Does proximity matter? Researching Journey to Work by Rail in Metropolitan Sydney
S Jones, B Simpson, E Dimitriadis, M Jones

Introduction

This paper outlines how the Rail Infrastructure Corporation (RIC) is applying solid transport research to help drive future decision-making that will impact on resource allocation for major new rail infrastructure valued in the hundreds and billions of dollars.

One of RIC's many research challenges, patronage demand in the journey to work (JTW) market, is discussed and important research principles and lessons learned are highlighted. Some of the research directions for future research tasks are then outlined.

Background

The metropolitan passenger rail network

Sydney's metropolitan network (1,400 km of track along 651 km of routes) is the largest urban commuter network in Australia (with almost 270 million journeys in 1996/97). Its complexity and intensity imposes challenges for the owner and manager of the NSW rail network and rail operators. Economic, commercial, environmental and social factors are all driving demand for increased rail use.

Between 1979 when the Eastern Suburbs Railway (Martin Place, Kings Cross, Edgecliff and Bondi Junction) was opened and now, Sydney's population has grown by a further 858,000. However, in the last decade, apart from the link from the city to Kingsford

Smith Airport, there have been no other major extensions to the Metropolitan Network, which was developed predominately pre WWII.

Given that this paper is focusing on the JTW market, it is pertinent to examine the potential growth in JTW rail market (based on forecasts of CBD office employment). The graph below illustrates that during the last 20 years rail patronage has grown by nearly 80,000 patrons per day. The vast majority of this rail travel is to the CBD and the biggest concentration is in the 6.30 to 9.30 morning peak period.

Employment (Stand Alone Office) and Rail Patronage
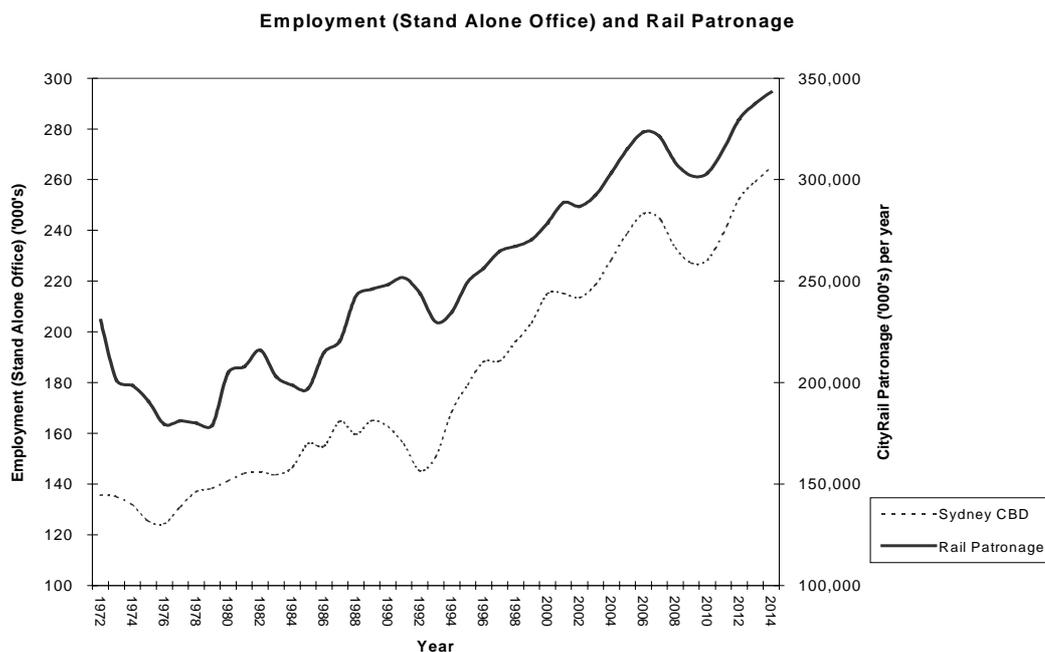
The planning problem

In 1996, the NSW Government pursued several major reforms that affected the strategic planning of the State's rail infrastructure.

Rail Access Corporation[1] (the owner and maintainer of rail infrastructure) included a small team devoted to planning & development. Similarly, State Rail Authority (the major passenger service provider) included a small rail development group. In the years immediately following the 1996 reforms, these two groups were characterised by:
- severe resource constraints (both staff and money) devoted to strategic planning;
- corporate and political agendas necessitating the progression of a number of key projects; and
- immediate priorities that emphasised long term asset planning for line segments (rather than the whole network).

---

[1] Now part of the newly formed Rail Infrastructure Corporation

During this same time period (from 1996), Sydney has experienced the strongest period of growth since the 1960's. In 1994, Sydney's growth for 1991-96 was forecast at about 31,000 persons per year. According to the Department of Urban Affairs and Planning, the actual figure realized was around 42,000 per year. From 1996 to 1999 average growth increased to 54,000 persons per year and in 1999 growth reached 59,000 per annum. The higher than anticipated population increase has been credited to a combination of the strong economic and employment growth associated with Sydney's emerging role as Australia's 'world city' together with higher overseas migrant intakes.

In 2000, the strategic planning environment changed for a number of reasons including:
- short term safety, reliability and efficiency issues;
- a public and media focus on rail;
- events casting doubt on the validity of previous patronage forecasts (eg, the overestimation of Airport Rail Link patronage, underestimation of Illawarra Line growth, and the range of forecasts for the proposed Parramatta Rail Link);
- change of key personnel more empathetic to strategic planning; and
- the need to progress several major new infrastructure projects in a considered and prioritised metropolitan framework.

