

Increasing the Patronage of Adelaide's Northern Rail Corridor

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Abstract

Transit-oriented development (TOD), with a focus on rail corridor transport provisions with implications for urban planning, has the potential to reduce tensions of the energy crisis and global warming. Increasing rail frequency and developing higher density residential areas around railway stations may not, however, be enough to increase rail patronage. This is especially the case in cities with lower population densities such as Adelaide. TOD implementation needs to include local socioeconomic factors associated with travel mode and residential location choice behaviour. This paper analyses local travel behaviour by observing the means people use to access train at rail interchanges and by asking about their habits and the reasons for their choices in focus group sessions. Evidence suggests the existence of significant barriers for local residents to use public transport which need to be addressed for gaining a higher patronage. Proposed TOD strategies that target these main issues and other related factors would be a useful planning tool for transport policy makers and metropolitan planners.

Key words: Transit-oriented development, transport survey, patronage, Adelaide rail corridor, travel demand, transport policy

1 Introduction

Transportation is a major contributor to environmental pollution and energy shortages, transit-oriented development (TOD) has been recognised as a useful strategy in helping to reduce these issues (Button & Rothengatter 1993; Mees 2009). TOD notions of promoting people to use public transport as a substitute for cars, attracting people to live close to public transport stations and encouraging people to walk and cycle to shops, services and work, is popularly applied by planners and policy makers. This has been concluded as 'dense, diverse, pedestrian-friendly land uses near transit nodes that, under the right conditions, translate into higher patronage' (TRB 2004). Determining how to increase patronage is at the top of TOD goals for the majority of transport agencies (Lund, Cervero & Willson 2004).

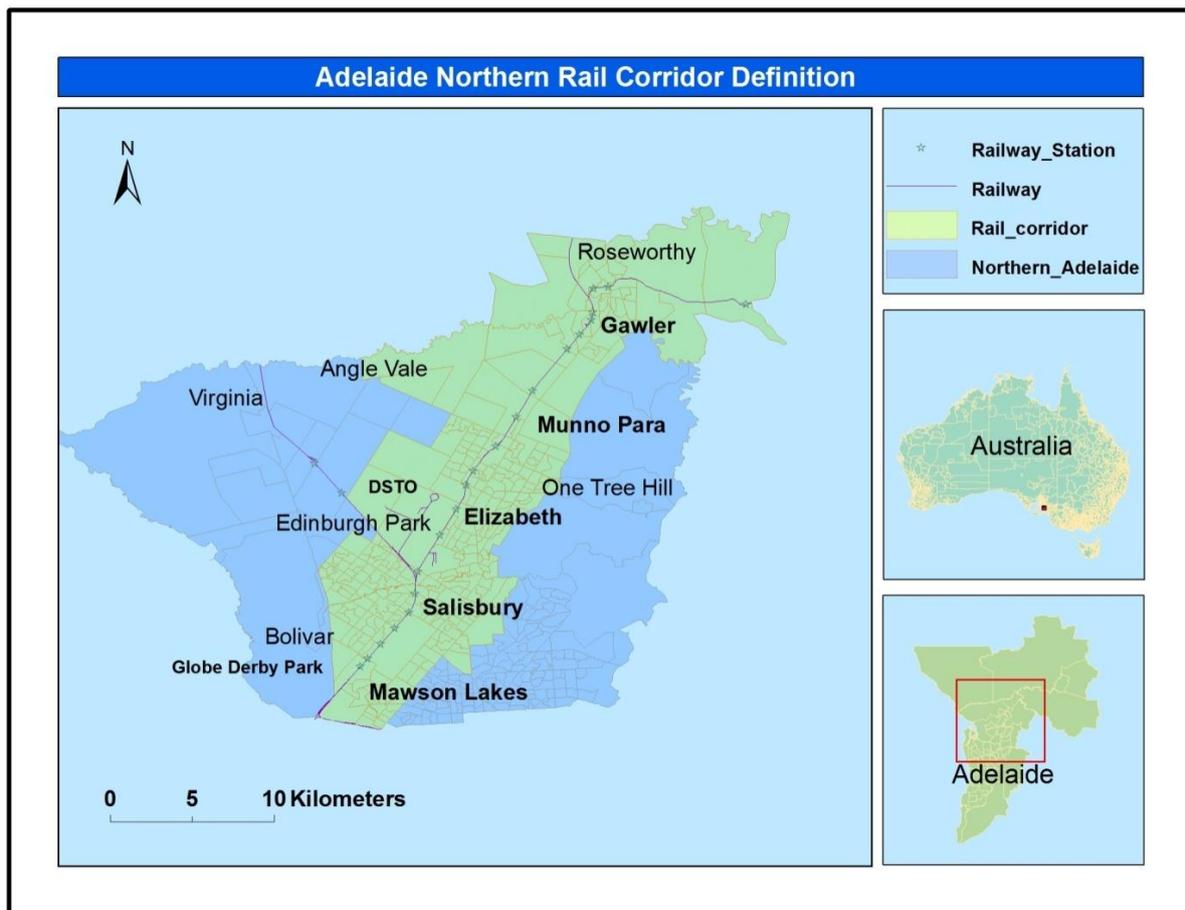
Although TOD methods, such as integrated land use-transportation planning, have been applied for more than half a century (Hall 1989), when applying TOD to a specific area it has to be uniquely designed according to the local history, culture and economy. TOD is a planning strategy which focuses on mixed land use around transport stations with safe access for pedestrians and cyclists (Dittmar & Poticha 2004; Dittmar, Zelzer & Autler 2004). However, there is no generic definition, due to the nature of TOD being subject to its geographical and historical conditions and that it can change over time and location (Hall 1989).

