

Is Behavioural Utility Measure A Valid Proxy For Accessibility Improvement?

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Abstract

Transport accessibility is traditionally measured in time, distance or 'generalised cost' from origins to destinations, and sometimes weighted by the number of opportunities at destinations. This paper proposes to use a behavioural utility measure to indicate the accessibility improvement. This approach has many advantages over traditional measures. As it is derived using the information from both the demand and the supply sides, one of the key assumptions is it could distinguish the accessibility improvement by different travellers who may perceive differently travel times, transport costs and other factors influencing their travel choice decisions. This paper further assumes that with the proposed utility measure, the accessibility improvement derived from a transport infrastructure project can be used to assess the project benefits.

This paper investigates the proposed concept through an example within the Sydney Metropolitan Region. The Sydney Strategic Travel Model incorporates a behavioural-based mode and destination choice, taking into account a wide range of residential socio-economics and transport service variables, and modelling a set of travel purposes. This paper calculates the difference of logsum values generated from the STM between the base and option cases in order to quantify the accessibility improvement by population segment and travel purpose. Comparing with a generic measure of generalised travel time improvement which is assumed to be the same for all travellers, the proposed method would offer some insights into transport project assessment in terms of accessibility improvement.

1. Introduction

Accessibility is a key element in transport and land use planning. It was first introduced by Hansen in 1959 to measure the transport time or distance between locations. Many research projects and papers have studied various transport accessibility measures for various purposes. Most of the studies focus on the three main types of accessibility measures: isochrones, gravity-based and utility-based (Alam 2009; and LaMonida et al 2011).

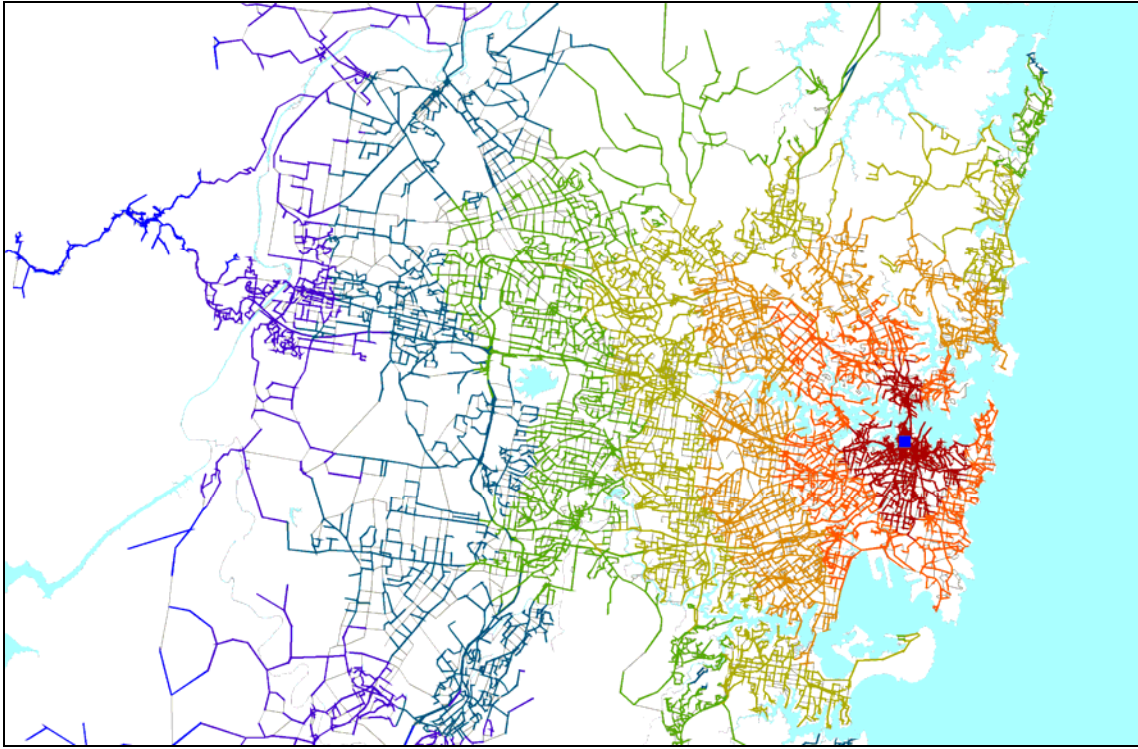
This paper starts with a discussion of each of the three measures, then moves onto a brief introduction of the Sydney Strategic Travel Model, describes the background of the case study, quantifies the accessibility improvement using the proposed method, and concludes with some findings.

