

The Transport Impacts of Employment Decentralisation in Brisbane

Dr Matthew Burke¹, Dr Tiebei Li¹ and Dr Jago Dodson¹

¹ Urban Research Program, Griffith University, 170 Kessels Road, NATHAN QLD 4111

Email for correspondence: m.burke@griffith.edu.au

Abstract

Employment decentralisation may be defined as a process by which city-regions increase the proportion of jobs that are located outside of their central business district (CBD) and its immediate frame. The Queensland Government has embarked on a program of targeted program of employment decentralisation, seeking to move 20 per cent of it's office space, or around 5,600 public servants, out of the centre by 2017 (Sectorwide 2008:2). This paper explores the transport impacts of such decentralisation policies for greater Brisbane. A methodological framework is developed from a review of previous modelling efforts exploring decentralisation and office relocations in Oslo, Melbourne and in US cities. Scenarios based on the Queensland Government's program are developed. The multi-modal Brisbane Strategic Transport Model is then used to examine the likely impacts of this Queensland Government's initiatives. Results are provided in terms of vehicle kilometres travelled, travel time, levels of service on key links and public transport patronage/mode share. The results are interrogated to isolate possible effects on reverse commuting and transport network optimisation. Means to expand this pilot work into a more holistic assessment of the transport and housing impacts of decentralisation are then proposed.

1. Introduction

Brisbane and Perth have both announced major programs of employment decentralisation, promising to move large numbers of government workers out of their central business districts and into sub-centres in the suburbs (Department of Public Works 2009; Marmion 2010). A new era of urban restructuring may well be commencing. However transport agencies have had little to do with these government announcements, and the transport impacts of these policies have not been assessed in either city.

This paper provides the results of preliminary investigations into the transport impacts of employment decentralisation policy in Brisbane. The paper commences by defining employment decentralisation and the type being proposed for Brisbane. Previous research on decentralisation is discussed, highlighting the likely impacts and some key questions that need to be resolved in the context of the emerging policies in Australian cities. A method for examining the question using conventional strategic transport modelling and additional analyses is proposed. Preliminary work using this method is then outlined, using the multi-modal Brisbane Strategic Transport Model (BSTM) – the main strategic model for Brisbane. An extremely idealised scenario focusing government employees tightly into transit-oriented locations with strong parking policies and the roll-out of significant public transport links is provided, and compared to a scenario without decentralisation previously modelled for the year 2031. Comparative results are provided that highlight possible transport impacts across a range of measures. The limitations of this preliminary work are outlined, and a future research agenda identified.

2. Decentralisation in Cities

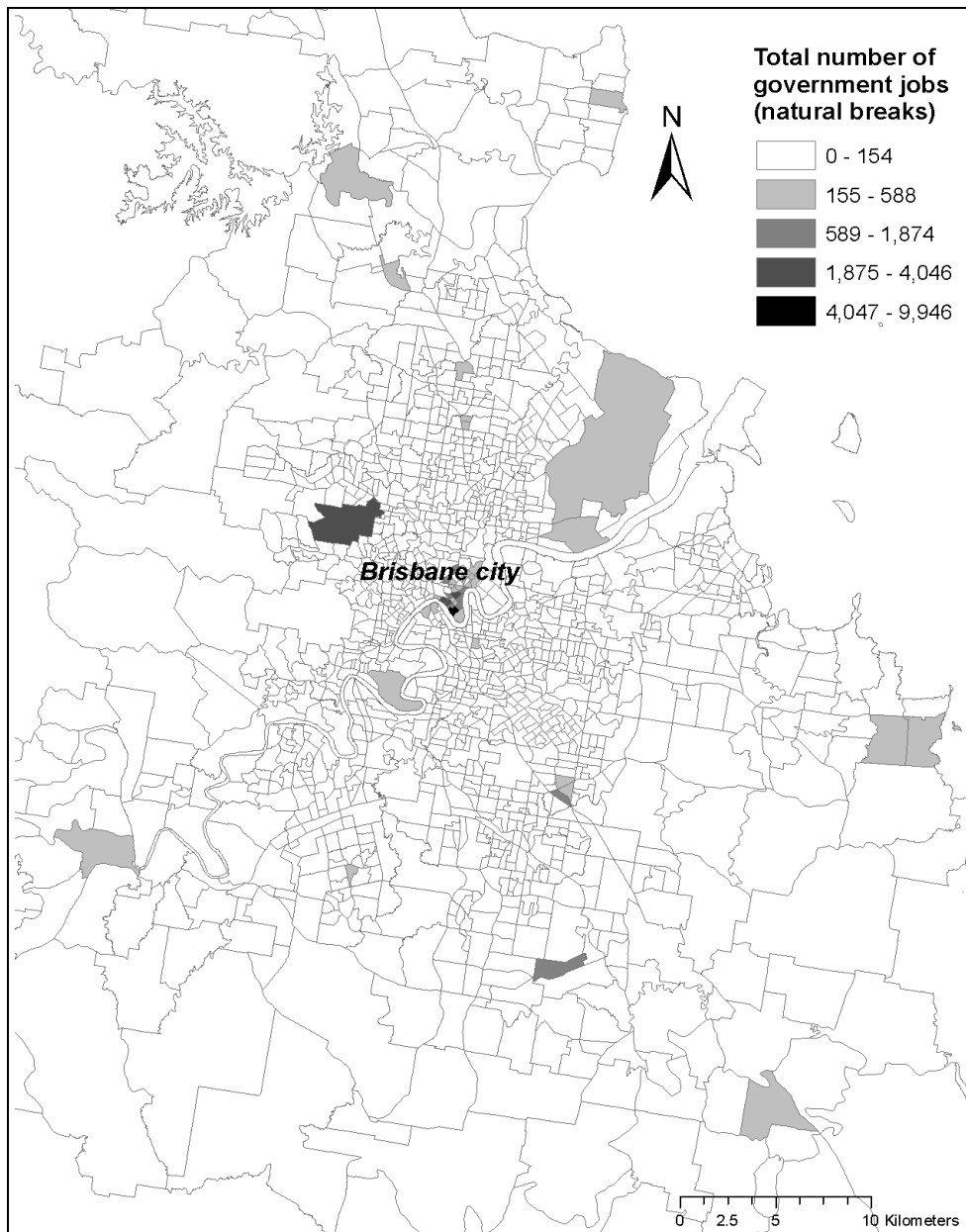
Those interested in the government and management of urban transport have often viewed the links between the spatial structure of urban development patterns and transport systems as offering potential to manage the impacts of urbanisation. Modern urban planning arguably emerged as an attempt by urban thinkers to shape patterns of urbanisation by reducing congestion and spatial competition within highly concentrated urban cores by improving access to peripheral zones where land was plentiful. Ebenezer Howard's (1902) 'Garden City' model of planning promoted the creation of new 'satellite' towns distant from the existing centre of an industrial city. Although it has changed in form and content over the subsequent century, this planning vision underpins much contemporary urban thinking.

