Volterra

Light Rail Transit Review

Auckland Transport

A report by Volterra Partners, February and 2015

Volterra

1 Introduction

There has been a resurgence in LRT systems over the last 25 years or so. Trams were once a significant part of public transport, but after the early 20th century were rapidly replaced by cheaper and more flexible bus based services. By the 1960s there were relatively few LRT systems left. The recent increase in LRT around the world means there are now almost 400 light rail, tram or streetcar systems in operation.

LRT schemes are often difficult to justify economically on pure transport grounds. More expensive than buses, they often struggle to generate enough transport user benefits to give a comparable Benefit to Cost Ratio (BCR). If bus services can deliver most of the transport benefits for a fraction of the cost, then investing in LRT becomes difficult to justify.

The strengths of LRTs derive from two areas: transport and development. For the transport benefits LRTs are generally more successful at achieving mode shift from car than buses are. That may be as a result of them getting a higher degree of priority over road traffic than buses generally do – providing faster and more reliable journeys. It may be down to the higher quality of LRT compared to bus or it may be about negative impacts LRTs frequently impose on car journeys. In almost all LRTs the prime source of passengers is mode shift from bus.

The other important impact of LRT is about development. These development impacts are generally ignored in transport appraisals, but can deliver significant economic and social benefits. In the past Volterra has argued that those development impacts come from a combination of:

- **Accessibility** – LRT generally delivers significant increases public transport accessibility. This can be at the expense of car traffic if significant priority is given to LRT.
- **Capacity** – LRT provides higher capacity than bus services which can be useful for centres of an appropriate scale. LRT capacity covers a broad range, perhaps from 7,000 passengers per hour per direction up to about 20,000.
- **Image/public realm** – LRT generally enhances the places it serves. It puts forward a modern, smart, environmentally friendly image and is frequently accompanied by public realm improvements and reduced traffic.
- **Permanence** – LRT is permanent, fixed track and its stops provide reassurance to potential investors. Compare this to a bus system, which could be stopped and rerouted at short notice.

Through the development impacts, LRT is often used as a transport tool for changing land use in an area. This can be regeneration of a deprived area or agglomeration – enhancing the accessibility and quality of a successful area.

Development impacts associated with the provision of transport are difficult to quantify a-priori. We therefore draw on ex-post analysis of LRT impacts

through a number of case studies. The objective of this is to help Auckland Transport decide on: what benefits LRT could bring to Auckland; where would be the most appropriate corridors to service; what supporting policies would help maximise its development impact.

2 Case Studies

This section defines what we mean by LRT schemes and sets out the findings of a set of international case studies. We are interested in whether LRT schemes have brought about transport benefits and economic development. Have LRT schemes attracted passengers, and is there evidence that they influence land use by leading to an increase in population and/or employment density within their catchment area?

LRT

LRT is rail transport but not generally on a fully segregated right of way. LRT is fixed to rails, and hence less flexible than bus. Although it often shares the same space as cars and bus, LRT generally has a higher level of priority. Priority comes from a range of measures: dedicated rights of way; LRT priority at signalled junctions; banning turns across LRT, removing on-street parking etc.

LRT generally connects the central business district (CBD) or commercial hub of a city to suburban residential areas. In larger cities LRT can provide services within the city centre, but that is unlikely to be appropriate for New Zealand.

LRT generally provides a faster and more reliable service than bus, largely because of the greater priority it is awarded. There is no inherent reason why LRT should accelerate or brake faster than bus, but priority measures enable it to offer a relatively fast and reliable service. LRT should not be confused with metro. It caters for a lower level of demand and ridership than a metro. Annual use of LRT systems can nevertheless be into the tens of millions.

The use of LRT has accelerated over the last thirty years. Figure 1 shows the opening years of currently operating LRTs since 1860, according to continent. Popularity of LRT was initially strong before diminishing in the mid 1900s. They can now be found all over the world, from Europe to Asia and the US. A typical LRT system has become longer over time, with larger distances between each station. This is shown in Figure 2.