2. Isochrones

Isochrone measures are interested in the transport supply information such as travel time, distance, or 'generalised cost' from origins to destinations by a transport mode. The isochrone measures represented in colours or contour lines are able to capture the essence of the concept of accessibility. For example, the measures are able to indicate the time or distance from the most accessible to the least accessible to a target location presented in colour grades. Such measures have been widely used in establishment of an accessibility index for evaluation of transport system performance and identification of service gaps to

prioritise future transport investments (Mamun and Lownes 2011). Figure 1 indicates an auto access time to the Sydney CBD GPO for the AM peak hour.

Figure 1: STM 2011 AM Peak Auto Time to the Sydney CBD GPO (by 20 minutes)



Complemented with land use information at destinations, such measures can represent the ability of residents to reach a number of opportunities such as goods, services and activities (McGurrin and Greczner 2011). Isochrone measures are able to reveal the changes in accessibility as a result of changes in the transport and land use systems, which are crucial to assessing the effects of the urban policy design process (Straatemeier and Bertolini 2008) and help review job accessibility through analysis of home-to-work distance (Manaugh et al 2010). Specifically, changes in land use represented by isochrones can demonstrate how the trip making patterns might be changing and the transport system performance measured by the time or distance would in return provide a basis to evaluate alternative land use policies. On the other hand, sophisticated residents are able to appreciate the transport accessibility as a measure of quality of life, and wisely utilise such information to assist their location choice for housing, office and facility (Chen et al 2008).

With a slight extension of the scope, isochrone measures can include the cumulative number of opportunities, within a certain time or distance, from an origin (Chen et al 2011). The 2010 NSW State Plan which aimed to achieve 75% of residents living within 30 minutes by public transport of a major city centre in Sydney, has been a good example of such a measure, except for the order adopted in the measurement, which is reversed in terms of the coverage of residents within the 30 minute catchment from a centre by public transport.

Isochrones are the simplest measures, easily understood by decision-makers and the community, and adequate for certain applications in projects. However, the assumption that the accessibility is in a linear relationship with distance or time, could be better handled through other measures.

3. Gravity-based

Gravity-based measures differ from isochrones measures in their inclusion of a distance-decay parameter, challenging the linear relationship assumption. They are a function of the sum of total opportunities weighted by the distance or time from an origin (Pirie 1976).

A typical gravity measure is illustrated in the following formula:

$$A_i = \sum_{j=1}^n O_j * D_{ij}^{-b}$$

Where: A_i = Accessibility for zone i

O_j = Opportunities in zone j

D_{ij} = Frictional cost such as distance or time between zone i and zone j

b = Distance-decay parameter

The parameter represents the degree of influence of distance or time on trip making. When other components in the equation are equal, the larger the parameter value, the more severe the effects of the frictional cost on trip making, that is, the less the accessibility. That is, the formula implies that the accessibility could be declining in an exponential step of the increase of distance or time.

As an alternative to other measures such as isochrones, gravity-based measures have a number of applications such as developing transport performance metrics (McGurrin and Greczner 2011), analysing the impacts of transit accessibility on the employment prospects for the welfare recipients (Alam 2009), assessing transit service quality (Minocha et al 2008) and creating accessibility scores for some Australian cities using the ARRB accessibility metric (Austroads 2011).

However, isochrones and gravity-based measures share a number of features which are considered inadequate to meet complex research needs:

- They cannot distinguish time components that may be perceived differently (except “generalised time or cost” derived from transport models which are not always available). For example, a journey of 30 minutes to a workplace includes 15 minutes in train, 5 minutes for walk access, 5 minutes for wait and 5 minutes for walk egress; while another journey of 30 minutes to the same workplace includes 10 minutes in train, 10 minutes for walk access, 5 minutes for wait and 5 minutes for walk egress. Although the total journey time for both options is 30 minutes, the perception on the accessibility would be different due to the different walk access times. In fact, the workplace would be perceived more accessible for the first journey.
- They often rely on the shortest path in terms of distance or time in the calculation of accessibility. Addition of any new alternative, which does not have the shortest distance or time, would not change the equation of accessibility. In reality, the addition of a new mode would expand the mode choice for travellers. If someone missed the best option for any reason, the person still has the second best option as a choice. Therefore, the accessibility would be improved in terms of additional comfort of choice due to the addition of a new alternative.
- They cannot adequately explain why some people would like to travel a longer distance or spend a bit more time travelling to a more distant location to obtain better opportunities. For instance, commuters would like to drive a longer distance to obtain a larger house at a better price and ensure improved life-style (Manaugh et al 2010).