The expansion of residential and employment activities to new ex-urban zones has been pursued through both rail-based metropolitan planning schemes such as the Stockholm 'finger' plan (Cervero 1998; Hall 2002) as well as through 'market-led' road and automobile based dispersed suburbanisation. Not surprisingly, the extent of decentralisation within the cities of the developed nations has been uneven. While some cities underwent extensive suburbanisation of housing and jobs in the latter decades of the 20th Century, this pattern has not been universal. Many US cities, especially those in the newer sunbelt zones, were developed almost from their initial settlement as suburbanised poly- or a-centric metropolises (Jackson 1987). Some of that decentralisation has occurred for particular reasons not solely related to urban functioning. In contrast, Australian cities, with their strong radial rail systems, experienced a high degree of residential dispersion but relatively low levels of employment dispersion, especially in terms of commercial office employment, a relationship borne out in research by Kenworthy et al (see Union Internationale des Transports Publics 2001; Vivier 2001).

In Australian higher socio-economic status white collar employment, and especially government jobs, are heavily concentrated in the core, as shown in Brisbane in Figure 1. Except for the Enoggera army base to the north, there are very few government employees outside of the central area in Brisbane. This centralised white collar employment is accompanied by relatively wealthy population cohorts in the surrounding inner and middle suburban residential zones. As noted by Dodson and Sipe (2008) many middle- and outer-suburban white collar workers are confronted with long (and in many cases 'extreme') commutes to the CBD.

The centralisation of employment in Australia's cities has produced a range of urban management problems. Hyper-concentration of office employment in the CBDs of Australia's largest cities has been tied to traffic congestion, extreme long-distance commuting, high subsidies for public transport, office rent shocks, jobs/housing mismatches and distorted housing markets (Badcock 1997, 2000). When transport and housing costs rise in such a manner, CBDs can experience problems of labour supply (Button 1993:239). The burden of commuting to central locations falls heaviest on lower socio-economic status households who are allocated to outer suburban localities by the high prices exhibited by Australian inner-urban housing markets. A high degree of centralisation can also produce efficiency problems for urban transport systems due to demands for high peak-hour capacities to support mono-directional commuting flows. Continued investment in additional capacity on centrally oriented transport routes can reinforce highly centralised structures and intensify competition for inner urban land resulting in high rents.

Figure 1 Spatial distribution of government employment, Greater Brisbane, 2006



These problems have begun to prompt Australian state governments to investigate employment decentralisation policies to transform urban structures, especially in reducing the costs of leasing costly office accommodation for government employees. As in Howard's original contribution, decentralisation can be conceived as a planning tool that may be actively deployed by governments to solve urban problems. Employment decentralisation may be defined as a process by which city-regions increase the proportion of jobs that are located outside of their central business district (CBD) and its immediate frame. Employment decentralisation does not necessarily mean reducing the absolute number of jobs in the CBD, nor does it necessarily mean displacing the CBD as the primary focus of city-region activities. Employment decentralisation can occur through the actions of the market (i.e. led by the private-sector) or via state intervention. Typically, planned employment decentralisation is used to resolve disequilibria in the distribution of urban activities, especially employment, and to reduce the costs to government of rents for public sector offices.

The Queensland Government has committed itself to a program of employment decentralisation, seeking to move 20 per cent of its office space, or around 5,600 public servants, out of the centre by 2017 (Sectorwide 2008:2). The type of decentralisation currently being employed in Brisbane is intra-urban decentralisation – moving jobs within the broader city's boundaries, rather to regional cities such as Mackay or Townsville. The Western Australian government has matched this proposal, also seeking to move 20 per cent of its office employees out of the Perth CBD (Marmion 2010). Depending on how such policies are implemented, and the multiplier effects achieved, these attempts at urban restructuring may have significant impacts, including on transport systems and housing markets.

A range of government actions may support decentralisation, including land-use zoning, subsidies and incentives, strategic planning, and location decisions for state-sector office accommodation (relocating government jobs). It is important to note that the decentralisation of a proportion of the government workforce does not by and of itself necessitate or imply political decentralisation. Employment decentralisation involves only the location of jobs away from the city centre. In most circumstances this provides for a minor form of 'administrative de-concentration' rather than signifying the spatial *devolution* of government functions and decision-making to other levels of regional or local government (Burke, Dodson and Gleeson 2010:7).

Transport is the fastest growing contributor to greenhouse gas emissions in Australia, and the passenger car fleet is the largest single contributor (Bureau of Infrastructure Transport and Regional Economics 2009:v). It is generally believed that, if poorly implemented, or the wrong scenario selected, decentralisation could create significant increases in both vehicle kilometres travelled (VKT) and greenhouse gas emissions. Employment decentralisation may reduce the growth of noise and air pollution (such as sulphur dioxide, carbon monoxide and particulate matter) on links in and leading to the CBD. But it may increase noise and air pollution both near new suburban locations, and for the city as a whole, should road transport increase its mode share, and the total distances travelled by car increase.

3. What does past experience tell us?

The actual transport outcomes of decentralised employment policies in cities are quite varied, both in terms of the degree of decentralisation they have achieved relative to the city centre, and in terms of their transport and other impacts. We explore here a set of international experiences, before turning our attention to the Australian experience.

3.1 International experiences

In Singapore, restrictive transport and land use planning regimes have forced a transit-orientation on the city and its populace (Wong 1998). Land development there is tightly focused on public transport nodes. Singapore's image as a pioneer of residential transit oriented developments (Bernick and Cervero 1997) belies its also boasting a set of distinct employment nodes across the island in 'Regional Centres' (Malone-Lee, Loo and Chin 2001). The city therefore features strong public transport mode shares, significant bi-directional flow on its transport networks, and more optimal use of its infrastructure.