More specific definitions of TOD occur in specific geographic locations. In metropolitan Adelaide, the 30 year planning document for the city describes a TOD as 'a transit-oriented city connected by efficient mass transit systems, affordable public transport and safe bicycle and pedestrian networks' (Government of South Australia 2010). The TOD in Adelaide aims

to create 'walkable, mixed-use, connected communities' (Government of South Australia 2010, p.61) and use 'higher density development centred on a major public transport access point' (Government of South Australia 2010, p.78).

The research reported herein summarises the findings to date of an Australian Research Council (ARC) Linkage funded project. The research project entitled "The potential role of transit-oriented development in Australian cities: a critical assessment using a suburban rail corridor" defines a TOD study area along Adelaide's Northern transport corridor from the suburb of Mawson Lakes to the town of Gawler along the railway line as depicted in Figure 1.

Figure 1: Adelaide Northern Corridor definition



Corridor based TOD implementation demonstrates its advantages. One example is the Bay Area Rapid Transit (BART) system in San Francisco where suburban growth along rail corridors has been guided by planning for nearly four decades with great success (Cervero & Landis 1997). The BART area attracted 140,000 more residents than non-BART service areas in the first 20 years after development. Employment growth has been consistently higher around BART stations and it has been providing economic benefits in the downtown area through the establishment of more shopping centres. BART helped the San Francisco bay area become a mixed land use place with an increased ridership (Cervero & Landis 1997).

Some of the more popular urban design strategies for TOD, e.g. the Dutch 'ABC location' policy and 'urban villages', perhaps share a common shortfall being a lack of consideration of socio-demographic factors (Breheny 1995, 1997; Renne 2007). This presents a need for a better method of understanding travel behaviour. To overcome this problem, researchers

suggest more emphasis should be placed on residents' self-selection, thus taking account of travel mode and housing choices in accordance with people's natural preferences in a TOD environment (Cervero & Duncan 2008; TRB 2008). Further, it also provides policy makers a potential space to break down the barriers (TRB 2004). Therefore, the proposed project in this study focuses on local residents' travel mode choice and residential location choice behaviour in the defined corridor.

This paper considers TOD strategies in this complex context and analyses the key TOD features of the rail corridor. It also identifies major TOD barriers by observing the access modes of train users at selected transport interchanges and inquiring about local residents' preferences on whether or not to use rail. These results are discussed to assist in the analytical process, with findings summarised. Conclusions drawn from the research and indications for future study are also presented.

2 TOD in the Adelaide Northern Rail Corridor

It is important to take into account the preferences of the local population and other local factors when planning a TOD (Cervero & Landis 1997). A TOD strategy that has worked in one geographic location may not necessarily work in another due to local factors. Adelaide has its own distinctive characteristics and perhaps requires a specific TOD solution that incorporates these characteristics.

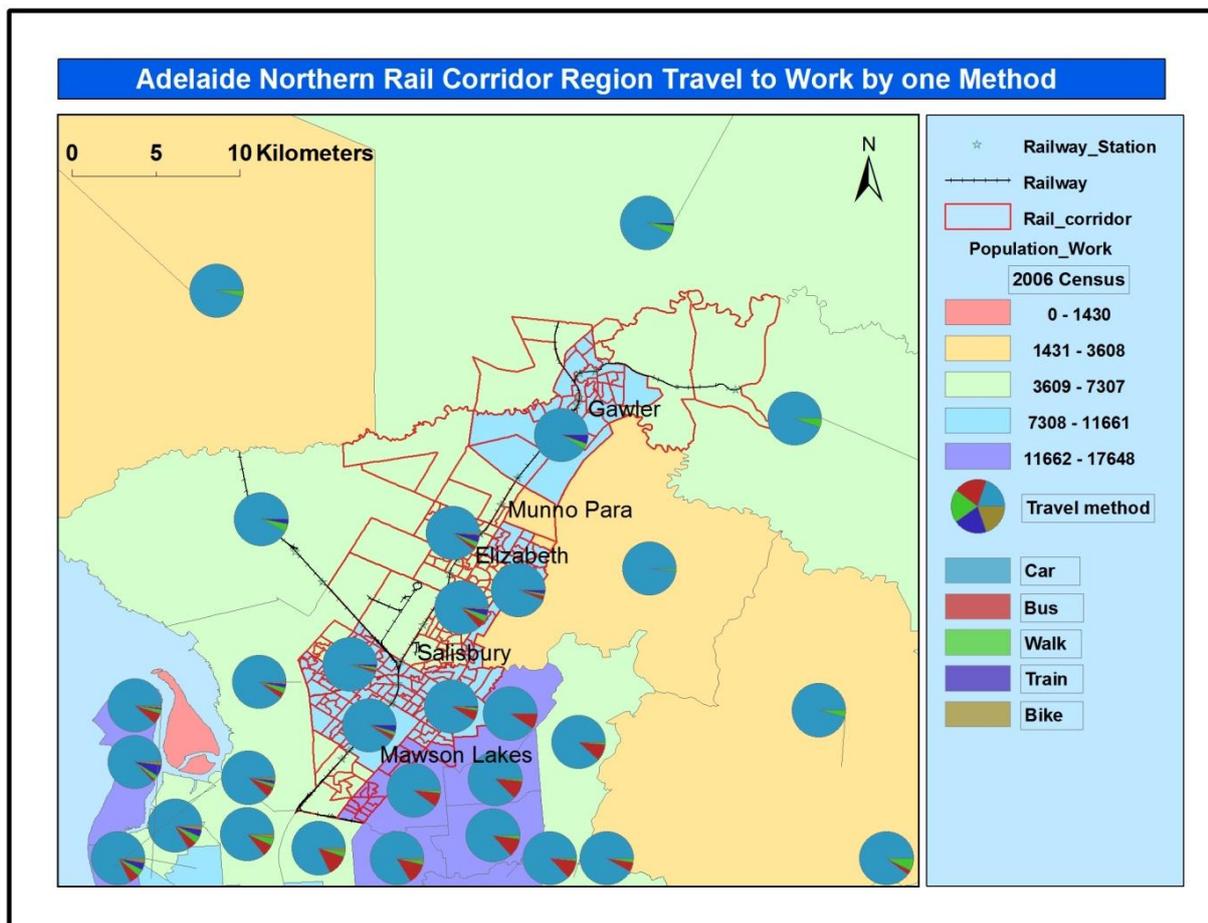
Population and its growth are important factors for public transport. Between 2006 and 2009, the population of South Australia exhibited grew steadily according to data from the Australian Bureau of Statistics (2009). The annual growth rate of South Australia is 0.8% while Outer Adelaide has increased by 2.1% per year on average. Adelaide is dominated by an extensive arterial road network accompanied by expressway links connecting the city to the outer Northern and Southern suburbs, providing an effective means of transport by car. This has contributed to making Adelaide a more car dominant city compared to other Australian cities. High car use has resulted in lower numbers of passengers using public transit, which has started a domino effect where transport operation costs are higher than the fares received, resulting in a highly subsidised service that may experience reduced service frequency, transferring even fewer passengers. Attracting sufficient passengers to cover operating costs is a vital issue for public transport (Mees 2009) with further predicted population growth in the North of Adelaide, currently there are needs to consider ways to increase the train patronage.