Together these factors led to creating an environment conducive to much improved strategic planning across the metropolitan passenger network. Hence, much greater resources were allocated, and together RIC and SRA are progressing an ongoing strategic planning program designed to examine Sydney's long term rail needs.
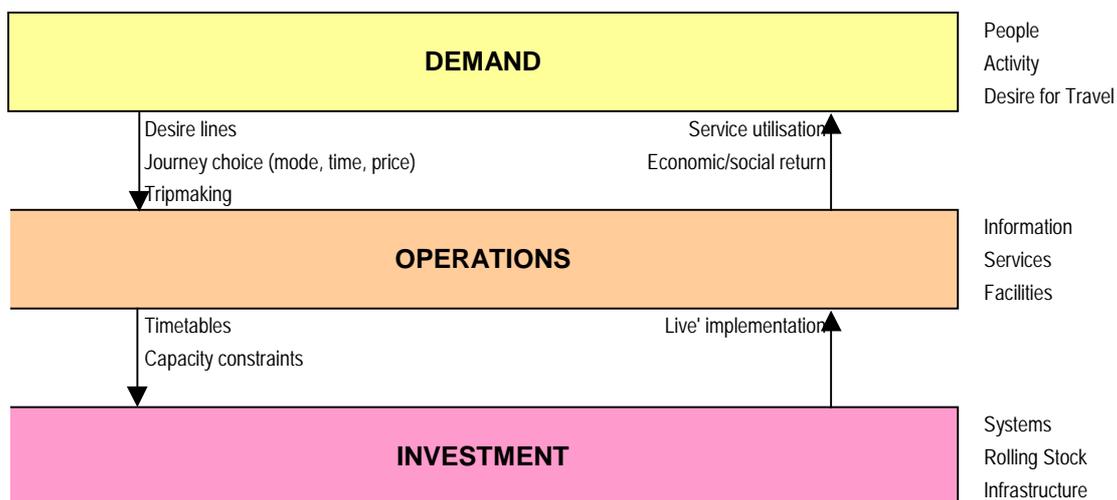

As initial steps in our strategic planning process, we realised the need for:
- a range of products for a variety of stakeholders and purposes;
- the need to undertake fundamental research, particularly on the demand side (eg population) to provide a sound foundation for forecasting; and

- the creation of transport modelling to simulate interaction between sources of demand and means of supply, including drivers of modal split for different types of journeys in different markets.

To move forward an integrated research package was agreed. Its principal components are illustrated below:
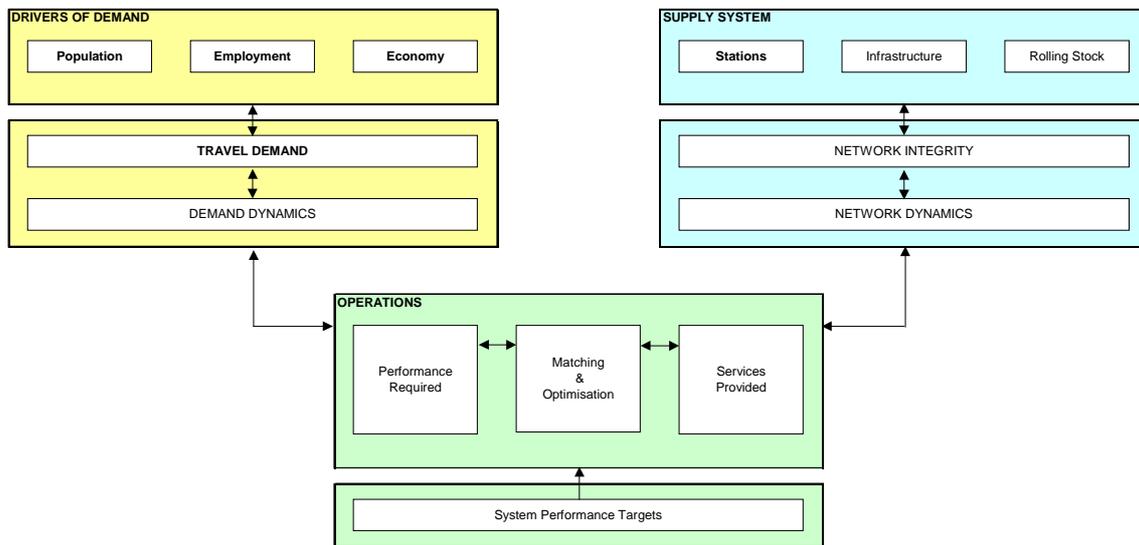

The proximity package

The objective

To determine whether proximity to rail matters ie, are there significant differences in the JTW market for those employees living closer to the rail stations versus those employed but do not live in close proximity to the rail network?

Organising the research

The research and report product was organised as follows:

Does proximity matter? Researching Journey to Work by Rail in Metropolitan Sydney

S Jones, B Simpson, E Dimitriadis, M Jones

1. PROBLEM DEFINITION

2. APPROACH & METHOD

3. SYDNEY IN CONTEXT

Sydney

GMR

4. SYDNEY BY PARTS

A. **LGAs by Distance from CBD**

Inner
Middle
Outer

Sydney = Inner+Middle +Outer

B. **LGAs by Rail Service**

Poor Rail	Limited Rail	Poor Rail
	Adequate Rail Service	
Poor Rail		Poor Rail
	Limited Rail	

Sydney = Adequate + Limited + Poor

C. **Rail Corridors**

Non-Rail Areas
Rail Corridors
Non Rail Areas

Sydney = Rail Corridors + Other
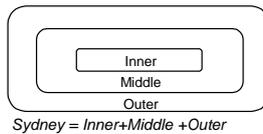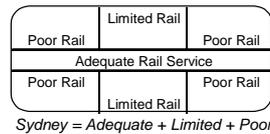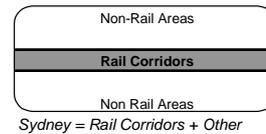
5. RAIL CORRIDORS & STATION CATCHMENTS

C1.
Rail Corridor 1
Comparing Rail Corridors
Rail Corridor 2

C2.
Station Catchments along rail corridors
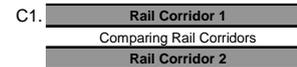
6. TRAVEL DYNAMICS

Between LGAs & Groups of LGAs

Along Rail Corridors

A.
Inner
Middle
Outer

B.
Poor Rail	Limited Rail	Poor Rail
	Rail Service	
Poor Rail		Poor Rail
	Limited Rail	
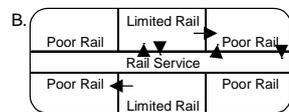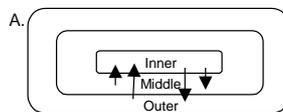
C.
LGA Catchments along rail corridors
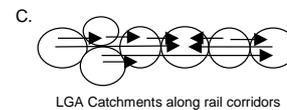
7. INTEGRATION & FURTHER RESEARCH

NOTE: LGAs = Local Government Areas

The information source

Australian Bureau of Statistics (ABS) Journey to Work (JTW) Sydney Census Data was specifically sorted for this RIC research task and then analysed for a 20-year period (1976 to 1996) to establish trends in the journey to work transport market. For our purposes, 'worked at home', 'did not go to work' and 'not stated' categories were excluded from journey to work figures.