Figure 1: Number of new LRT schemes since 1860, by continent

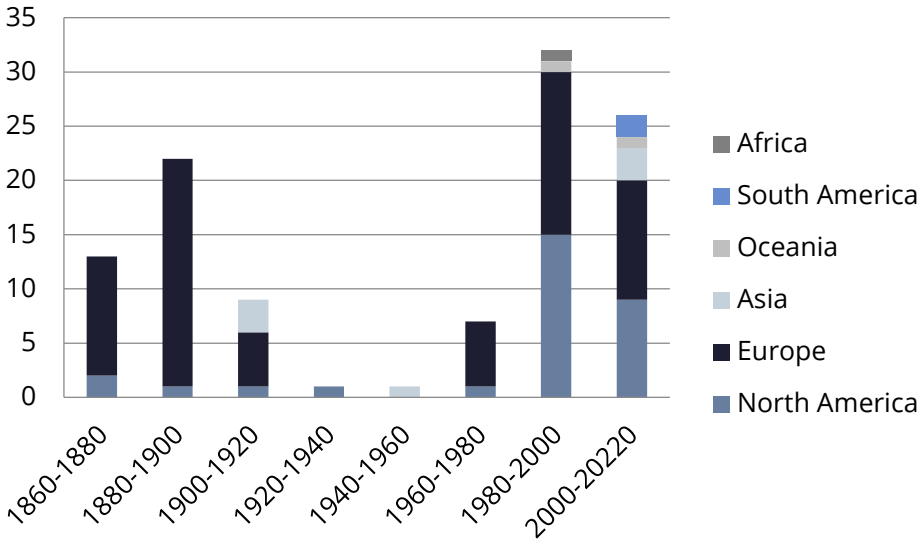
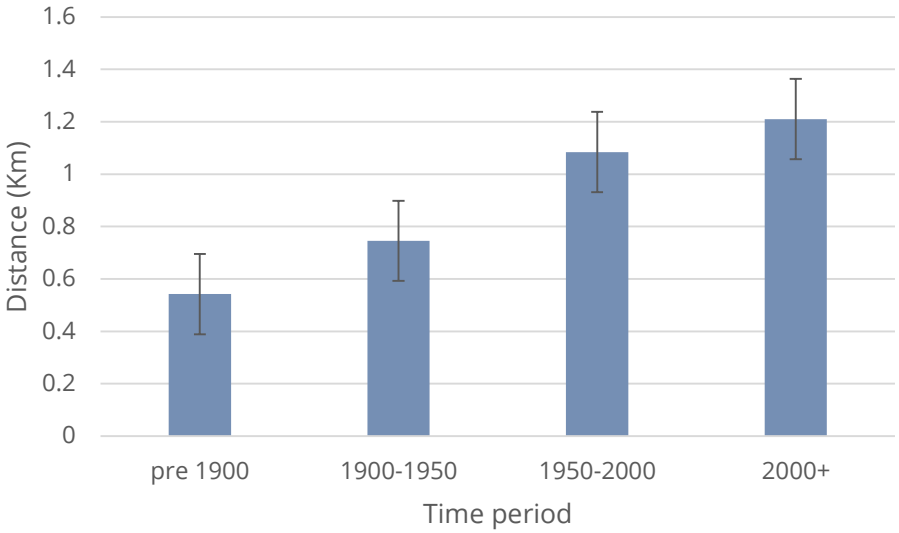


Figure 2: Average distance between stops, by time period



LRT as a transport system is becoming increasingly attractive as policy makers begin to recognise their development impacts. LRT has become an important transport tool within urban design and development.

Case Study 1 - Docklands Light Railway

The Docklands Light Railway (DLR) is a fully segregated LRT system that opened in London in 1987. It was created to help redevelop the Docklands area – located at the Isle of Dogs (IoD), and provide links to the City of London and London City Airport. The DLR was one of the first LRT schemes in the UK to focus on regeneration.