Substantial population growth has been proposed in the Adelaide 30 Year Plan (Government of South Australia 2010). The government projects a population growth of 560,000 people over the planning period, with a growth of 258,000 homes and job growth of 282,000. The projections for the Northern Adelaide region are for a growth of about 169,000 people, 67,600 dwellings and 79,000 jobs. In the Barossa Region which lies to the north of Gawler, the proposed scale of growth is 110,000 people, 46,400 dwellings and 38,500 jobs. In relation to the Northern Adelaide rail corridor, the plan proposed that growth of 46,300 people, 20,500 dwellings and 12,000 jobs will occur. The growth areas near the northern corridor include Angle Vale and Bolivar (provisional sense), a strategy of new employment land at Roseworthy and the Greater Edinburgh Park, Globe Derby Park, the Australian Military land of the Defence Science and Technology Organization (DSTO), a regional centre at Elizabeth and three district centres—Salisbury, Munno Para and Gawler are also included in this plan. All of these strategies provide promising opportunities for the development of the Northern Rail Corridor.

Northern Adelaide has a well connected road network that incorporates Main North Road, Salisbury Expressway and the newly built Northern Expressway. It also has a railway line linking Adelaide to Gawler, which is served by several feeder bus routes at interchange stations. Expressways, feeder buses and 'park and ride' facilities around the railway stations can increase the quality of rail transport (Mees 2000; Curtis 2006). One of the greatest advantages is that the Northern railway line is currently being upgraded to a rapid electrical railway, with a significantly shortened travel time. Therefore, rail has a high potential to become the major mode of transport in Northern Adelaide.