Methodology

JTW data is derived from the ABS Census of Population and Housing which is conducted every five years. JTW data provides information on the trip to work on Census day undertaken by all employed people aged 15 years and over who were counted on Census night.

Does proximity matter? Researching Journey to Work by Rail in Metropolitan Sydney
S Jones, B Simpson, E Dimitriadis, M Jones

This paper examines the Sydney Statistical Division (SD) (Sydney) and the Greater Metropolitan Region (GMR). The Sydney SD includes the Local Government Areas (LGAs) of Wyong, Blue Mountains and Wollondily. The GMR comprises the Sydney SD and the Newcastle and Illawarra regions.

The GMR has been classified into the following categories:
- Inner LGAs – LGAs 0 to 10 km from the Sydney CBD;
- Middle LGAs – LGAs 11 to 25 km from the Sydney CBD;
- Outer LGAs – LGAs 26 to 100 km from the Sydney CBD; and
- Beyond 100km LGAs – LGAs 101km plus from Sydney CBD.

The distance from the population centroid of LGAs relative to the Sydney CBD has been used to classify LGAs. Refer map below.

Local Government Areas in Sydney SD
Grouped into 'Inner', 'Middle' & 'Outer' Regions
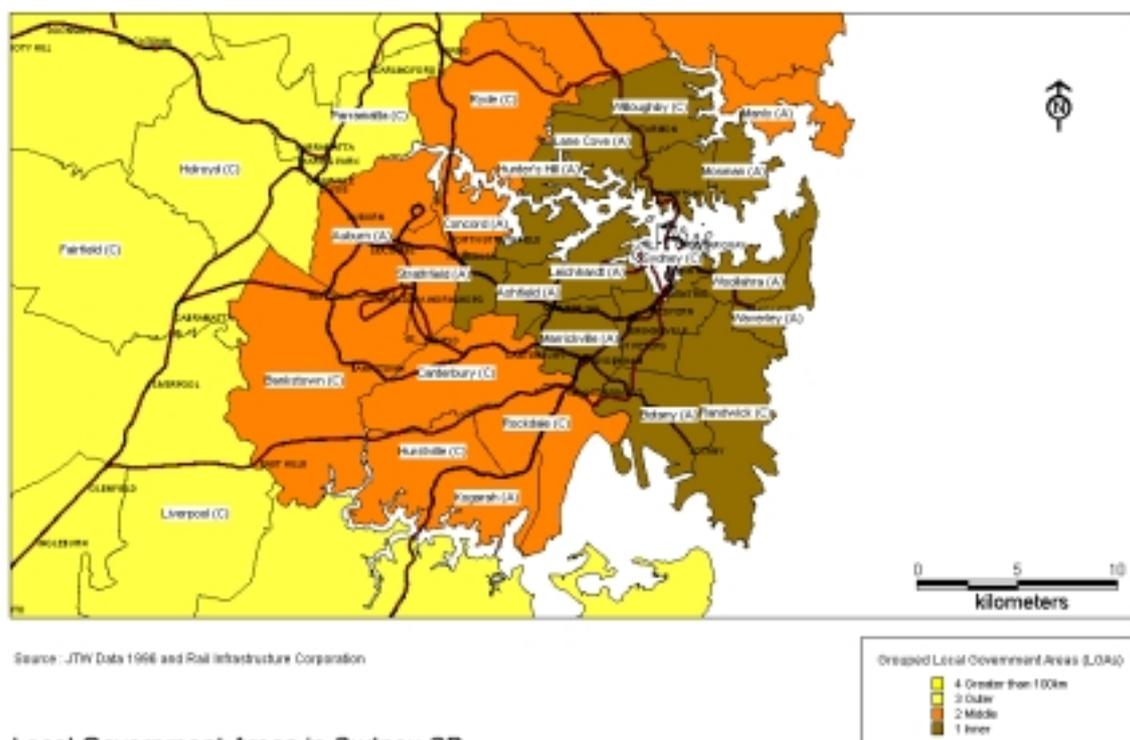
LGAs have also been classified according to the level of rail access/proximity to rail, namely:
- LGAs with 'no' rail access - LGAs with no railway station eg. Warringah LGA;
- LGAs with 'limited' rail access – LGAs with up to two railway stations eg. Baulkham Hills LGA with Carlingford station only; and
- LGAs with 'some' rail access – LGAs with three or more railway stations eg. Sutherland LGA with Como, Jannali, Sutherland, Kirrawee, Gymea, Miranda, Caringbah, Woolooware, Cronulla, Loftus, Engadine, Heathcote and Waterfall stations.

This simple classification is a broad guide that serves as a reasonable indicator for this ABS data set. It does not reflect factors such as train stopping patterns; number, frequency and speed of train services; factors that the rail industry would normally use in a detailed service assessment.

The GMR rail network has been divided into 17 'lines'. Lines generally reflect current CityRail train operating patterns. In 1996, the total population in the "1 km catchments" was approximately 42% of the 3.7 million people in the Sydney SD.

To enable effective data interpretation and analysis branch lines have been represented as separate rail lines. For example, the Richmond line has been defined to include all stations between Richmond and Blacktown (typically the Richmond branch line), as well as, all stations and interchange stations, between Richmond and North Sydney. Rail line definitions have resulted in some repetition of stations, for example on the West [Richmond] and West [Emu Plains] lines.

The main findings

Journeys to work in Sydney

The car is the dominant mode of transport for journeys to work across the Sydney SD and accounts for approximately 70% of journeys to work.

Rail (including rail with other) and bus account for 21% of journeys to work across Sydney. This mode split is 15% for journeys to work involving rail and 6% for journeys to work by bus.

Rail is the second most popular mode of transport for journeys to work and accounting for 15% of journeys to work in Sydney. Rail is the preferred mode of public transport for medium journeys to work (11-25km). Mode share for travel involving rail is greatest in the middle local government areas of Sydney (LGAs 11 to 25km from the Sydney CBD) and contributes 17% of journeys to work.