These conventional measures are unable to include those factors, which are considered in people's choice, in addition to distance and time.

- Accessibility using the two conventional measures is assumed to be equal for all travellers from the same zone. The measures cannot efficiently evaluate the effects of any transport policy which may affect differently on different groups of people due to varying socio-economic factors or travel purposes.

To face the challenges in today's transport world, accessibility measures need to have the following characteristics:

- sensitive to travel time and cost components;
- inclusive of all feasible alternatives;
- measurable of destination choice, and
- distinguishable by population segment and travel purpose.

The fast-developed utility-based accessibility measures which are good at capturing individuals' choice behaviour, live up to these challenges. They have shown their ability to deliver consistent results by revealing actual access to opportunities (LaMondia et al 2011).

4. Utility-based

Utility is a value perceived by an individual (Koppelman and Bhat 2006), originating from the choice behaviour theory rooted in micro-economics. A key feature of the choice theory is it assumes the consumer is rational, and would spend time and use goods in such a way that he can maximise his total utility, often constrained by budget and time (Meloni et al 2008).

In the transport context, utility is a function of a range of factors or variables which have been shown to be statistically significant in influencing the travel behaviour of a rational traveller making a choice from a set of mode and destination alternatives. With parameters estimated from travel surveys and differentiated by travel purpose, the factors or variables can be grouped into:

- Individual characteristics such as age, gender, income level, car ownership and household size;
- Transport supply attributes such as travel time or distance (public transport and car), access time, wait time, transfer time and fares (public transport), vehicle operating and parking costs (car);
- Land use patterns such as employment opportunity and retail space in destination.

The utility resulting from such a function is able to represent most of the relevant information with a single value. Therefore, the utility is recommended as a proxy for accessibility, especially from an individual's perspective. For example, some travellers aim to reach their destinations as quickly as possible, while for others, not having to wait at stations or walk long distances between services may be the most important factors. Taking into account the differences of individual travel behaviour, the accessibility measured by utility is distinguishable by population segment.

Utility also provides a platform to investigate accessibility by travel purpose, overcoming a single index of accessibility for all travel purposes. This is important given the distribution of activities are different and served by various levels of transport services.

Accessibility measures developed with such a utility framework have been recommended for transport and land use evaluation (Zondag et al 2007), benefiting from its capability to recognise the different effects of transport and land use policy by residential socio-economic profile, type of available transport alternatives and kind of activities at destinations. With

such a utility measure, a traveller can choose a more distant location with a corresponding higher utility, due to the joint effects of transport and activity opportunities at the destination.

However, there is an important caveat. The utility depends on the size of the choice set and the measure can result in either a negative or positive value referenced from the predefined alternative. That is, the utility always has a relative value which does not have any measurement unit. The advantage of this feature is its ability to incorporate a new alternative of mode or destination which would influence the relative value of the utility. Its disadvantage is that the absolute value of utility would not mean much if the alternative referenced is unknown.

Due to the limitation imposed by the absolute value, adoption of the changes of logsum of the utility calculated across all alternatives between scenarios is recommended for accessibility improvement assessment (Kohli and Daly 2006). The logsum is the logarithm of the denominator of the logit choice probability to derive the expected utility (Zondag et al 2007). Therefore, the utility-based measures are designed to assess the changes of accessibility, thus, the benefits or dis-benefits associated with those changes, instead of measuring them in an absolute term.