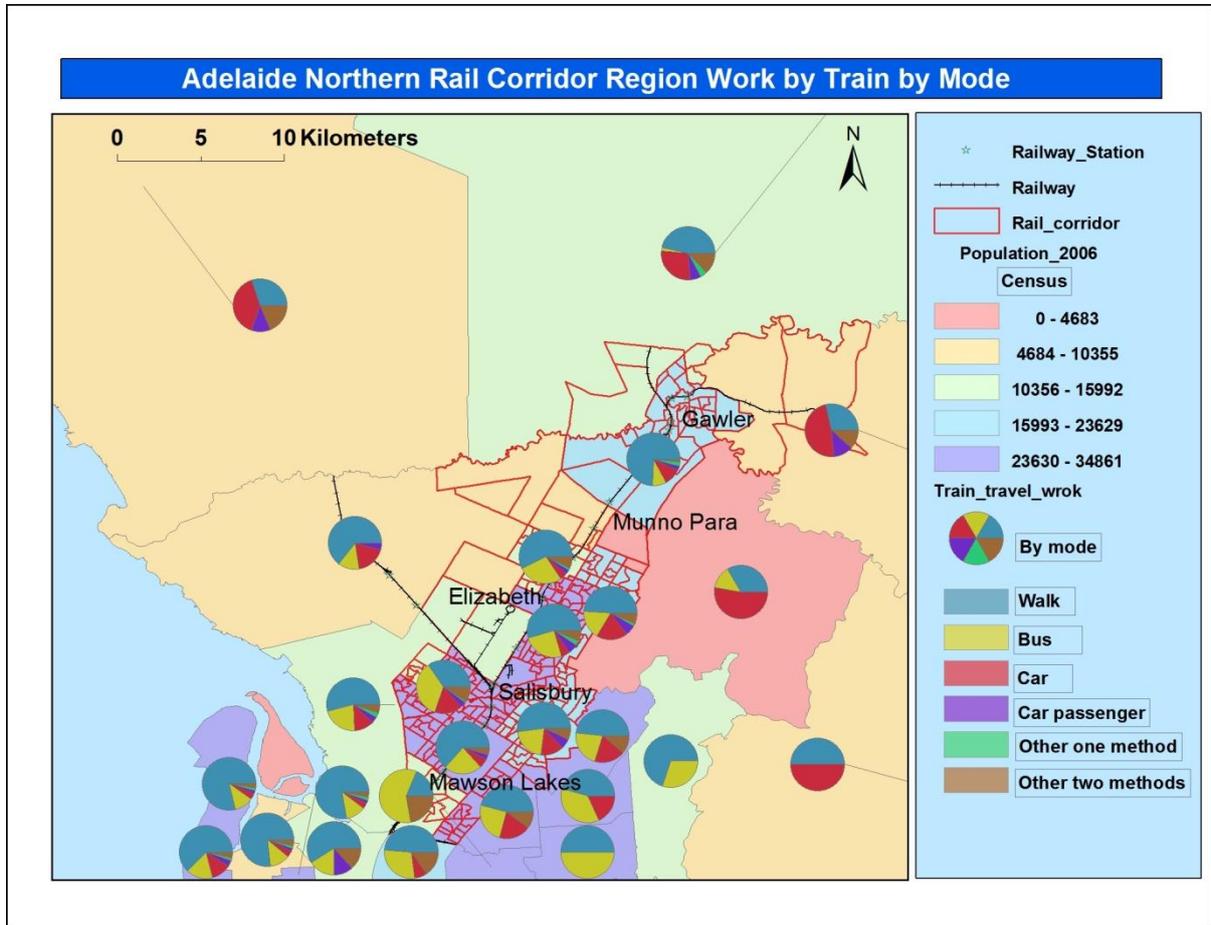
The travel behaviour of local residents in this area appears to exhibit a high car preference (Australian Bureau of Statistics 2006). The majority of people drive a car to their work, even those who live near a railway line. Figure 2 illustrates where the working populations in the rail corridor are located, and their one method travel to work. It reflects the dominance, in most cases, of the car mode compared with public transport. The train mode is slightly more popular for people who live closer to the rail corridor than for those who do not.

Figure 2: Working populations and one method travel to work



This statistic data set also provides the methods train users use to access railway stations by geographical distribution along the corridor and beyond (Australian Bureau of Statistics 2006). Figure 3 provides this breakdown by suburbs; we suppose that one method to work by train resident access station by walk. Bus, car and other methods transfers play a more dominant role than walk to access the railway station. The walk mode is used slightly higher for people who live near the railway line than people who do not.

Figure 3: Whole population and train user access mode to railway station



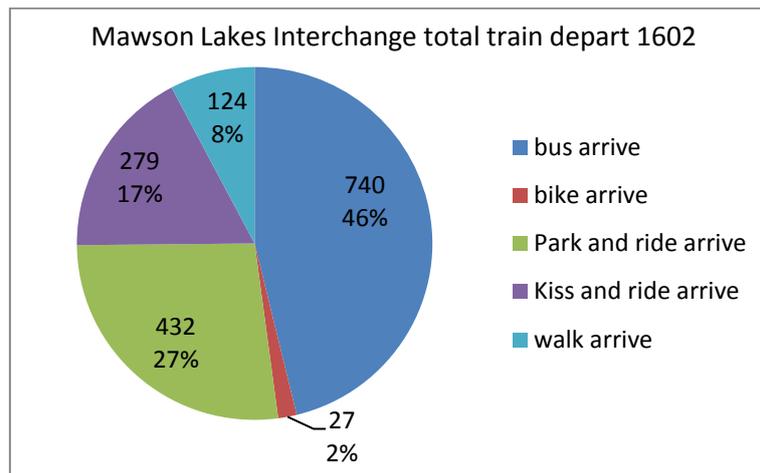
Based on this information, the current study has collected data in the corridor area including railway station observation data and focus groups. A railway station observation survey covered all the station access points from 6am–7pm and recorded at 5 minute intervals the passenger transport demands at Mawson Lakes, Elizabeth and Gawler interchanges on one day each in 2010. Access modes used by train users included walking, bike riding, bus, 'park and ride' and 'kiss and ride'. From this data, it is possible to describe the travel patterns of the train users. Focus groups questions were designed based on a literature review about TOD features and six groups of people were questioned. The six groups comprised of one each from Mawson Lakes, Elizabeth, Gawler, one from suburbs in the corridor excluding the aforementioned three suburbs, frequent rail users and students at the University of South Australia's Mawson Lakes campus. This data gave a better understanding of corridor resident travel behaviour, transport connection demand and residents environmental concerns.

The following section combines the results from the railway station observation surveys, focus groups and local characteristics to analyse what are the main impacts on TOD.