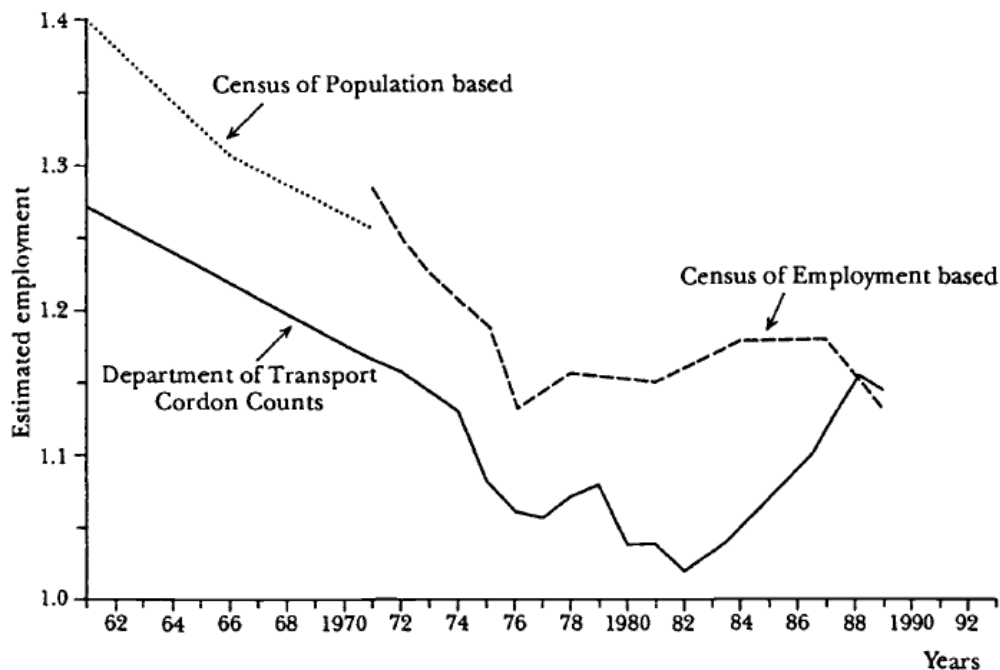
In Paris, employment sub-centres have developed relatively close to the central business district rather than on the metropolitan periphery (Aguilera, Wenglenski and Proulhac 2009:686). Central Paris shed a large number of jobs in the 1980s and 1990s, whilst inner-suburban sub-centres grew. Some of the sub-centres were developed explicitly to revitalise sites in the eastern parts of the city (Searle 1996:43). Paris has experienced a rise in 'reverse commuting' – workers travelling against the peak flow to access suburban employment. Yet in terms of redistributing opportunity across the urban area of Paris, few jobs have actually moved far out at all, and the reverse commutes are short. Paris has also created new towns such as Mar-la-Vallée and Massey-Saclay that incorporate regional town

centres and employment, to more rationally distribute residences and employment (Tuppen 1979:56). In 1999 Massey-Saclay had 107,000 jobs, with only 92,200 workers resident locally, suggesting it is an important employment node in the greater region (Bontje and Burdack 2005:321).

In the UK, more attention has been given to inter-urban decentralisation (as opposed to intra-urban) with the development of the post-war new towns. The UK new towns policy was driven by a range of policy objectives only some of which related to urban efficiency. Most new towns were built beyond the periphery of London which was limited in its outward developmental potential by a firmly enforced 'green-belt' policy. The new towns program also viewed decentralisation as a national security objective which would disperse urban populations and render them less vulnerable to wartime aerial strikes. The UK new towns were intended to provide for local employment opportunities rather than relying on commuting to the metropolis and thus were not supplied with high quality public transport. The majority of wage-earners in post-war UK new towns, such as Milton Keynes and Redditch, work locally and commute internally (Cervero 1995:48) although the new towns overall still experience high levels of radial commuting to London and are highly car dependent due to poor public transport provision. That said, the majority of commuters from the new towns to central London travel by rail.

The UK also used government office relocation as a key strategy. The actions of the Location of Offices Bureau from 1963 to the mid-1980s promoted the relocation of workers from central London to reduce road congestion, decrease over-crowding on public transport, and to slow the replacement by offices of other land uses in the CBD (Hall 1972:385-386). There was a significant decline in central London employment, particularly in the years 1963 to 1976, with commensurate reductions in traveller flows into the central area, as shown in Figure 2.

Figure 2 Declines in Central London employment and travellers entering the central area, 1962-1992 (Frost and Spence 1993:550)



Estimates of employment in Central London. Sources as indicated. (Note that 1977 is omitted from Census of Employment figures due to problems encountered by the Census in allocating incomplete postcodes. Such addresses were allocated to the Westminster Employment Office Area and the Department of Employment has estimated that the statistics for Westminster are overstated by 50 per cent).

In Stockholm, a stronger planning regime meant the development of new towns took place only on the commuter rail system, in relatively short commuting distance to the CBD. These centres were less self-contained than their UK counterparts, though they still included considerable levels of employment – Vällingby had equal jobs to the resident workforce. The majority of commuting external to the centres was by train, and so overall their travel was more sustainable than in the UK (Cervero 1995). However, Naess and Sandberg (1996) found for those workplaces that moved to the new centres, there were immediate increases in the average commuting distance of Stockholm workers, which were not reversed by subsequent staff turnover. Critically, the location of the new centres, nearer the outer-suburban termini of the rail lines than in the inner-city, created relatively strong employment nodes that could attract contra-flow public transport trips.

In the US, the mainly market-led and dispersed employment decentralisation in the San Francisco Bay Area has had less desirable transport impacts. An analysis by Cervero and Wu (1998) of the city found little evidence of self-containment and no decrease in mean commute trip distances or travel times due to employment decentralisation.

But perhaps the worst experience of employment decentralisation, in transport terms, has been the experience of Kuala Lumpur, where carefully planned car-oriented centres have flourished. The development of the outer-urban administrative centre Putrajaya, and the information-technology centre Cyberjaya, were both with minimal public transport provision in a city experiencing rapid motorisation (Barter 2004). The result has been a precipitous decline in public transport mode share and one of the fastest rises in per capita vehicle-kms-travelled for any city in recent years. Brugman (2009:115) describes the Putrajaya plan as producing 'only a functioning habitat for cars'.