Mathematically, a utility-based measure is represented as below:

$$A_{os} = (\sum_d t_{osd}^1 (\ln \sum_n \exp(u_{osnd}^1) - \ln \sum_n \exp(u_{osnd}^0))) / t_{os}^1$$

Where: A_{os} - the improved accessibility for the segment s in origin zone o

t_{osd}^1 - the tour demand of the segment s in origin zone o to destination zone d in the “Do Something” scenario

u_{osnd}^1 - the utility of the segment s in origin zone o with mode alternative n to destination zone d in the “Do Something” scenario

u_{osnd}^0 - the utility of the segment s in origin zone o with mode alternative n to destination zone d in the “Do Minimum” scenario

t_{os}^1 - the tour demand of the segment s in origin zone o to all destinations in the “Do Something” scenario

To explore the implications of the logsum difference in a meaningful way, the difference is to be divided by a time coefficient from the utility function to be translated into a travel time value, or by a cost coefficient into a monetary value. This translation is feasible only when the time or cost variable is in a linear relationship with the utility.

$$D_{os} = A_{os} / \alpha_t$$

Where: D_{os} - the equivalent time or dollar saved or lost for the segment s in origin zone o

A_{os} - the improved accessibility for the segment s in origin zone o

α_t - the time or cost parameter

Nevertheless, utility formulas are not developed independently. The utility and the derived accessibility measures often originate from travel demand models (Lee et al 2009). For destination choice in activity-based modelling, the utility is calculated from origin zones to all destination zones by all modes by time of day (Davidson et al 2011). Such accessibility measures have been used as explanatory variables reflecting the opportunities to conduct a travel tour for a purpose from an origin in terms of trip frequency (Daly 2007), destination

choice (Handy 1993), mode choice and tour complexity (Hanson and Schwab 1987). Whilst most serving modelling purposes, their applications for assessment of transport policy and measurement of transport improvement benefits are truly a by-product of the utility. Understanding of transport models is the pre-requisite, which to some degree, has prevented its wide applications in projects.

The development of sound travel demand models requires extensive data collection of individual travel patterns and preferences. In addition, the utility formula can be difficult and expensive to obtain and estimate in reality, not to mention the development of a plausible accessibility measure. Luckily, the Sydney Strategic Travel Model is developed using rich resource of information of individual travel choice behaviour collected from the Household Travel Surveys, making the model an ideal platform to demonstrate such a utility-based accessibility measure.

5. Sydney Strategic Travel Model

The Sydney Strategic Travel Model (STM) has been being developed by the Bureau of Transport Statistics (BTS) and its predecessors since 1999. The model discussed here is the STM 2. The Model, covering the Sydney Greater Metropolitan Area and built largely in the EMME environment, is a series of models and processes that attempt to predict, in a simplified manner, residents travel behaviour under various transport and land use scenarios (HCG and ITS 2002). Some of the key model characteristics are summarised below.

- It models seven travel purposes: work, business, primary school, high school, tertiary, shopping and other; and seven modes: car driver, car passenger, train including ferry and light rail, bus, bike, walk and taxi; producing 24 hour tour demand by mode and purpose, which is further processed into trips by period of day, based on the parameters estimated from the continuous BTS' Household Travel Surveys.
- Travel choice behaviour is modelled in the mode and destination models, in which utility functions are developed. The key variables included in the utility function for the travel purpose and modes of interest here are listed in Table 1. All variables are in a linear relationship with utility, except the cost items which are logarithmic. Importantly, other key components of the model such as license holding, car ownership and population modules are the inputs into the choice models and these modules are also affected by the accessibility measure in terms of the changes in the mode-destination logsum.
- The choice models are implemented for each of the 280 population segments, distinguished by travel purpose and the key socio-economic variables as indicated in Table 2. The effects of the changes of the mode-destination logsum would be the changes of the size of the population segments, subsequently leading to the changes of the quantity and distribution of the travel demand. Hence, the STM can accommodate the changes in travel behaviour by the segment very well.

A review of the STM shows that the model has all the key elements required to produce a sensible utility-based accessibility measure. For this research, the model's structure was kept intact but its operational mechanism was adjusted slightly. The adjustment was to save the utility and tour demand by the segment and travel purpose of interest to this case study, as a normal model run would supersede the utility of one segment by another.