3 Findings and analysis

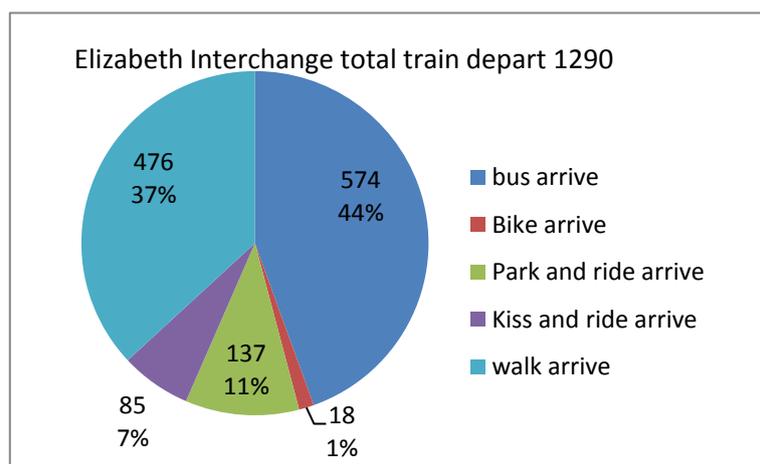
The result of the rail interchange survey at Mawson Lakes interchange by the project team in 2010 has shown a promising level of daily rail patronage. The station is busy at peak times, at around 7:30am and 4:30pm. 'Park and ride' users have an occupancy rate of 85% for most of the day of a total of 450 available car parks. 1602 passengers used the station to depart, arriving at the station by either bus, car, bike or walking, see Figure 4.

Figure 4: Arrival methods at Mawson Lakes Interchange



Security patrols around the station increase the feeling of safety for train users, which makes Mawson Lakes interchange a more attractive spot to get on and off the train, especially in the dark. Nine feeder bus routes bring in 740 passengers per day. Walk and cycle arrivals only account for 10% of total train users while 27% of users arrived using 'kiss and ride'. The results of the survey in Elizabeth show some slightly different results as illustrated in Figure 5.

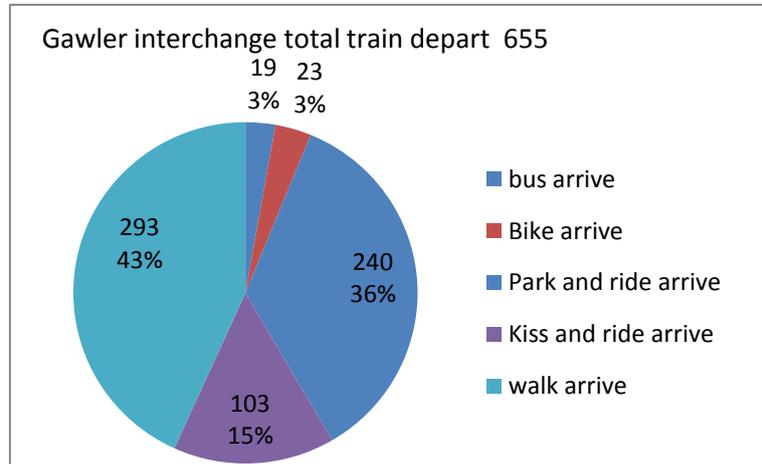
Figure 5: Arrival methods at Elizabeth Interchange



In Elizabeth 37% of train users arrived by foot, only 7% by 'kiss and ride' and 11% by 'park and ride'. A possible explanation for this may be that some of the walkers park their car in the nearby shopping centre car park or have been dropped off on the street nearby.

For Gawler, the survey results show that only 3% arrive at the station by bus but a higher amount of walkers arrive at Gawler station than at the other stations being 43%, as shown in Figure 6. A main reason for lower bus arrivals might be that regular scheduled bus services do not exist in Gawler with only a few regional services passing the station, mostly at peak times.

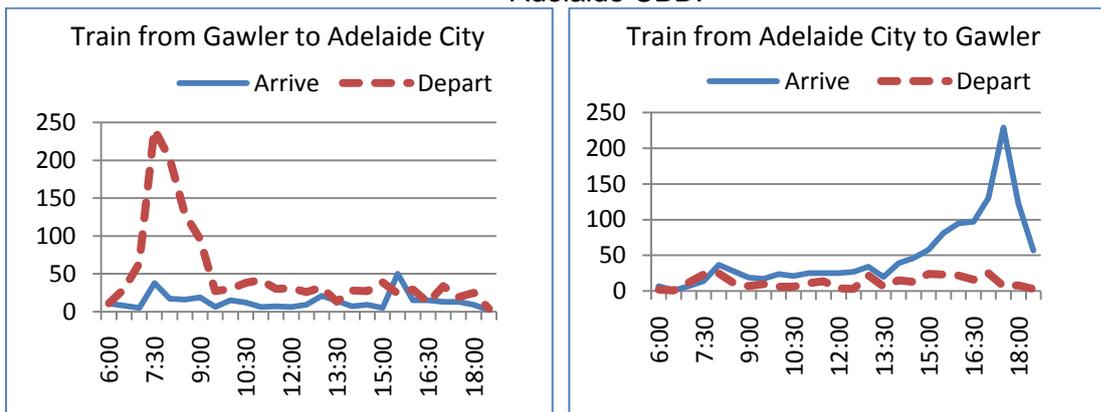
Figure 6: Arrival methods at Gawler Interchange



These patterns illustrate that local residents have habits that are influenced by the nature of the public transport and other transport infrastructure such as walk path and feeder bus availability. These are reflected in local focus groups that were held and the detailed analysis of these will be discussed.

From the same interchange survey, data shows (in Figure 7) the majority of train users left Mawson Lakes to the city in the morning peak time and in the evening peak time they returned from the city to Mawson Lakes.

Figure 7: Daily profile of train patronage at Mawson Interchange for trains travelling to the Adelaide CBD.