The DLR provided the first rail access to the Docklands area, and the initial system spanned 13km and covered 15 stations. Most of the DLR route is on elevated railway viaducts. In comparison with other LRT schemes, the DLR

now provides an extensive service, with 40km of track and 45 stations in between. It connects several strategic destinations within London including London City Airport, Canary Wharf, Stratford International station and the City of London through Bank. The most recent demand data showed that the DLR served 101.5m passengers in 2013[1].

One of the biggest successes of the DLR was its role in the regeneration of the IoD area via its development impacts. The transformation of the IoD began in the late 1980s, with the increase in density of low rise light industrial land use shortly after the DLR provided the first station access. This can be seen in Figure 3 to Figure 4, and within a year of opening the DLR was serving over 17m passengers[2]. The second significant land use responses was the construction of One Canada Square (often known as Canary Wharf), along with the few surrounding skyscrapers that were built. These large scale office spaces represented a significant change in land use in the Docklands, from brownfield light industrial use to the global financial centre that Canary Wharf is today. One Canada Square was the first major skyscraper in the UK, providing office and trading floor space for the financial and business services sector. This can be seen between 1985 shown in Figure 4 and 1991 shown in Figure 5.

The full transformation of the IoD is not just a result of the DLR. It was not until the Jubilee Line was extended to serve the IoD, and pro-development planning policies were introduced, that the transformation of the IoD accelerated. It is important to recognise that the Jubilee Line is a metro and not an LRT. As previously discussed, a metro system tends to serve a much higher ridership than LRT, and development impacts can be larger. The DLR played an important role in beginning the regeneration of the IoD, but the passenger demand created by a financial hub was inappropriate for LRT and required an additional metro.

Figure 3: Isle of Dogs 1980

Figure 4: Isle of Dogs 1985

Figure 5: Isle of Dogs 1991

Figure 6: Isle of Dogs 1999

Research undertaken by Colin Buchanan[3] looked at whether DLR impacted on the property market. A regression analysis was used to determine whether the amount of planning applications in an area was correlated with the amount of rail investment. One of the rail investments looked at was the extension of the DLR extension to King George station. The analysis found that there was evidence of an acceleration in planning applications either side of the introduction of the DLR extension. This is shown in Table 1. However, the relationship was not conclusive because of the time lag in land use impacts – land use responses typically take at least a decade and probably 15 years from the initial transport investment.

Table 1: Density of planning applications

DLR Wards	Rest of Newham	Rest of Inner London Minus DLR
3.0	1.4	1.7

Source: Colin Buchanan, 2009, Impact on the Property Market

Glenelg Extension

The Glenelg Tram extension in Adelaide, Australia, is an example where LRT has successfully led to higher development around stations. These land use impacts are smaller than those associated with the DLR and other LRT systems, and are not as concentrated to one area. Similar to the DLR, once extended the Glenelg Tram line connected important commercial locations to suburban residential areas.

In 2008 the Australian Government announced an extension to the Glenelg Tram line. Prior to its extension, the Tram line was popular as a commuter link and tourist attraction, but did not serve a number of important passenger destinations. These included the business, cultural and retail precincts in the city centre of Adelaide, the Adelaide Railway Station and the emerging City West precinct. The extension delivered a new direct route from the suburbs to these destinations and to the University of South Australia West Campus, serving over 5,000 students and workers. The