Regional patterns

The majority, 78%, of Sydney's population resides in LGAs with 'some' rail access (defined as LGAs with three or more railway stations). Only 14% of Sydney's population resides in LGAs with 'no' rail access (defined as LGAs with no railway stations). Distribution of journeys to work by rail between the 'rail access' zones is shown below:

Does proximity matter? Researching Journey to Work by Rail in Metropolitan Sydney
S Jones, B Simpson, E Dimitriadis, M Jones

Origin Zone	Destination Zone			
	LGAs with no rail	*LGAs with limited rail*	*LGAs with some rail*	Total
LGAs with no rail	716	171	6,534	7,421
LGAs with limited rail	884	159	9,636	10,679
LGAs with some rail	22,346	4,470	157,105	183,921
Total	23,946	4,800	173,275	**202,021**

The majority of journeys to work, by all modes, originate from the outer LGAs of Sydney. 52% of journeys to work for Sydney eminate from the outer LGAs. Distribution of Journeys to work by rail between the inner-middle-outer zones is shown below:

Origin Zone	Destination Zone			
	Inner LGAs	*Middle LGAs*	*Outer LGAs*	Total
Inner LGAs	19,405	5,011	3,784	28,200
Middle LGAs	43,094	6,649	5,934	55,677
Outer LGAs	81,714	14,049	22,381	118,144
Total	144,213	25,709	32,099	**202,021**

The comparative mode share in the different 'regions' is illustrated below.
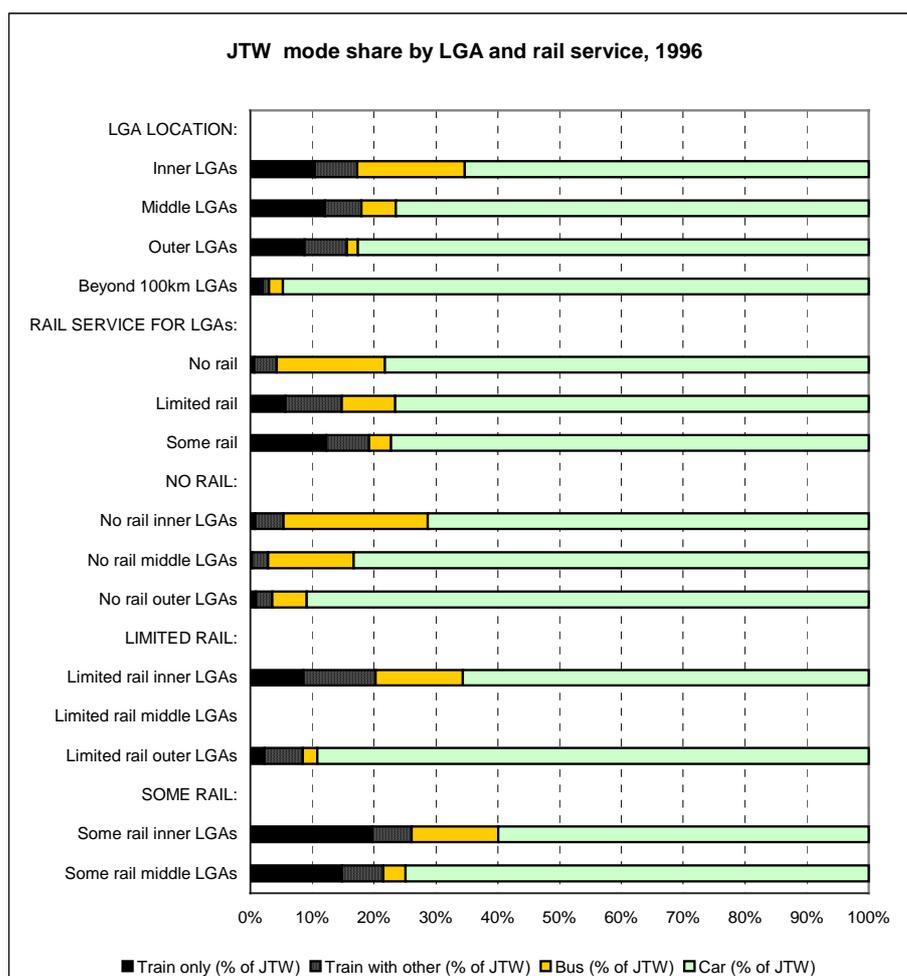
Note: % shares for nominated modes only. Share of all JTW is less.

The greatest number of journeys to work made by rail only, are generated within the Illawarra [Bondi-Cronulla] corridor and accounted for approximately 38,000 journeys/day. By comparison, only 725 journeys to work by rail only, per day, are generated within the Hunter corridor. The greatest number of journeys to work by rail with other modes are generated within the Inner West corridor (approximately 11, 000 journeys/day). By comparison, only 209 journeys to work by rail with other mode, per day, are generated within the Hunter corridor.

The North Shore line shows the greatest rail only mode share (17% of journeys to work). The Inner West line shows the greatest rail combined with other mode share (5% of journeys to work). The Hunter line shows the lowest mode share for rail only and rail with other mode at 2% and 1% respectively.

The shares of rail, bus and car, for the 1996 journey to work market for the different rail corridors are shown below.

Does proximity matter? Researching Journey to Work by Rail in Metropolitan Sydney
S Jones, B Simpson, E Dimitriadis, M Jones

JTW mode share by rail line, 1996

RAIL LINES (1km station catchment):

North Shore
Illawarra [Bondi - Waterfall]
Inner West
West [Emu Plains]
Illawarra [Bondi - Cronulla]
Main North
West [Richmond]
Main South
Blue Mountains
Cumberland
Bankstown
Carlingford
East Hills
Central Coast
Southern Highlands
South Coast
Hunter

