995)

A new density of 25 dwelling per hectare would appear a conceivable target along potential LRT corridors within the New Zealand urban setting.

LRT AND TRANSIT ORIENTED DEVELOPMENTS

An important feature to help promote patronage is to encourage urban growth around stations that facilitate ridership of light rail. These policy initiatives are known as 'Transit - Oriented Developments' and have been commonly adopted in North America and Australia.

The concept of 'Transit - Oriented Developments' (TOD), also known as 'Transit Villages' or 'Urban Villages,' depends on a mix of residential and commercial developments surrounding a public transport node where residents and workers can walk to and from place of residency/employment to the public transport node. This 'Transit Village' concept is designed to support public transport by encouraging appropriate developments to locate within easy walking distance of a station or bus interchange, thus reducing car dependency and its associated problems of pollution and traffic congestion.

Calthorpe's guidelines refer to two specific different development patterns, Urban TODs and Neighbourhood TODs:

An Urban TOD 'may be developed at high commercial and residential densities and can consist of offices, large-scale shopping centres, and moderate-to high-density housing (12-60 units in a four-storey building are considered moderate). They are located near light rail and bus stops to allow users to get to many locations using transit.'

Neighbourhood TOD's 'have a residential or shopping focus with a mix of single-family houses and apartments. They must be on a bus line with frequent service or within ten minutes of transit travel time from a light rail or express bus stop. By being compact and promoting active streetscapes and central public spaces, neighbourhoods TODs encourage walking, provide densities adequate to support a transit system, and create distinct, identifiable neighbourhoods. The mix of housing types also contributes to making communities affordable to people of many ages, incomes and backgrounds' (Corbett 1993).

The TOD concept is not new, and in many ways is a return to how traditional towns emerged around railway stations as new rail networks crossed both North America and Europe. Today, however, the concept is influenced by the new urbanism movement values of design, community values and pedestrianisation.

Within the New Zealand urban setting, a walking distance of 400 – 600 metres away from a fixed guideway station is perceived as a reasonable definition of the area falling within a TOD.

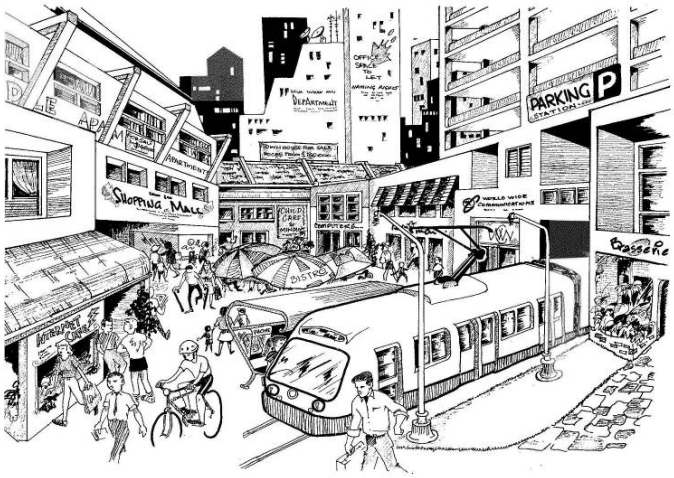

Illustration: 1 The TOD Concept Illustrated in broad Principle - Source: Peter Pritchard, 2000

In the last fifteen years, the concept has also been further promoted by the Railvolution conference, a movement composed of transit and urban planners who meet at an annual conference in the USA to discuss and promote close land use and transport integration around public transport interchanges. The birth of the Railvolution in September 1995 occurred in Portland, Oregon, where the first national forum was held to share views and experiences on the attributes of transit and land use working together to produce livable communities.

Portland is considered a leader in planning urban land uses in association with its light rail stations (Sirmans & Gatzlaff 1999). Much of Portland's high profile can be attributed to the existence of the only elected regional government in the USA. This body promotes land use and transport integration around public transport. Portland is one such case were TODs have been actively applied.

In Portland, the new western extension of MAX has seen each local planning authority develop a land-use planning scheme within a half-mile radius of each new station to promote the TOD concept. One proposed station, Sunset, used a 'Charrettee' public participation process to bring developers, landowners, residents and government agencies together. This took place over a few days and from this they established an agreed land use that would encourage utilization of the LRT system (Ginn 1996).

Arrington (1996) provides examples of transit-oriented developments planned for the Westside line. Intel is investing $2.2 billion in a new silicon chip plant for 1,400 employees on 190 acres north of Orenco MAX station. Tri-Met, the City of Hillsborough and land developer Pac Trust, have a vision to create a community within these 190 acres. They plan for it to have pedestrian links to the station, which will be lined by parks. They also hope to build high-density residential and commercial neighbourhoods along the routes. At Beaverton Creek MAX Station, Tri-Met prepared a master plan for a 122 acre site, with a TOD to include 1,325 dwellings plus retail, office areas and parklands that link to Nike's World Headquarters to the north. Tri-Met (Website 2000) cites that the Westside MAX line 'has become a magnet, attracting nearly 7000 housing units and more than $500 million in new transit-oriented communities within an easy walk of the stations.' Evidence of the impact that these developments are having can be found in the fact that patronage on the light rail system went from the high 20,000's to over 60,000 passengers per day following the opening of the MAX line west in late 1997 (Tri-Met Web site 2000).