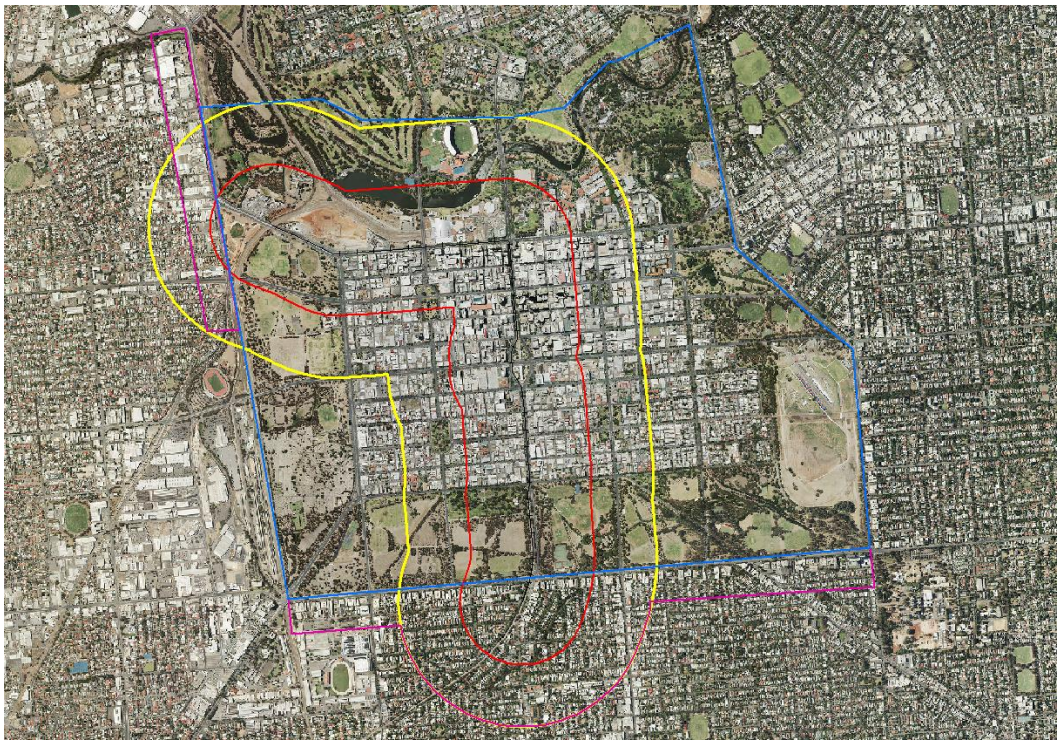
Glenelg Tram now spans 15km with 28 stations on the line. Annual ridership was 2.9m as of 2013[4].

Research was carried out by SKM to establish if there were any land use responses to the Glenelg Tram extension. It found that employment growth per annum was 1.7% faster between survey blocks within 400 metres of the Tram extension[5], compared to survey blocks beyond 400 metres. The report showed a statistically significant change in the employment growth rate in the immediate area around stations served by the Glenelg Tram extension.

Land use responses typically take at least a decade and probably 15 years from the initial transport investment. The first Tram extension opened in 2007 and so the full extent of the land use response was estimated by extending the differential growth up to 2022 implying increased density of 18-29% after 10/15 years.

There were limitations similar to the Colin Buchanan research due to the timing of the study being too close to the initial transport investment to allow for the full extent of development impacts. Statistically significant changes in employment growth were nevertheless observed within 400m boundaries of the Tram Extension. Figure 7 shows the 400m boundary around the Tram extension in red. An 800m boundary was also used, in yellow, but deemed too large to distinguish the development impacts of the transport investment alone.

Figure 7: Glenelg Tram Extension Impact Areas



Source: SKM 2014 'A Study into the Application of WEBs to Support Infrastructure Project Funding Proposals'

Case Study 3 - Dallas Area Rapid Transit LRT

The Dallas Area Rapid Transit (DART) LRT opened in Dallas in 1996 to provide the city's first high order transit. It is now the longest and most used LRT system in the US. With over 144km of track, the DART LRT has an annual ridership of 29m[6]. The four LRT lines serve the majority of major commercial sites in Dallas, including the CBD, as well as Union Station and Dallas Fort Worth International Airport.