0%   20%   40%   60%   80%   100%

■ Train only (% of JTW)   ■ Train with other (% of JTW)   ☐ Bus (% of JTW)   ☐ Car (% of JTW)
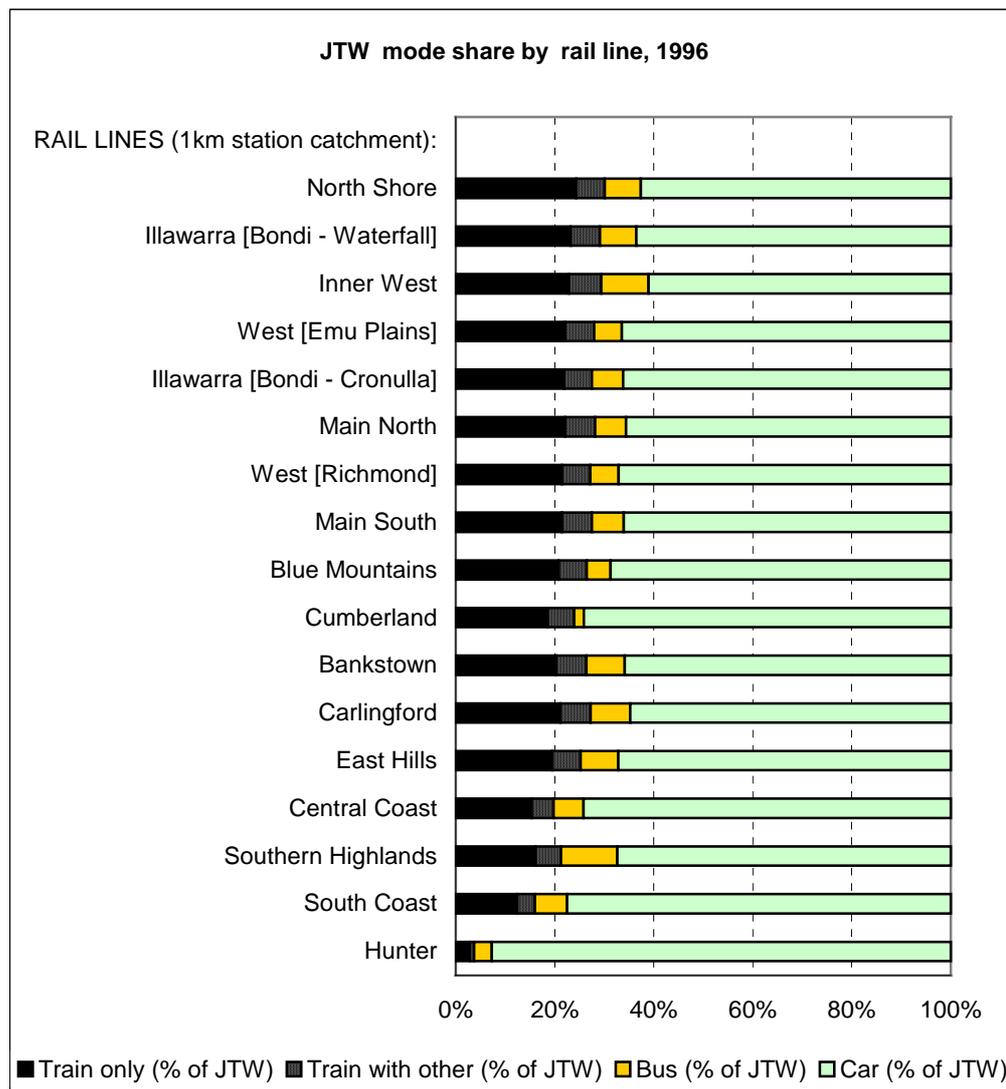
Note: % shares for nominated modes only. Share of all JTW is less.

The Illawarra [Bondi-Cronulla] line is the most populated of all the lines within the greater Sydney rail network with a population of approximately 508,000 people. This line includes the densely populated suburbs of Bondi Junction and Kings Cross. Similarly, the greatest number of private dwellings are located along the Illawarra [Bondi-Cronulla] line (approximately 225, 000 dwellings). The Hunter line reports the lowest population and number of private dwellings with 90,000 people and 39,000 dwellings respectively.

Station catchments

Analysis of station catchments shows, that the majority of the population within a 1km catchment (catchment within one kilometre radius from a railway station) reside within the middle section of the rail line (11-25km). Similarly, the greatest number of journeys to work is generated within the middle section of the rail line eg stations in this category include Hurstville, Auburn and Gordon.

Does proximity matter? Researching Journey to Work by Rail in Metropolitan Sydney
*S Jones, B Simpson, E Dimitriadis, M Jones*

Kings Cross rates as the station catchment with the highest population and greatest number of dwellings. Conversely, Coalcliff rates as the station catchment with the lowest population and least number of dwellings.

Ashfield rates as the station catchment with the greatest number of journeys to work by rail and involving rail.

For the period between 1981 and 1996, the Sydney Census Data shows that growth in population, number of dwellings and journeys to work has only been significant in the inner city and eastern suburbs of Sydney.

Census information for a sequence of '1km' station catchments along the Bondi–Cronulla section of the Illawarra Line is illustrated below:
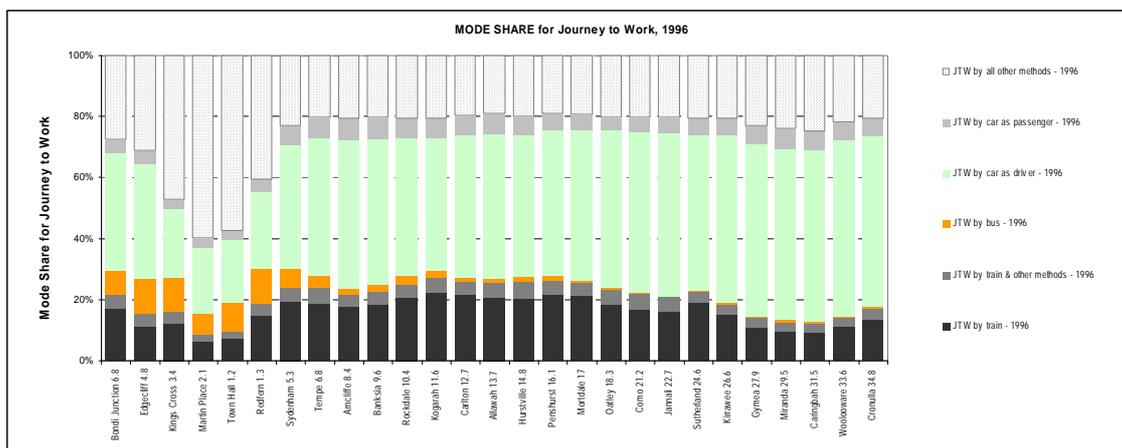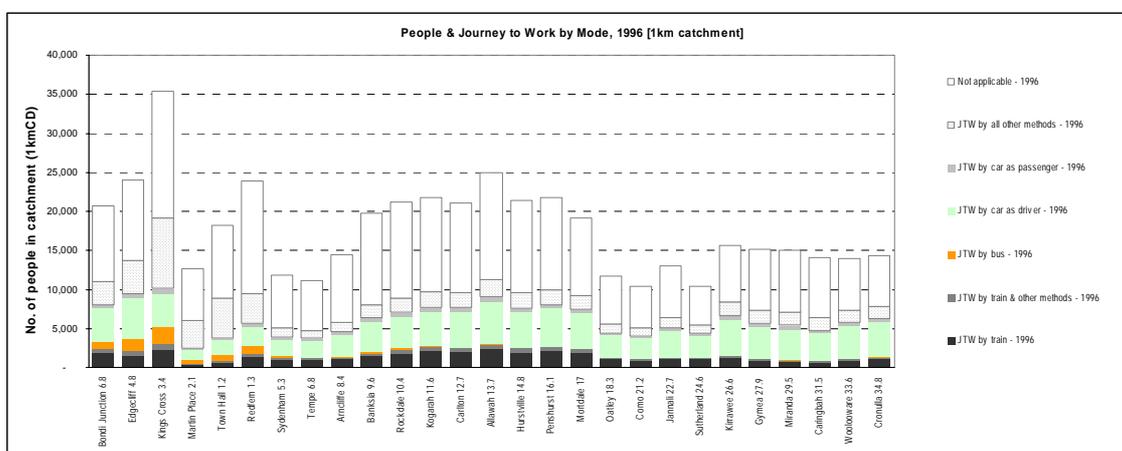