3.2 Australian experiences

Melbourne has mostly failed to achieve meaningful planned decentralisation. Melbourne's metropolitan planning scheme of 1954 pursued a form of decentralisation via five suburban 'district centres'. However, enforcement was limited and the policy was largely abandoned in the subsequent 1971 plan in favour of metropolitan expansion along weakly described suburban corridors. The 1980 Melbourne Metropolitan Plan introduced a set of 20 existing and proposed 'activity centres' on rail lines. Despite a statutory requirement for large office and retail developments to locate at these activity centres from 1983 onwards, there was significant resistance and attempts by non-designated shopping malls to expand. The policy was breached when Coles Myer were allowed to develop their large corporate headquarters at Tooronga (see Logan 1986). In 1993 the incoming Kennett government gave the green light to numerous shopping mall expansions. Planned decentralisation to centres only really re-emerged with an update to the city's metropolitan strategy released in December 2008, which included a proposal for six additional 'Central Activity Districts' in middle and outer suburban locations (Department of Planning and Community Development 2008:11) although the implementation strategy for this new policy is indistinct. As such, employment decentralisation in Melbourne has been mostly market-led, occurring in middle and outer ring locations in Melbourne in highly dispersed locations, that fail to support (public) transport and land-use integration. The dispersed journey patterns that result cannot be conveniently served by radial public transport systems (Mees 1995:21). There is also evidence that some re-centralisation has occurred with the rise of the 'information' economy focused on the CBD, with a significant increase in business services and finance jobs in the 1990s (Tsutsumi and O'Connor 2006).

The most planned city in Australia, Canberra, also has had mixed fortunes. Canberra's urban structure was explicitly selected in part to protect the city from land use and transport pressures (National Capital Development Commission 1970:61). It sought to reduce the 'length and cost of the journey to work; to minimise traffic congestion; to reduce public

investment, and to provide opportunities for people to live and work in the same town' (National Capital Development Commission 1984:54). But with generous road provision, built on an extensive arterial road plan and with no significant segregated line-haul public transport, the city is highly car dependent. But it does not suffer the traffic congestion the city might expect were it to be highly centralised. Employment self-containment was a major objective of the 1970 Canberra 'Y' plan but this has not been substantively achieved in practice. Tuggeranong, for example, where 25 per cent of the city's population resides contains just 9 per cent of metropolitan employment.

The Australian city with the most successful decentralisation programs has probably been Sydney. Decentralised employment sites such as Parramatta, Liverpool and Chatswood have succeeded in part because they are located on major rail lines, play a role in bus-rail interchange, have been designated by state planning authorities as subregional centres since as early as the 1940s, and, most crucially, have benefited from the planned decentralization of public sector employment by the NSW Government (Freestone and Murphy 1998:289). In particular, Parramatta, which began with only 10,000 jobs in 1970, had around 40,000 jobs by 2005 even attracting workers in the key employment categories of business and finance (New South Wales Government 2005:86). Support for decentralisation in Sydney is continuing. In the current metropolitan strategy the NSW Government proposes to strengthen three key 'regional cities' – Parramatta, Liverpool and Penrith. Partly to reduce transport flows into central Sydney. In total 27 existing strategic centres are identified in the metropolitan strategy, which seeks to distribute an additional 236,000 jobs within these locations. Local governments are to be forced to show that their planning controls provide for future commercial development in these centres, small grants have been provided for centre revitalisation projects, and there are infrastructure plans that support these locations increased employment function (New South Wales Government 2005:89-94). See Burke et al. (2010) for more on this experience.

In summary, where the proportion of suburb-to-suburb commutes increases in cities, the more that car use tends to increase as workers travel further, faster and more often by car (Aguilera, Wengleski and Proulhac 2009) and follow routes not served by existing public transport services (Thompson 1977). But numerous researchers have suggested there are advantages in seeking to model scenarios for different urban structures, such as mono-centric, poly-centric and dispersed cities, so as to know more (Alpkokin et al. 2008; Song 1995).

4. Methods

We have commenced modelling of urban structures for Brisbane, based on different employment decentralisation scenarios. However, this is very much pilot work, is not yet funded, and limited in scope. Further, it is exploratory work only, seeking to provide indications of what might occur under highly theoretical and improbable idealised city structures. We are seeking to ascertain what factors matter in producing preferred transport and land use outcomes.

We present here the results of only one scenario. An idealised employment decentralisation scenario for Greater Brisbane was developed, derived from the publicly released information available on the Queensland Government's scheme (Sectorwide 2008:2) and the centres policy contained in the *South East Queensland Regional Plan* (Department of Infrastructure and Planning 2009), extrapolated out to the year 2031. In this scenario, there are modest multiplier effects applied, in that the government employees' move encourages related private-sector office development to also shift to the suburban centres. A scenario weighted towards shifting employment to middle suburban, as opposed to outer suburban locations, was developed. Jobs were clustered tightly into the suburban centres, public transport links to the centres were included, and parking controls remained static at the sub-centres. Obviously, such a scenario is unlikely to be realisable without radical state planning and

relies on multiplier effects being achievable. The scenario is not in any way government policy.

2031 was selected as the planning horizon as the timeframe with the advantage that full land use scenarios for 2031 were included within the BSTM_MM. Jobs were 'relocated' from this 'base case' scenario to key zones that were situated within activity centres at each node, mostly on rail and busway links (including links proposed for development by 2031 within the BSTM_MM). The differences in employment at key nodes for the base case and the idealised decentralisation scenario are shown in Table 1. The locations of these centres are provided in Figure 3.

The idealised decentralisation scenario was modelled using the BSTM_MM and compared with the 2031 base case. The total employment at each destination was modified within the trip generation sub-model. The total number of trip attractions for work purposes for specific traffic zones (TAZ) were adjusted based on Table 1. Changes were also made to adjust individual zone trip attractions, including the total number of jobs by employment category. The density of employment was also re-calculated for individual TAZs, to ensure more accurate inputs to the mode choice sub-model. Total trip attractions for the entire study area were checked to ensure it was balanced with total trip productions, ensuring the scenario was solely about job relocation (and not gain or loss).