DART LRT is considered as a major success story in Dallas. It not only provided transport solutions, but there is evidence to suggest it has had significant development impacts. DART LRT is a good example of achievable development impacts under a service that connects the CBD, suburban residential areas, and other major links.

The Centre for Economic Development and Research in the US led research into the development impacts of DART LRT[7]. To differentiate the impacts of the transport system from growth that would have otherwise happened, the paper compared changes in areas within 0.25 miles of DART LRT stations with changes in controlled areas. The differential between the two was the impact of DART LRT. Evidence was collected for 1993 to 2013, starting just before the opening of DART LRT. It is questionable whether enough external impacts are controlled for to identify development impacts from LRT alone. The use of controlled areas does not account for stronger growth in areas around LRT stations because of non-transport reasons. The evidence collected nevertheless shows some important and significant development impacts associated with the LRT system. These can be split into two.

Land use changes

New development associated with DART LRT is estimated at $932m so far. The strongest growth in land use was seen for office space and multi-family residential space. Table 1 shows the total appraised value of development by property type associated with Dallas LRT – the differential between LRT impact areas and controlled areas. The drawback of this data is that it does not separate property price impacts from increases in land use density.

Table 2: Total Appraised Value of Development Impacts from Dallas LRT, by Land Use, 1993 to 20013

Industrial	Multi-Family	Office	Retail	Single-Family
$4m	$582m	$180m	$93m	$73m

Source: Centre for Economic Development and Research, 2014

Figure 8 and Figure 9 give a graphical representation of the comparative pace of development near DART LRT stations for multi-family residential space and office space – the two land use types with the highest impact. Both land use types exhibit a significant uplift in volume just after the

opening of DART LRT in 1996. Growth has continued at a higher rate than in the controlled areas, and appears to spike around the time of DART LRT improvements. Significant improvements to the Red and Blue line were started in mid 2000s and the Green and Orange line began fully operating at the end of 2009.