This reflects the problem of a lack of employment density in Mawson Lakes. Few retailers have established businesses along the way from the University to the interchange. Focus group participants said that the shops that are currently at this location are not the type that they would frequently visit. For example, residents have been waiting for some time to have a 'fish and chip' shop but there has been difficulty in having the establishment of one approved. The developer has expressed difficulty in attracting commercial land use in this area. Mixed land use could create more job opportunities and reduce the need to travel, as it

creates housing, offices, schools, shopping centres and entertainment near a transit station (TRB 2008).

Focus group discussions uncover and explore issues associated with living, working and travelling within the Northern regions of Adelaide with a special emphasis on TOD planning characteristics. Table 1 summarises the results of the focus groups organised by location.

Table 1: Major transport related issues in the Northern Corridor (√ indicates concern)

TOD features	Issues	Location			
		Mawson Lakes	Elizabeth	Gawler	Other area
Public transit infrastructure	Security, anti-social behaviour, crime	√	√	√	√
	Train carriage dirty, graffiti, scratches	√	√	√	√
	Station accessibility	√	√	√	√
	Weekend trip connection	√	√	√	√
	Work place public transport availability		√	√	√
	Public transport cost	√		√	
	Bus availability			√	√
	Bus station parking availability				√
Urban land use	Child recreation facilities	√		√	√
	Neighbourhood environment		√	√	√
	Non-daily service	√	√	√	
	Preferred School			√	√
	Shops	√		√	
	Outdoor activities			√	√
	Mixed house type	√			
	Job availability				
	House affordability				
Road infrastructure	Pedestrian lane			√	√
	Bike lane			√	√
	Road design			√	√

An important result was that anti-social behaviour, security and crime on trains are one of the most concerning issues for all of the participants. In the discussion, teenagers were perceived as the major contributors of anti-social behaviour. Some comments received included complaints about 'high-school aged persons who are intimidating/ boisterous and loud', there is a 'need for a conductor in train carriages and more guards on the stations', and that there are 'kids gangs everywhere'. People also felt unsafe when in areas with graffiti and window scratches and that the smell and dirt on the train made them feel uncomfortable. The highlighted issues prevent people travel by trains, especially at night. Some female passengers feel the need to ask family to pick them up when it is dark as they do not feel safe. This problem is not exclusive to Adelaide, but also affects other cities like Melbourne (Diec, Coxon & de Bono 2010).

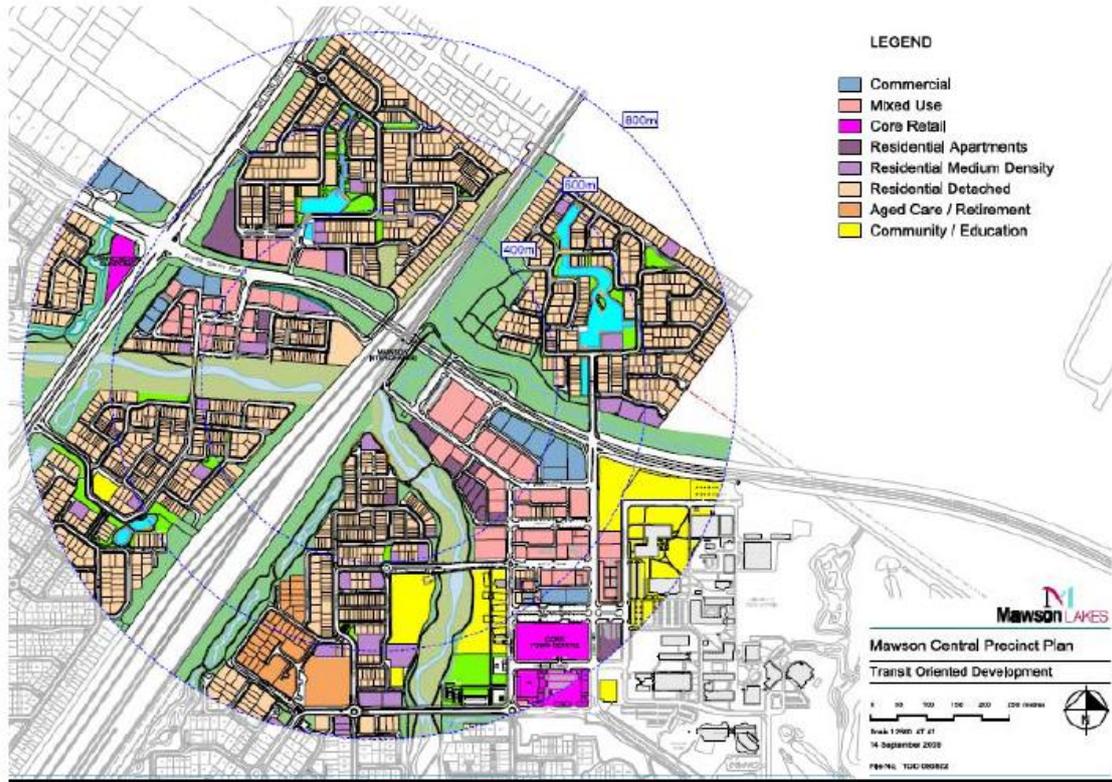
Another shortfall of public transport infrastructure highlighted during the focus group sessions is station access. Station design should not only be about providing an easy entry into the train carriage but also about providing friendly accessible walkways, bike lanes, locker availability, convenient bus transfers and 'kiss and ride' spots. 'Park and ride' facilities may also be required to attract people to use trains in a car dominated city like Adelaide (Mees 2000; Bos et al. 2004; Willson 2005; Curtis 2008). A major complaint about the Salisbury interchange is that there is a bar nearby and passengers have been harassed by intoxicated patrons. Similarly, Elizabeth station has an adjacent pawn shop that attracts some people to loiter around the station, which causes train users to feel uncomfortable. The newly established Mawson Lakes interchange only provides easy access from the eastern