These (and other) graphs of 1996 ABS census data show for this section of the Illawarra, for example:

- the greatest number of people within the 1 km station catchment, reside between the Banksia to Mortdale segment of the rail line.
- the car is the dominant mode of transport for journeys to work along the line.
- the Eastern Suburbs and inner city segments of the line (0-10 km from Central station), have the greatest bus mode share for journeys to work

- rail patronage for journeys to work is greatest between the Banksia to Mortdale segment of the rail line (10-20 km from Central station).
- approximately 20% of the journey to work transport market involve rail.
- car ownership is greatest along the Kirrawee to Cronulla segment of the rail line.

Travel along rail corridors

Origin-destination journey to work by rail data has been used to illustrate rail travel patterns between LGAs situated along rail corridors. The Main West to North Shore Line (from the Blue Mountains to Penrith, Parramatta, Strathfield, the CBD, North Sydney, and beyond) is illustrated in the graph below.
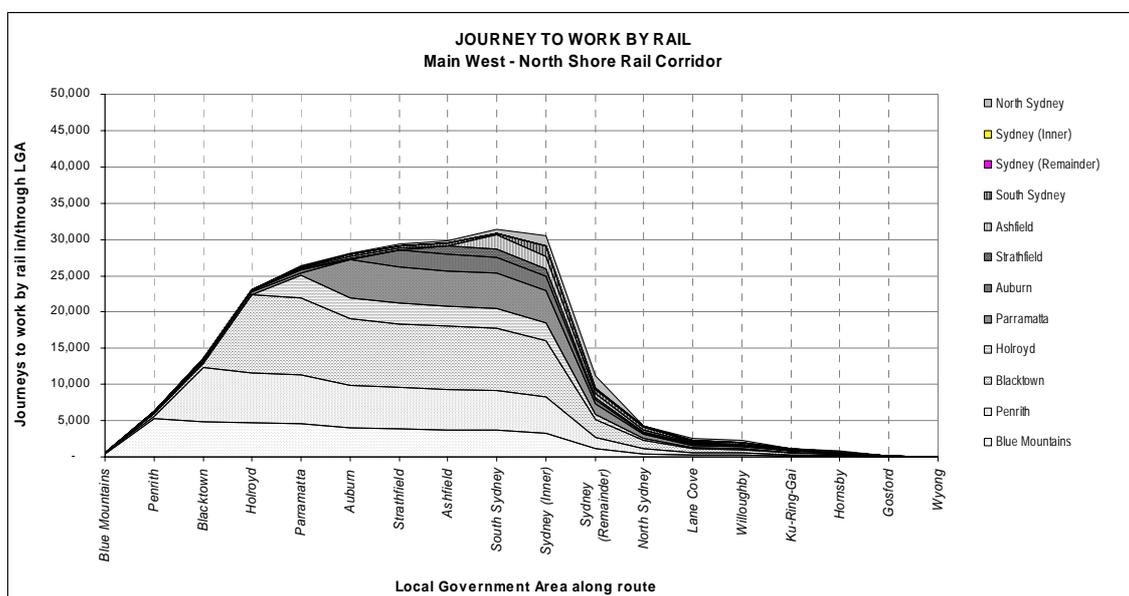
On this corridor, the dominance of eastbound 'long haul' journeys to work by rail from west of Parramatta to the CBD is shown by the lighter bands showing the volume (height of the band on the vertical scale) and length (along the horizontal scale) of most journeys from the western areas (to the left of the graph) to the CBD (at the centre of the graph). Relatively few rail passengers 'west' of the CBD/North Sydney travel beyond the CBD.

Understanding of these patterns (from these and other sources) is essential to optimise the rail system.

Summary of ABS JTW data analysis

Journeys to work involving rail account for 18% of journeys to work in LGAs with 'some' rail access. Journeys to work involving rail account for 4% of journeys to work in LGAs with 'no' rail access. It could be hypothesised that a demand for rail exists in

LGAs with no rail presence. One could also predict, with some basis, that the rail mode share for LGAs with no current rail service would increase on the provision of a rail service.

JTW Sydney Census Data shows that rail has performed a significant role in the Sydney JTW transport market and can be expected to continue to play a major role in sustaining Sydney as a major economic centre.