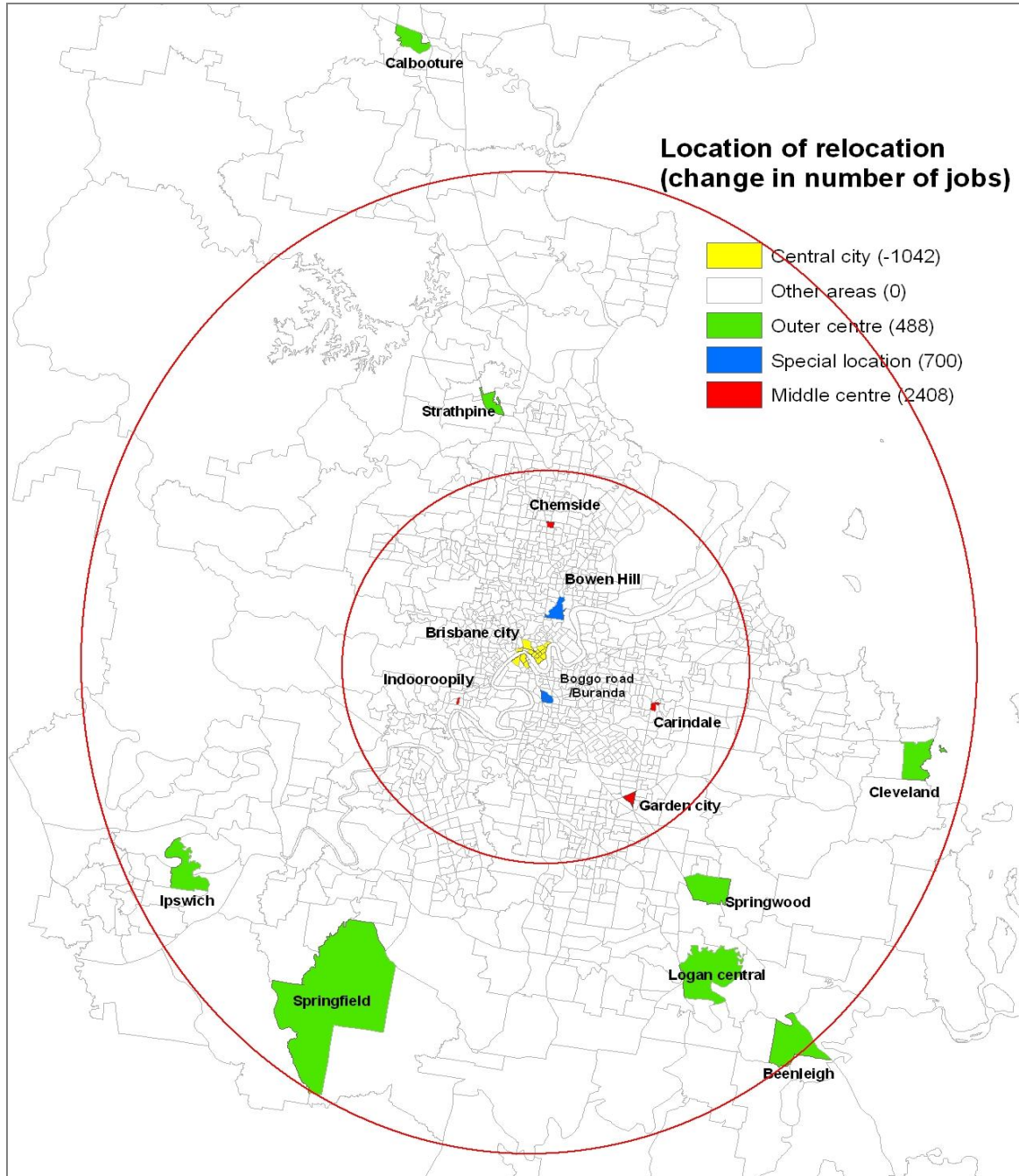
Table 1 Changes in total employment between the base case and idealised decentralisation scenario, Brisbane, 2031

Total no. of jobs removed from the Brisbane CBD and immediate frame	Total no. of jobs moved to middle suburban locations (75% of relocated jobs)		Total no. of jobs moved to outer suburban locations (25% of relocated jobs)	
-15,630	Chermside	2,408	Ipswich	488
	Garden City	2,408	Cleveland	488
	Carindale	2,408	Beenleigh	488
	Indooroopilly	2,408	Caboolture	488
	Buranda/ Bowen Hills	2,100	Logan Central	488
			Springwood	488
			Springfield	488
			Strathpine	488
	TOTAL	11,732	TOTAL	3,904

Given the re-adjusted trip generation datasets, we ran the full BSTM_MM procedure using EMME/3 software. The full procedure included all of the four steps of standard transport models (the sub-models of trip generation, trip distribution, mode choice and trip assignment). The destination choice of each trip is determined by the newly estimated total travel cost between origin and destination including the number of job opportunities, travel distance, toll charge and parking cost. The outputs from the trip distribution model of the BSTM_MM are a trip matrix by trip purpose that is combined using time period factors to give separate AM peak, day off peak, PM peak and night period matrices. The procedure of the mode choice sub-model converts these matrices into a vehicle matrix from which the trip matrixes by different transport mode (e.g. public transport, vehicle driver, vehicle passenger) were separated. The trip assignment model then allocates the trip matrices for various transport modes simultaneously on the transport networks. The final outputs of the BSTM_MM are total traffic volumes, vehicle travel distance and vehicle travel time on links,

nodes and intersections, as well as for the network as a whole. For this study we focus on the outputs for AM peak hour trips and their changes between the base scenario and the idealised decentralization scenario.

Figure 3 Locations of middle suburb centres and outer suburb centres, and CBD in Brisbane



5. Results

The BSTM_MM modelling suggests quite dramatic changes in travel flows under the idealised decentralisation scenario. This is highlighted most directly in Figure 4, which compares the total numbers of vehicles forecast per link on the road network under both the base case and employment decentralisation scenarios, for the whole network. The vast majority of links experience a decrease in traffic flows (displayed as links with green bars)

under the employment decentralisation scenario. Indeed some key links, such as the Ipswich and Logan Motorways, experience very dramatic decreases. A number of outer-suburban arterials experience a modest increase in vehicular traffic.

Figure 5 Changes in traffic volume on road links, base case scenario vs. idealised decentralisation scenario – AM Peak Hour only – 2031 (Note: a green bar represents a decrease in traffic volume; a red bar represents an increase in traffic volume).