side. However, on the west, the railway lines themselves can only be traversed by a grade-separated road, which adds inconvenience to the trip and restricts walking access from the northern side. One Mawson Lakes resident complained that 'the station is just before me, but I need to walk around for more than 10 minutes to get there'. There is a lack of friendly walk ways; of the people who walked to access the train at Mawson Lakes, 80% of them used access along a local creek route to the station where scattered plants and a pleasant environment around the creek make the walking journey more enjoyable. An access problem appears at Gawler station as well, where there is no bike lane on the local road network, and the only bus access is from a regional bus service which is only available on an infrequent basis.

Another issue for public transit infrastructure was the connection problems including poor availability on weekends and lack of service to areas further away from railway lines. People choose public transport to get to work as a habitual choice, but on weekends it is harder to get the same level of service. From the focus groups, up to 70% of the Mawson Lakes group of students own a car to use for visiting their friends or going shopping on weekends, even though they walk every day to the University campus at Mawson Lakes. This might be one of the reasons that help explain Adelaide's high level of car ownership. Other participants said that their children would love to use public transport for weekend trips but unfortunately, it takes 30 minutes to one hour to wait for the next transfer which means the trip is tiring. As a result they choose to drive a car instead. A good suggestion from the Mawson Lakes residents is to create public transport routes that service scenic, historical and other places of interest. The problem has to be solved both from a transport infrastructure and from a resident point of view. Bus availability is more of a concern for people who live or work away from train stations, as well as car parking around a bus station. They wish that Adelaide's successful O-Bahn express guided bus way service could be extended to their residential area. This is a good indication that residents would like to access a reliable and frequent public transport service with a high quality standard in general.

Urban land use effects local residents lifestyle and travel patterns. The focus group sessions have revealed that people who live further away from rail corridors accept that they usually have to drive some distance to their closest shops, services and possibly their work place and have become accustomed to this travel pattern. However, a need for recreation such as close good outdoor activities, preferred schools and for children activities are always their issues. Oppositely, people who lived near the rail corridor and close to regional centres which have a better mixed land use tend to use public transport options over private cars more often. For a TOD-like area like Mawson Lakes, shops and services existing within a walkable distance becomes an important factor for their local urban structure. For example, some participants complain that the post office is to be located too far away because it takes 3 minutes to drive there. Mawson Lakes faces the challenge to provide more shops, facilities for irregular activities and other services. One female Mawson Lakes resident stated that 'I have a walkable distance to work, but I have to drive a car to take my children to Elizabeth or City for activities'. However, much of the urban structure of Mawson Lakes exists within 800 metres or a reasonable walking distance of the train station (Figure 8) and provides facilities for a range of outdoor activities, good bus transfers to the train station, good walkways and bike lanes within the town, and a higher density of housing development which are all factors that show a high potential for an advanced TOD. This development attracts more residents and has helped the City of Salisbury to gain the highest Adelaide Statistical Division (ASD) population growth rate of 1.6% from 2005-2006 (Australian Bureau of Statistics 2009). On the other hand, the higher density apartment types prevalent in Mawson Lakes may not be as popular with some local residents who show a 'not in my backyard' attitude towards apartments and claim that they damage the whole scenery.

Figure 8: Mawson Lakes Interchange



Source: (Branford & Hains 2010)

Infrastructure provisions such as walkways and bike lanes heavily impact upon the quality of living areas. Figure 9 is an image of one of the more popular parts of Mawson Lakes Centre, viewed from the south. It consists of restaurants, core retail outlets, education facilities and walkable routes along a creek and lake scenery. However, this convenience does not appear everywhere, e.g. the areas around railway interchange. Developers at Mawson Lakes have been allowed a great deal of freedom in designing the landscape. This might cause a lack of consistency in the urban form. A detailed street design should not only include a defined width of the street but also include footpaths, cycle lanes (Newman, Kenworthy & Vintila 1995) and even the location and type of the trees, flowers or art sculptures. Overall, the Mawson Lakes development creates a quiet, safe and liveable town centre, but could be enhanced by a more advanced application of TOD principles.

Figure 9: Mawson Lakes Town Centre at Mawson Lakes Blvd



Source: (Branford & Hains 2010)

The town of Gawler has a different structure to Mawson Lakes. Being a historic town dating from the 1850s, Gawler encounters difficulties in the redesign its narrow streets and to reorganise heritage sites. Bars and hotels in the area generate income for the local economy, but passengers who have been consuming alcohol arriving by train from Elizabeth cause worries for local residents. With respect to transport planning in Gawler, one resident posed the question in regards to the town's future development as 'how can there be such a large growth in population being planned in the 30 years plan but without any plan for how to develop transport in the area'. This question highlights local residents' concern for transport issues that affects their daily life and will be a continuing concern into the future.

4 Discussion and recommendations

Taking into account our research project is ongoing, this paper provides some recommendations which are issue specific and other recommendations to develop potential policy strategies utilising the application of a Discrete Choice Modelling (DCM) methodology (See Table 2). During the DCM development, the research process will collect more household data based on these issues and identify behavioural reasons related to them. A more detailed explanation of DCM development is discussed in literatures, such as Ortúzar and Willumsen (2002).