Figure 8: Cumulative value of multi-family development, 1993 to 2013

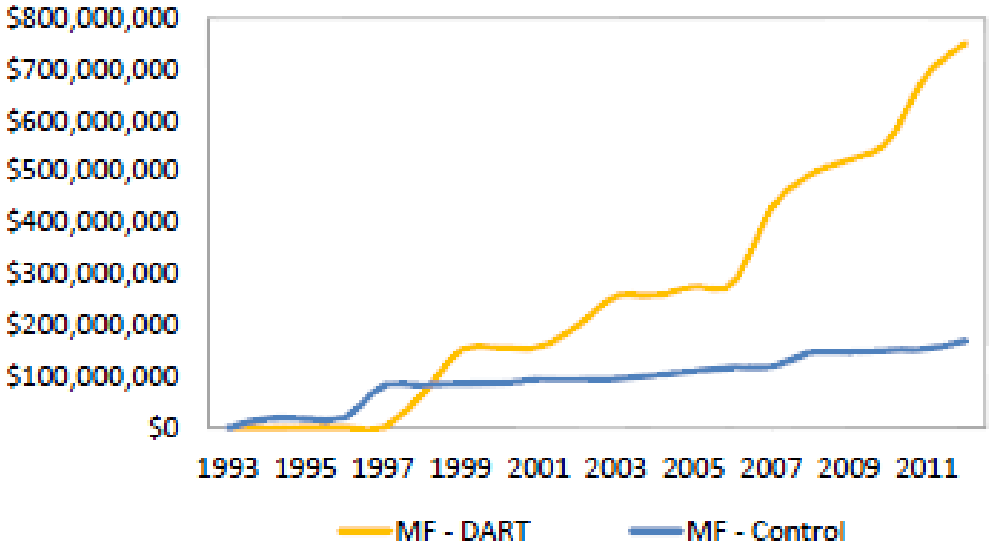
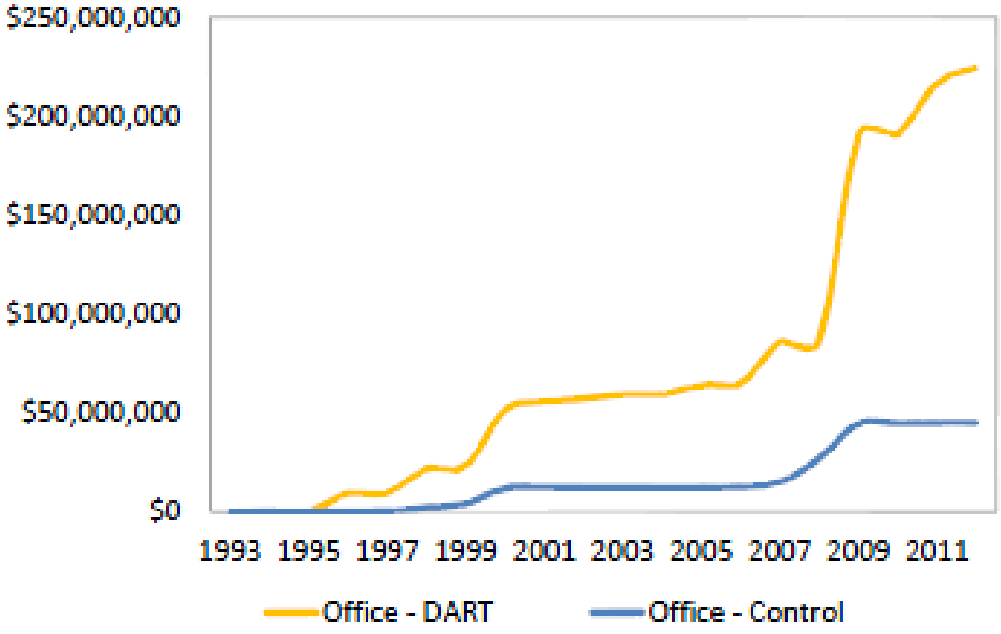


Figure 9: Cumulative value of office development, 1993 to 2013



Property price impacts

Office properties within the LRT development impact boundary were found to have a significant premium over the average market area rate. A regression analysis estimated that office properties within 0.25 miles of LRT stations had a $2.61 per ft2 premium when controlling for building age, and

class of commercial space. The analysis was repeated for office properties within 0.5 miles but found no significant effect.

In our view an uplift in property prices is not as much of a benefit as increasing development density. Increasing employment density can feed through into higher productivity via agglomeration, and increasing residential density creates additional local jobs and boosts LRT demand and revenues. In the case of a property price uplift it would appear only the property owners benefit. The implications of property price uplifts are discussed further in the conclusion of this report.

Case Study 4 – Croydon Tramlink

Croydon Tramlink is an LRT scheme serving the south London Boroughs of Croydon and Merton. It began operation in 2000 and was intended to improve accessibility within the London Borough of Croydon which previously had no metro or LRT service. Tramlink covers a substantial distance at 28km and has an annual ridership of 31.2m1.

Tramlink is different from the other LRT case studies in that it only serves the outer suburban area of a larger city. Arguably this is why Tramlink is an example where LRT has not led to any significant land use impacts.

The method of reviewing planning application activity levels was used to determine if Tramlink led to any identifiable land use impacts. Research by DfT concluded that there have been no significant changes in planning application activity levels as a result of Tramlink.

It is likely that Tramlink has failed to deliver significant development because it serves areas that are too similar to each other. It does not serve a big enough centre to either change development in that centre or to change residential development associated with access to that centre.

Case Study 5 - Montpellier

Over the past 12 years the total route mileage of the tramways system in France has multiplied by five. Across France, both large and smaller scale cities have been adopting Tramways with policy initiatives in mind; to provide sustainable and reliable means of transport, to reduce car patronage and congestion and to rejuvenate city centres. The available literature suggest that LRT schemes in France principally serve to integrate city centres with a focus on urban renewal rather than absolute patronage and passenger demand, although to a certain extent the two are intrinsically linked.