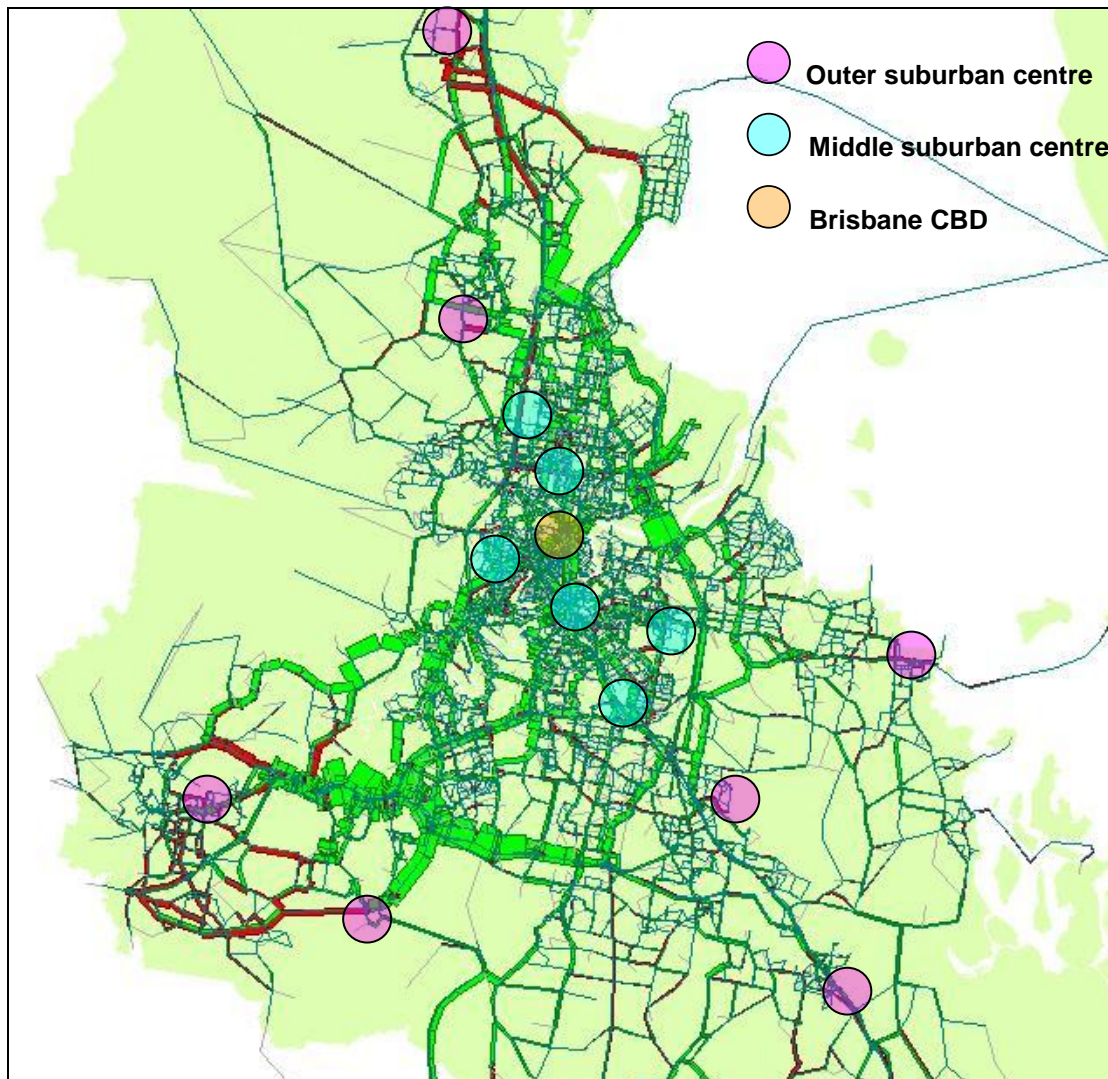
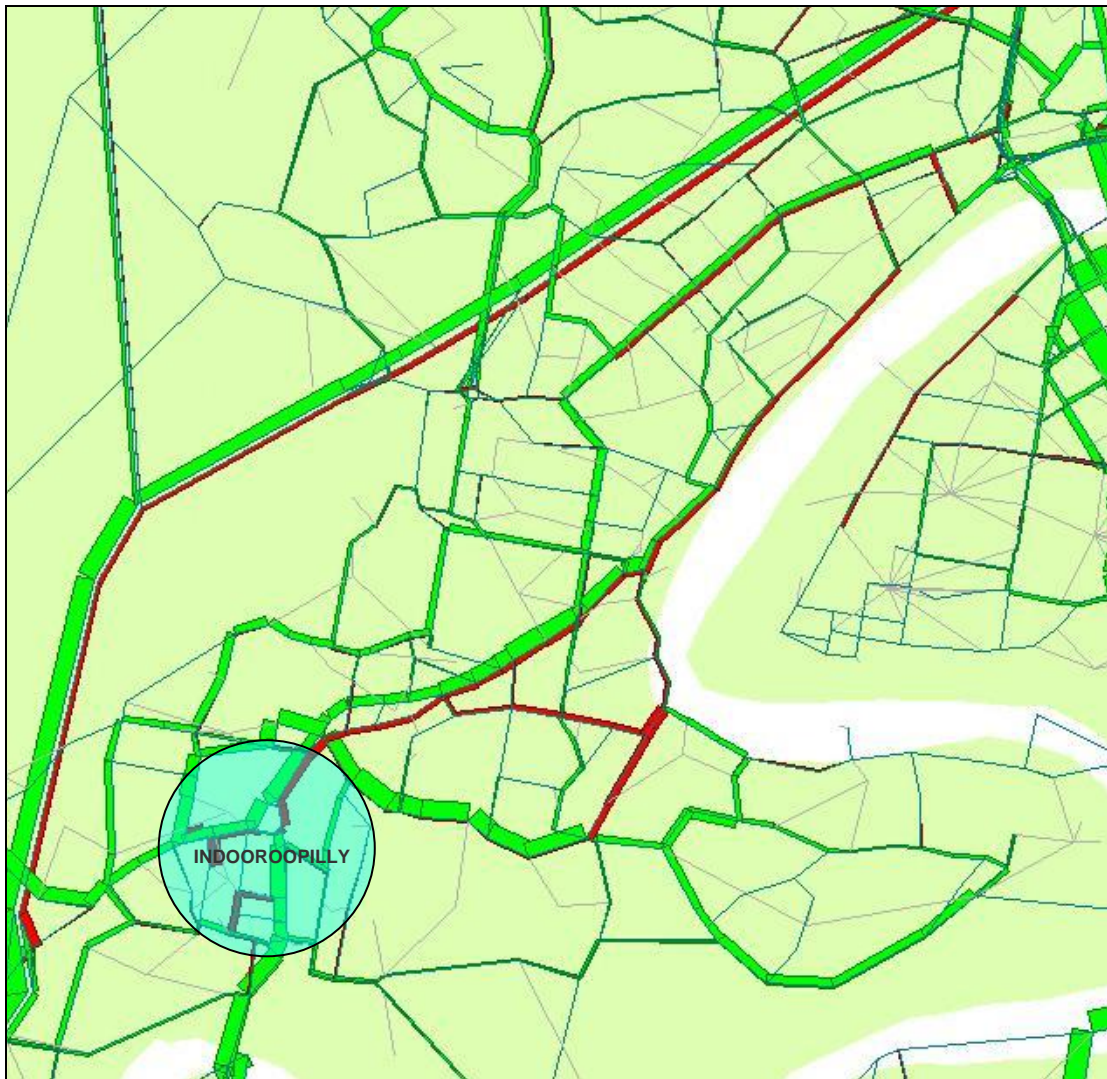