Table 2: Preliminary recommendations for issues related to TOD features

TOD features	Issues	Recommendations
Public transit infrastructure	Security, anti-social behaviour, crime	Improve train quality, DCM
	Train carriage dirty, graffiti, scratches	Improve train quality
	Station accessibility	DCM
	Weekend trip connection	Bus route management
	Work place public transport availability	Bus route management
	Public transport cost	Increase patronage from community
	Bus availability	Bus route management
Urban land use	Bus station parking availability	Bus route management
	Child recreation facilities	DCM
	Neighbourhood environment	DCM
	Non-daily service	DCM
	Preferred School	DCM
	Shops	DCM
	Outdoor activities	DCM
	Mixed house type	DCM
	Job availability	DCM
	House affordability	DCM
Road infrastructure	Pedestrian lane	DCM
	Bike lane	DCM
	Road design	DCM

Increasing the feeling of safety for passengers is highly likely to encourage increased train usage by residents along the corridor. To improve security and limit anti-social behaviour at transport interchanges, acknowledging residents' wishes by having a conductor on the train carriage and guards at the major stations might be helpful. While this may appear to be an expensive proposal, if having conductors attracts an additional 3000 passengers a day, this may be able to cover the conductors' wage cost. The most important aspect is that this may help residents to form a habit of using the train.

Another suggestion for increase the patronage is to reduce offensive behaviour and crime and build up the positive citizen aspect for young people rather than to emphasise the troublesome behaviour of young people (Muncie and Walters cited in White & Sutton 1995).

For example, the education of the benefits of public transport and friendly social behaviour in school could help to reduce the incidents of bad behaviour on the train. It is also important to approach crime prevention using a supportive approach with a strong advocacy and to stress the implementation power at a local level (White & Sutton 1995). For example, using public campaigns like advertisements might improve public awareness and help create an environmentally friendly life style.

The design of a railway station shelter interiors and structures can also potentially minimise medium to high severity anti-social behaviour and crime (Loukaitou-Sideris, Taylor & Fink 2006). These authors suggest a series of security strategies to adopt at stations including security guards, CCTV cameras, emergency preparedness, and a means for reporting suspicious activities. They also recommended that new stations could be designed to promote security by using transparent materials, good lighting and limited entrance points. Another valuable suggestion is to provide arrival information system and security awareness campaigns.

It is also important to involve the community to encourage travel behaviour change and to support rail based travel (Taylor & Ampt 2003). The research on 'Travel Smart', 'Individual Marketing' and other travel behaviour change programs, such as those reported in Ampt, Wundke and Stopher (2005) and Stopher et al. (2009), have a successful record in encouraging communities to change travel behaviour in favour of more sustainable transport options. Wiblin (2010) discussed a travel plan which includes targeting new employees and commercial tenants, encouraging them to use sustainable transport and promoting events with the notion of sustainable travel, such as the 'Walk to Work Day'. This kind of plan could convert short term changes into habits providing a focus on individual benefits.

To promote a higher train patronage for areas which locates further away from the railway line, connection buses to railway stations need to be provided in those areas (Calthorpe cited in Dittmar & Poticha 2004; Currie 2005). It is more environmentally friendly to use a shorter and more frequent bus route as a rail feeder than to have longer less frequent routes. For example, a bus running parallel with the rail line from Adelaide City to Elizabeth could be converted to a shorter route to link newly developed areas such as Andrews Farm and Blakes Crossing to a railway station. The infrastructure that supports bus services should also offer 'park and ride' or 'kiss and ride' facilities (Semler & Hale 2011).

5 Conclusions and further research

In conclusion, for increasing train patronage, transport policy makers might consider to have a conductor on each train carriage and implement security strategies such as the use of security guards at some major interchanges to attract more train users. Schools could introduce programs that encourage environmental responsibility and good manners on public transport. Advertisements and community travel programs and events could be utilised by promoting residents and citizens to change their car dominant travel habits and attitudes towards public transport. Bus feeders to train stations might run higher frequencies and shorter routes. Furthermore, the new feeder bus routes design might be an interesting area for a future research project following from this TOD rail corridor study.

The method of obtaining potential policy solutions to the other issues not addressed in recommendation will be assigned to the development of DCM for continuing study through using railway station access models and residential location models. The proposed methodology has been applied in previous studies (McFadden 1978; Srinivasan & Ferreira 2002; Bhat & Guo 2007; Givoni & Rietveld 2007; TRB 2009; Olaru, Smith & Taplin 2011) with desirable results for urban planning policy guidance. Thus, the next step in this research

will be to allocate these issues in hypothetical choice scenarios to estimate individual behaviours and describe the influence of these issues on planning policies, such as public transportation infrastructure, residential land use, local services development and industrial employment planning. Additional survey work is therefore proposed and will include such stated preference survey data collection and analysis alongside personal and household travel patterns including origin-destination surveys.

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The paper and its conclusions represent the views of the authors, and do not necessarily represent the views of DTEI, LMC and the South Australian Government, or those of the Cities of Playford and Salisbury, the Town of Gawler and Delfin Lend Lease. DTEI, its staff or the South Australian Government along with all of the other industry partners cannot be held responsible for any material contained within the paper, and are not liable for any loss or damage suffered by anyone who uses or relies on the information contained in the paper.

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