Source : ABS & Rail Infrastructure Corporation

Rail Line	CD Coverage
—— Line	▨ Region

Actual Area Covered by 1km ABS Station JTW Data - 1996

NOTE: With 1km radius circle shown around each station
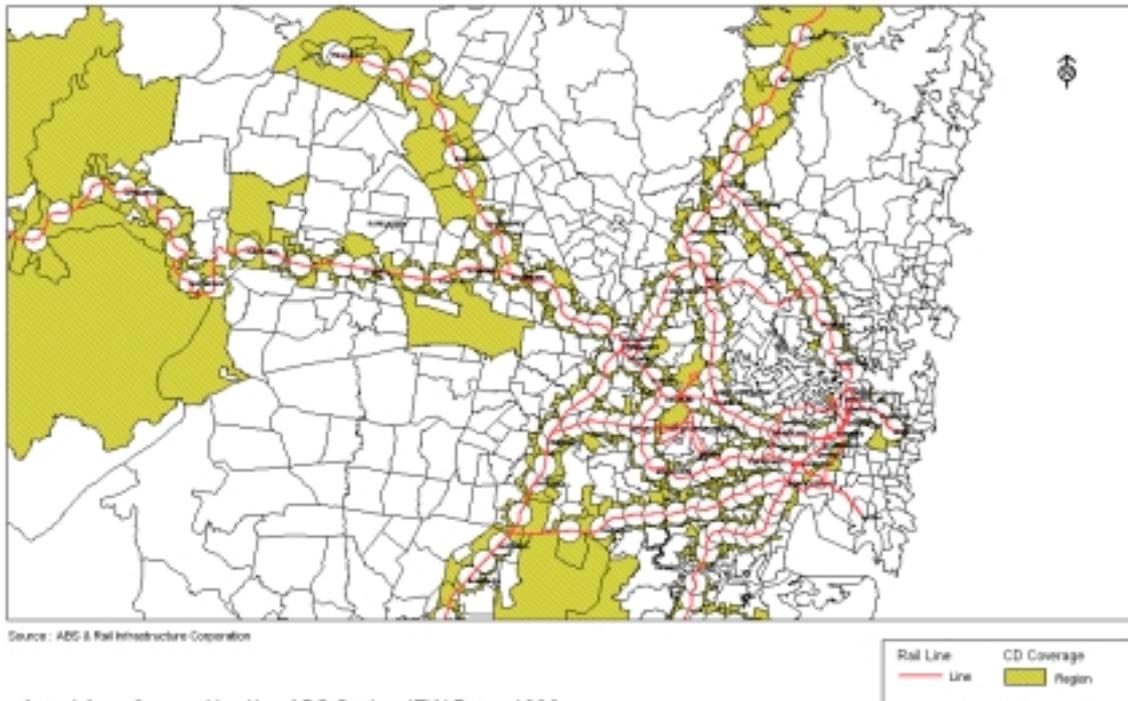
Lessons

From our experience, lessons that may help other researchers include:
- Wherever practicable undertake the research in a pilot (or preliminary) way, before committing to the full project or acquiring all data. For example, in our case pilot sampling could have shown that:
  - a comprehensive historical data set was unnecessary;
  - little insight was provided by the 500m data set (given the 1km data); and
- Don't underestimate the time and resources needed to properly analyse data, test assumptions, eliminate bias, summarise and graphically present information in ways that are relevant, meaningful and understandable by a range of stakeholders with varying degrees of expertise and interests.

The above comments are particularly relevant where complex relationships are involved.

Next Steps
- The JTW data analysed as part of RIC's planning research should be compared to and analysed with regard to actual CityRail data barrier counts, ticket sales, passenger loadings and stopping patterns, and non-journey-to-work travel. Some examples follow:

Does proximity matter? Researching Journey to Work by Rail in Metropolitan Sydney
S Jones, B Simpson, E Dimitriadis, M Jones

Station Entries: Patronage from outside the "1km catchments" is significant, particularly to major business centres and interchange nodes (eg with good bus connections or commuter parking stations). These large nodes (with more station entries in the morning peak) are far more significant than explained by their '1km catchment' population.
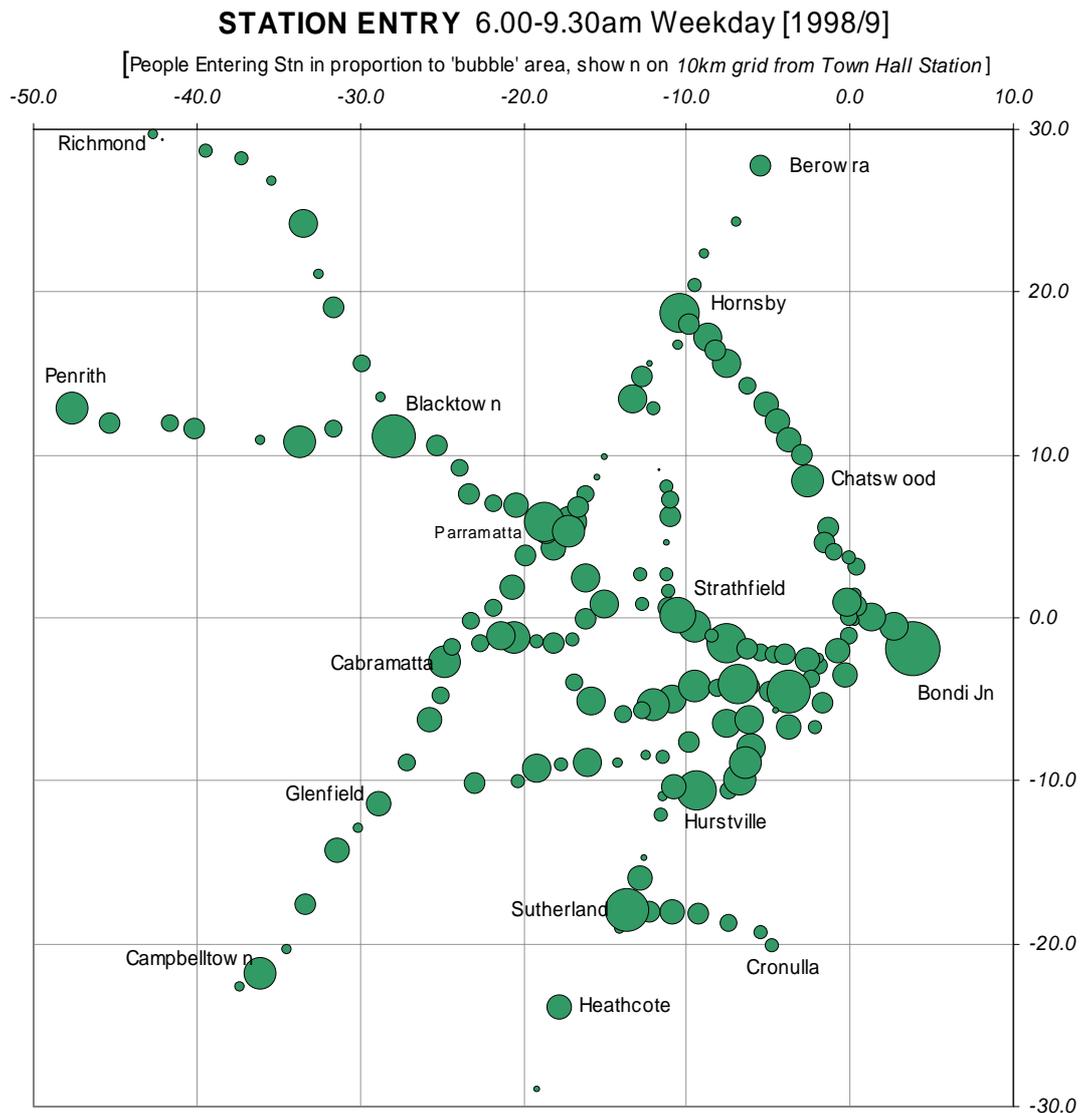
STATION ENTRY 6.00-9.30am Weekday [1998/9]