Figure 4 disguises the fact that the BSTM_MM actually provides results for both in-bound and out-bound travel on road links. Exploring the results in more detail, at small spatial scales, allows the user to see more clearly the differences in the scenarios. Figure 5 shows results for the suburb of Indooroopilly, where over 2,000 jobs were relocated in the idealised decentralisation scenario. The mapping shows very strong decreases in traffic flows on key arterials near and through the centre, with more modest decreases in flows on outbound links, particularly Milton Road.

Figure 5 Changes in traffic volume on road links, base case scenario vs. idealised decentralisation scenario – Indooroopilly, Brisbane – AM Peak Hour only – 2031 (the green bar represents the decrease in traffic volume and the red bar represents the increase in traffic volume).



At the network level, summary headline results obtained from the BSTM_MM for the two scenarios are provided in Table 2. Our idealised employment decentralisation scenario provides significant decreases in vehicle hours travelled and in vehicle kilometres travelled. However, these results have not as yet been peer-reviewed, are only pilot work, and are obtained from a simplistic scenario that would be difficult to achieve in practice.

Table 2 Comparison of transport performance between the base case and the idealised decentralisation scenario within the BSTM_MM – AM Peak Hour trips only – 2031

	Base Case Scenario	Idealised Decentralisation Scenario	Percentage Change
Total Vehicle Kilometres Travelled (VKT)	14,054,805	13,718,766	- 2.4%
Total Vehicle Hours Travelled (VHT)	402,310	365,138	- 9.2%
Total No. of Public Transport Trips	348,060	372,270	+ 6.5%

Car driver trips fall slightly (-0.7%) but car passenger trips decline more (-3.6%, though off a low base). The latter may relate to fewer households having two or more adults working in the same employment centre under decentralisation. As noted in Table 2, public transport trips rise 6.5%. In addition, there is a decrease in walk only trips (-3%) and an increase in bicycle trips (+3%). The decline in walking may be due to less people being within walking distance of office employment, as the suburban centres are not surrounded by high-density residences in the same way that the CBD is. Conversely, the increase in cycling may be due to more office workers being within relatively easy cycling distance of their workplaces, as cycling offers a much greater catchment than walking.

6. Discussion

The results should obviously be viewed with caution, remembering this is only an idealised scenario being modelled, and that this is pilot work, without the numerous iterations that improve modelling performance and specification. But the results do suggest some insights into how aspects of the idealised employment decentralisation scenario may lead to specific transport outcomes in Brisbane.

The preliminary results obtained suggest relocating government offices may provide some improvements in Greater Brisbane's transport performance. Reducing the concentration of office employment within the CBD and its frame appears to offer lower commute times (especially by car). Savings in VKT are more questionable, based on overseas experience. If (and it's a 'big if') there is strict enforcement of centres policy, tight clustering on busway and rail links, new public transport links and strong parking policies applied, then decentralisation may not necessarily be harmful to public transport mode share. However we doubt that mode share gains, such as that obtained for the idealised decentralisation scenario, are realistically achievable. Further interrogation of the modelling results suggests there is also noticeable optimisation of the road, rail and busway networks, which may reduce the costs of 'dead-running' contra-flow services in peak hours, and potentially defer investment in new infrastructure. Optimisation of the public transport networks again relies heavily on a strong planning approach to decentralisation.

Though this is early pilot work on the employment decentralisation question, and there are numerous limitations that suggest these results are very optimistic, the findings are sufficient to warrant further enquiry.

In terms of the results obtained, one key limitation is that we have only used the BSTM_MM as supplied by DTMR for the year 2031. No other appraisal methods have been used to supplement the results, providing alternative insights, in this paper. The base case includes numerous transport investments and service improvements, especially key orbital road links

and public transport improvements, that though planned may not necessarily come to fruition. Another is our use of a decentralisation scenario that moves jobs directly to key centres on public transport nodes, rather than a more 'market-led' scenario that sees employment decentralise to less transit-friendly locations. And we have used the trip distribution procedure within the BSTM_MM to distribute employees to workplaces, which will be very different to the likely origin-destination pairs resulting from workplace relocation policies, at least in the early years of such interventions. There may be significant problems as workers are relocated to locations further, not closer, from their place of residence. Considerable time may be needed for social processes and employment and housing choices to redistribute the workforce to more optimal locations.

Many of these limitations may be overcome by further research. Alternative methods of viewing the problem, such as via jobs-housing balance studies (Cervero and Wu 1998), or social impact analysis (Dodson et al. 2007) may prove helpful in exploring the impacts of decentralisation policies. Different scenarios, including 'market-led' dispersal and decentralisation to outer-suburban locations can be modelled. There are many refinements that can be made to the BSTM_MM to improve the model's specification and performance for this purpose. And research can be conducted on those workers currently undergoing a workplace relocation, to ascertain their actual changes in behaviour over time, to understand the short- and long-term impacts. We hope to pursue such a research agenda.