Portland and San Francisco, in particular, have developed and implemented model examples of how TODs can work. New TODs are emerging in cities like Atlanta and Denver driven by funding through the New Starts Program, TEA-21 and the Federal Transit Administrations 1997 policy to support transit joint developments around stations. Since the start particularly of the turn of the 21st Century, many new TODs are emerging in the USA.

Recent evidence from North America is starting to question whether the concept of Transit Oriented Developments may need to be expanded to allow for some degree of Park & Rides. This would cater for those living beyond a reasonable walking distance of a TOD where no nearby suitable Park & Ride station facility can be provided. Conversely, some established station Park & Ride areas in the USA are being transformed for TOD.

Parking

To move car-based trips to public transport, the supply and demand for parking must be addressed. Ginn (1996) states that any city proposal introducing light rail, needs to seriously review its parking policies to support transit, as part of a whole package of travel demand measures. In North America, the use of the car is still a predominant factor working against achieving high levels of patronage on all forms of public transport systems. Light rail transit (LRT) operators in North America face the constant problem of cheap 'early bird' parking being provided in city centres continuing to attract workers by car. Parking charges downtown are typically between $5.00 and $12.00 a day, and between $50 and $120 per month (based on 2005 prices). In downtown Calgary, the main shopping centre offers $1 parking for 4 hrs on Saturdays, and free parking all day Sunday and evenings. Such features discourage transit use. The problem of cheap parking in North America is further compounded by the low cost of the typical medium size family car. In Canada, this cost is approximately $22,000, with the average salary being between $35,000 and $45,000 (based on 2006 prices). Similar issues prevail in the major New Zealand Cities.

Associated Urban Land Development

In Portland, USA, Arrington (1995) found that investment by the development industry around LRT stations exceeds the cost of the rail infrastructure by five times. He put this development value at US $1.23 Billion in 1995. In terms of value, the land adjacent to stations like the Lloyd Centre, 162nd Street and 181st Street in the period 1980-91 increased faster than the national average of 67.5 percent, giving increased values of 134 percent, 112 percent and 491 percent respectively.

In Dallas, the opening of the DART, LRT system in 1996 has seen a recent flurry of TOD activity. Mockingbird station, north of downtown Dallas is a well publicized success story lead by a private developer with more than $1.2 billion investment in commercial and residential developments around the station. The success of Mockingbird station has lead other local city councils to push TODs at Cedar, Plano, Addison Circle and Richardson emerge as new downtowns with commercial and residential developments around stations (Transportation Research Board 2004).

CONCLUSION

Good land use integration, support services and infrastructure all help ensure a good patronage base and help perpetuate the right perception. Light rail has the ability to be an effective travel demand management tool in our cities, as it provides not merely a new modern technology, but an instrument capable of promoting a positive image. The ability to provide a modern public transport system that takes people from their homes to where they want go quickly and efficiently, yet requires or generates minimal disturbance, enforces the right image that people will want to use LRT as a replacement for local car based trips. So is New Zealand ready for light rail? This paper has demonstrated the importance of the characteristics of light rail, density and urban form to support patronage, and the associated links with urban development/property value improvements. What is still needed is the right local champions and political will to move light rail on to the New Zealand landscape, if light rail is to be sold to the people as an effective travel demand management tool.

REFERENCES:

Arrington G.B (1995) **Beyond the Field of Dreams: Light Rail and Growth Management in Portland**, Tri-Met, pp 1-38

Australian Urban & Regional Development Review (1995) **Smart Planning not Sprawl - The cost & Benefits of Alternative Fringe Development,** Discussion Paper 5, pp 11, 21, 60-61

Cervero R. (1995b) **An Evaluation of the Relationships Between Transit and Urban Form, Research Results Digest**, *Transportation Research Board, No 7, June 1995, pp 1-55*

Corbett J. (1993) **San Diego Gets a Grip on Gridlock: City Ordinance Helps Region Manage Growth**, *Surface Transportation Policy Project Resources Guide, pp 1-6*

Gilbert D. and Ginn S. (2001) **Transit Oriented Sustainable Developments**, Built Environment Research Unit, *Queensland Department of Public Works*, August 2001

Ginn S. (1996) **Light Rail, as an Effective Tool in Travel Demand Management**, *Transport & Livable Cities*, *ITE Conference, Melbourne, May 1996*

Ginn, S (1998) **An overview of Light Rail Technology and its potential within an Australian Environment** *prepared for the Western Australian Planning Commission*

Glazebrook G. (1993) **The Strategic Importance of Public Transport Investment in the Better Cities Program**, *Strategic Public Transport Development, Better Cities Program, Occasional Paper Series 1, Paper 6, National Capital Planning Authority, pp 40*

Goss, P.(1995) **The Practical delivery of Non - User Benefits - Progress so Far** *Light Rail & Non Users Benefits Conference*

Hack J. (2002) **The Role of Transit Investment in Urban Regeneration and Spatial Development: A Review of Research and Current Practice**, *Canadian Institute of Planners Annual Conference 2002 – Making Waves, 19th June 2002*, www.cip-icu.ca/English/home.htm

Ker I. and Ginn S. (2003) **Myths and Realities in Walkable Catchments: The Case of Walking and Transit,** *Road and Transport Research.* Vol 12 No 2, June 2003

Lau, W. **Operating the Supertram System: Initial Experience** *South Yorkshire Supertram Ltd,* Sheffield,UK.

Middleton, W.(1990) **LRT helps reshape a city** *Railway Age*.

Thorne, R. **Bringing Croydon Tramlink to Life** *A special Light Rail and modern Tramway Report.*