[People Entering Stn in proportion to 'bubble' area, shown on *10km grid from Town Hall Station*]

Does proximity matter? Researching Journey to Work by Rail in Metropolitan Sydney
S Jones, B Simpson, E Dimitriadis, M Jones

Station Exits: Employment and other destination activity in the "1km catchments" is significant, particularly to major business centres and interchange nodes (eg with good bus connections or commuter parking stations). The dominance of the CBD is evident. Analysis of origin-destination patterns will help us consider the effects on rail patronage as more people live within the CBD and other major employment centres, rather than travel from the suburbs.
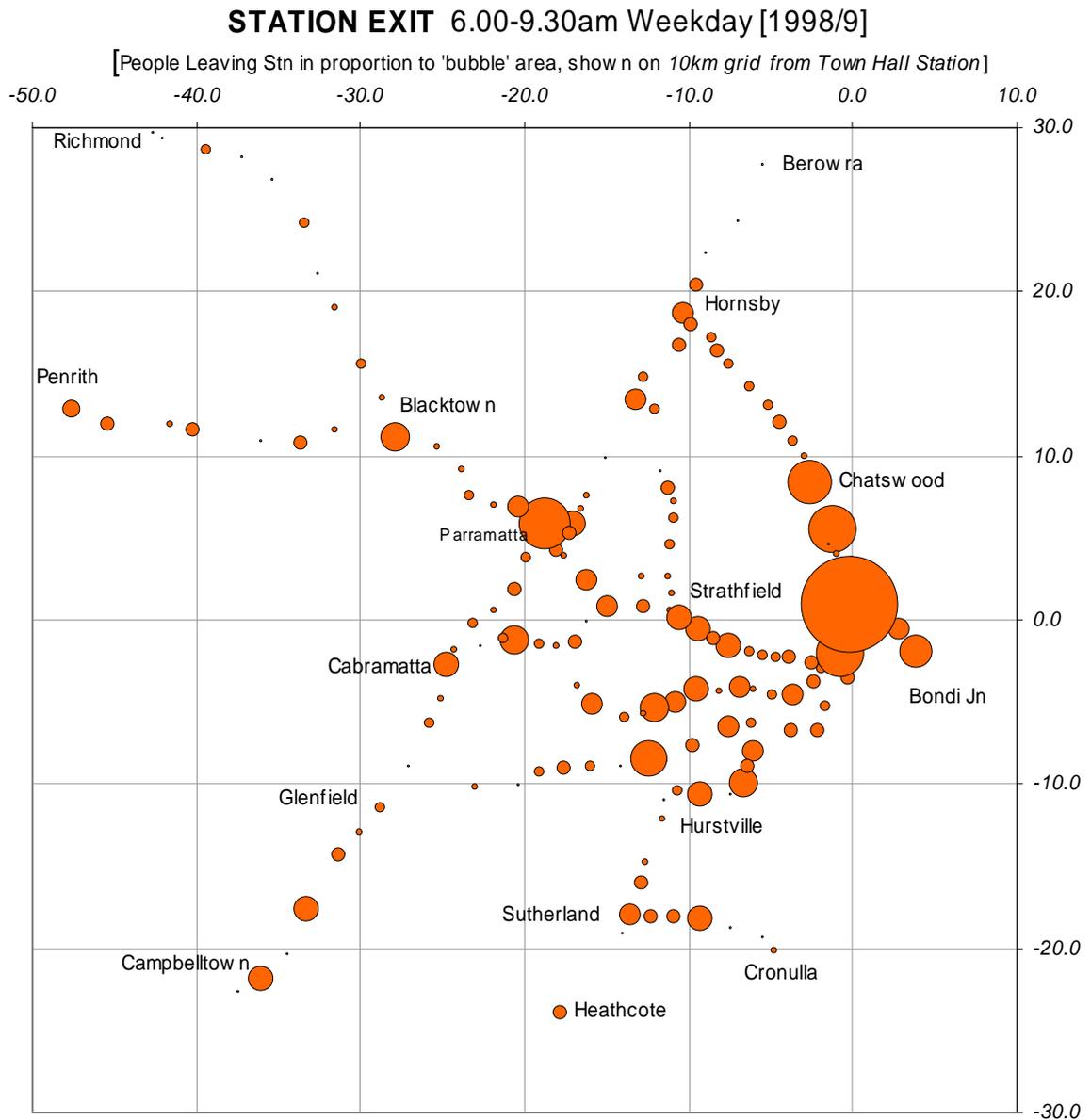
STATION EXIT 6.00-9.30am Weekday [1998/9]

[People Leaving Stn in proportion to 'bubble' area, shown on *10km grid from Town Hall Station*]

Passenger flows along rail corridors:

- At the outset, the limitations to available comprehensive data were acknowledged. Future research and analysis is required to examine population changes and journey to work patterns post 1996.
- Importantly a substantial set of work is required to better understand both origins and destinations for the journey to work market in Sydney.
- The analysis to date and the future research needs to be compared and analysed with a range of scenarios and future predictions for the actual and predicted locations of future employment growth in the Sydney Metropolitan area.
- The data and research needs to be translated into easy to understand forms that will assist in the decision making process for planned major enhancements and argumentation of the infrastructure so that it can most appropriately meet market demands.

Conclusion

Proximity matters!