Montpellier LRT is a four-line system with the first opening in 2000, the second line in 2006, and the rest in 2012. A fifth line is currently under construction with an expected completion date of 2017. Over the last half a century Montpellier has been the fastest growing city in France with large inward migration and a rapidly expanding University population. As a result there has been considerable emphasis placed on creating a city centre

which is both accessible and attractive. LRT in Montpellier was designed in response to the rapid growth in population, but also to reduce the use of car. This policy of implementing a reduction in car demand has become part of 'French urban transport legislation' (PDU) and has hence contributed to the growth of LRT as a viable city transport system.

As of yet there is no quantitative research into the impact of LRT in Montpellier. Qualitative evidence suggests it has in fact accelerated the amount and the effectiveness of land use change. Since the introduction of the LRT Line 1 in 2000, the University, hospital and main railway station have been upgraded (all served by Line 1). Line 1 terminates at 'Odysseium', a leisure, shopping and entertainment facility outside the city of Montpellier. The Odysseium complex is one of the main developments outside of the city centre. From here there are plans to build a new high speed rail station with routes to Paris and Barcelona. The majority of construction work for the four LRT lines has been accompanied by regeneration in Montpellier. This includes restoring the road network, creating pedestrianised zones and redeveloping public spaces. According the Minister of ecology, "the tram (LRT system) has structured urban development projects for 10 years".

3 Conclusions

LRT schemes are often difficult to justify economically on transport grounds. They are an expensive investment compared to bus, and can struggle to generate enough transport user benefits to give a comparable BCR. LRT can however deliver development impacts that other modes of transport such as bus and car cannot. The case studies have shown that these development impacts can be used in some cases to regenerate a deprived area, and in others enhance the accessibility and quality of a successful area. In this sense a successful LRT system is a transport tool for changing urban design.

What characteristics influence the success of an LRT scheme? In developing an LRT for Auckland, the following issues should be taken into consideration.

Level of segregation

Higher segregation tends to mean more priority, which makes the journey quicker and more reliable. It differentiates in transport benefits more from bus. Higher segregation also removes space from the LRTs biggest competitor - the car – thus improving the competitive position of an LRT. New LRTs often remove on-street parking as well as lane capacity, although this involves supportive development policies that are discussed below.

The areas it serves

The LRT system needs to link residents to employment; that is the key demand flow. Linking to employment also helps encourage use of LRT for commuting purposes. Having a good mix of passengers, not just leisure users but also commuting purposes, is more likely to support development impacts. Ideally an LRT route might also include one or more areas in need of regeneration and use the permanence, accessibility and image of an LRT to help deliver that land use change. Finally, a counter-peak trip generator such as a hospital, college or airport creates additional demand without impacting on peak flows and hence creating a capacity constraint.

Supportive development policies

Designing an LRT system should take into account the wider urban development of an area. It is important to recognise the planning policy in the area that is served by the LRT. Pro-development planning policies will ensure that development impacts from LRT are encouraged. LRTs want higher density employment around their central stations and higher residential development around their suburban stations. The extent to which local planning policies support or conflict with those objectives should have a major impact on route choices. It sounds obvious but there are numerous examples where transport investment has failed to encourage development because of restrictive legislation. The LRT system should also be integrated with other modes of transport. There needs to be

links at either end of the LRT line should passengers wish to connect to other transport modes, LRTs often provide Park& Ride services.

There is no definitive answer as to what makes an LRT system successful. Each city will have a different definition of 'success'. This will depend on their aims for economic growth, and what form of urban design accompanies this

This report has been put together in the limited time given. Because of the time constraint there are gaps in the research. The case studies represent information readily available to us rather than a representative cross-section of LRTs.

References

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[2] Transport for London, 2012, 'Docklands Light Railway Performance'
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