References

- Aguilera, A., S. Wengleski, and L. Proulhac. 2009. "Employment suburbanisation, reverse commuting and travel behaviour by residents of the central city in the Paris metropolitan area." *Transportation Research Part A: Policy and Practice* 43(7):685-691.
- Alpkokin, P., C. Cheung, J. Black, and Y. Hayashi. 2008. "Dynamics of clustered employment growth and its impacts on commuting patterns in rapidly developing cities." *Transportation Research Part A: Policy and Practice* 42(3):427-444.
- Badcock, B. 1997. "Recently Observed Polarising Tendencies and Australian Cities." *Australian Geographical Studies* 35(3):243-259.
- . 2000. "The Imprint of the Post-Fordist Transition on Australian Cities." pp. 211-227 in *Globalizing cities : a new spatial order?*, edited by P. Marcuse and R. van Kempen. Oxford: Blackwell.
- Barter, P. 2004. "Transport, urban structure and 'lock-in' in the Kuala Lumpur Metropolitan Area." *International Development Planning Review* 26(1):1.
- Bernick, M. and R. Cervero. 1997. *Transit Villages in the 21st Century*. New York: McGraw-Hill.
- Bontje, M. and J. Burdack. 2005. "Edge Cities, European-style: Examples from Paris and the Randstad." *Cities* 22(4):317-330.
- Brugmann, J. 2009. *Welcome to the urban revolution : how cities are changing the world*. New York: Bloomsbury Press.
- Bureau of Infrastructure Transport and Regional Economics. 2009. "Working Paper 73 Greenhouse Gas Emissions from Australian Transport: Projections to 2020." Canberra: BITRE.
- Burke, M., J. Dodson, and B. Gleeson. 2010. "Employment Decentralisation in SEQ: Scoping the transport impacts." Brisbane: Urban Research Program, Griffith University.
- Button. 1993. *Transport Economics (2nd Edition)*. Cheltenham, Glos. UK: Edward Elgar Publishing Limited.
- Cervero, R. 1995. "Sustainable new towns: Stockholm's rail-served satellites." *Cities* 12(1):41-51.
- . 1998. *The Transit Metropolis: a global inquiry*. Washington, D.C.: Island Press.
- Cervero, R. and K.-L. Wu. 1998. "Sub-Centring and Commuting: evidence from the San Francisco Bay Area, 1980-90." *Urban Studies* 35(7):1059-1076.

- Department of Infrastructure and Planning. 2009. "South East Queensland Regional Plan 2009–2031." Brisbane: Queensland Government.
- Department of Planning and Community Development. 2008. "Melbourne 2030: a planning update - Melbourne @ 5 million." Melbourne: Victorian Government.
- Department of Public Works. 2009. "Decentralisation." Brisbane: Queensland Government. <http://www.publicworks.qld.gov.au/majorprojects/Pages/Decentralisation.aspx>.
- Dodson, J., B. Gleeson, R. Evans, and N. Sipe. 2007. "Investigating the Social Dimensions of Transport Disadvantage II: From Concepts to Methods through an Empirical Case Study." *Urban Policy and Research* 25(1):63-89.
- Dodson, J. and N. Sipe. 2008. "Shocking the Suburbs: Urban Location, Homeownership and Oil Vulnerability in the Australian City." *Housing Studies* 23(3):377-401.
- Freestone, R. and P. Murphy. 1998. "Metropolitan Restructuring and Suburban Employment Centers: Cross-Cultural Perspectives on the Australian Experience." *Journal of the American Planning Association* 64(3):286-297.
- Frost, M. and N. Spence. 1993. "Global City Characteristics and Central London's Employment." *Urban Studies* 30(3):547-558.
- Hall, P.G. 2002. *Cities of tomorrow : an intellectual history of urban planning and design in the twentieth century*. Oxford, UK ; Malden, MA: Blackwell Publishers.
- Hall, R.K. 1972. "The movement of offices from Central London." *Regional Studies* 6(4):385-392.
- Howard, E. 1902. *Garden cities of tomorrow*. London: S. Sonnenschein & Co., Ltd.
- Jackson, K.T. 1987. *Crabgrass frontier : the suburbanization of the United States*. New York: Oxford University Press.
- Logan, T. 1986. "A Critical Examination of Melbourne's District Centre Policy." *Urban Policy and Research* 4(2):2-14.
- Malone-Lee, C., L. Loo, and L. Chin. 2001. "Planning for a more balanced home-work relationship: The case study of Singapore." *Cities* 18(1):51-55.
- Marmion, B. 2010. "Government targets savings in office accommodation costs." Perth: WA Government.
- Mees, P. 1995. "Urban transport policy paradoxes in Australia." *World Transport Policy and Practice* 1(1):20-24.
- Naess, P. and S.L. Sandberg. 1996. "Workplace Location, Modal Split and Energy Use for Commuting Trips." *Urban Studies* 33(3):557-580.
- National Capital Development Commission. 1970. *Tomorrow's Canberra! planning for growth and change*. Canberra: Australian National University Press.
- . 1984. "Metropolitan Canberra: policy plan/development plan." pp. v, 230 p. Canberra: NCDC.
- New South Wales Government. 2005. "City of Cities: a plan for Sydney's future." Sydney, NSW: Department of Planning. metrostrategy.nsw.gov.au.
- Searle, G. 1996. "Sydney as a Global City: a discussion paper." Sydney: Dept of Urban Affairs and Planning; Dept of State and Regional Development (NSW Government).
- Sectorwide. 2008. "Spreading the Jobs Around." p. 2 in *Sectorwide - monthly magazine for the Queensland public sector*, Sep 2008.
- Song, S. 1995. "Does generalizing density functions better explain urban commuting? Some evidence from the Los." *Applied Economics Letters* 2(5):148.
- Thompson, G. 1977. "Planning Considerations for Alternative Transit Route Structures." *Journal of American Institute of Planners* 43(2):158-168.
- Tsutsumi, J. and K. O'Connor. 2006. "Time series analysis of the skyline and employment changes in the CBD of Melbourne." *Applied GIS* 2(2):1-8.
- Tuppen, J. 1979. "New Towns in the Paris Region: an appraisal." *The Town Planning Review* 50(1):55-70.
- Union Internationale des Transports Publics. 2001. "Millennium Cities Database for Sustainable Transport." Brussels: UITP.
- Vivier, J. 2001. "Millennium Cities Database for Sustainable Mobility: analyses and recommendations." Brussels: UITP.

Wong, T.-C. 1998. "Land Transport Policy and Land-Use Planning in Singapore." *Australian Planner* 35(1):44-49.