Table 1: Utility Variables for Selected Modes and Travel Purposes in STM 2

Travel Purpose	Mode	Variable
Work	Car Driver	age, gender, car availability, car travel time, destination and CBD status, distance, personal income, employment type, and car cost including operating cost, parking cost and toll
	Train	rail, light rail, bus and ferry travel time, access time, first waiting time, other waiting time, destination and CBD status, employment, personal income, public transport fare, and distance
Shopping	Car Driver	age, car availability, car travel time, car cost including operating cost, parking cost and toll, CBD status, regional centre, employment type, location in terms of rings,
	Train	rail, light rail, bus and ferry travel time, access time, first waiting time, other waiting time, CBD status, regional centre, employment type, and public transport fare
High School	Car Passenger	car travel time, regional centre attraction, education attraction, distance, household income, car availability, car cost including operating cost, parking cost and toll
	Train	rail, light rail, bus and ferry travel time, access time, education attraction, regional centre, number of boardings, distance, and household income
Tertiary	Car Driver	car travel time, intra zone, education attraction, fulltime/part-time status, car availability, and car cost including operating cost, parking cost and toll
	Train	rail, light rail, bus and ferry travel time, access time, waiting time, education attraction, and fulltime/part-time study

Table 2: Population Segmentation by Travel Purpose in STM 2 Mode and Destination Choice

Travel Purpose	Car Ownership/ Availability	Personal / Household Income	Age/ Fare Status	Student Status	Employment Type	Total Segments
Work	8	4			4	128
Business	8	3				24
Primary School	5		2			10
High School	5	2				10
Tertiary	6			2		12
Shopping	6		6			36
Other	5	2	6			60
Total						280

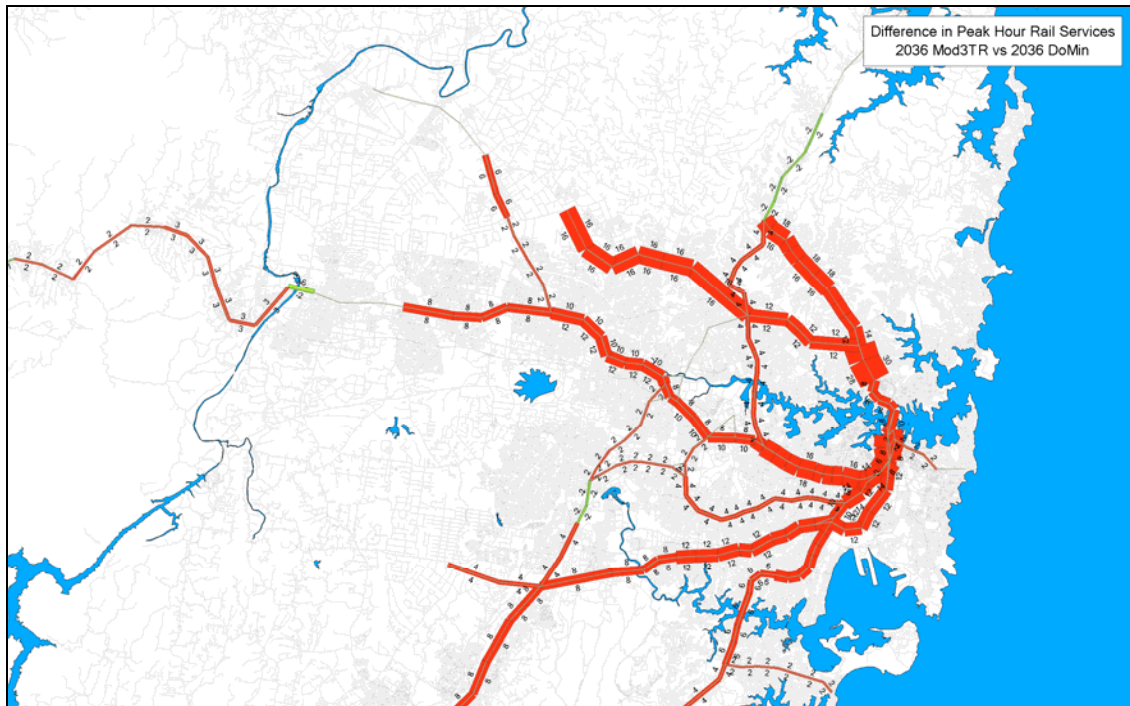
6. Case Study

Sydney is used for the context of this case study. Sydney's population is forecast to grow by 1.7 million people between 2006 and 2036 to 6 million¹. To meet this challenge, the NSW government has been working to deliver faster and more frequent rail services to improve the overall capacity of the CityRail network through a long term rail strategy. The strategy has assessed many alternative plans with the demand forecasts provided by the STM. This paper selects two of the options: 2036 Do Minimum (DoMin) and 2036 Modified 3 Tier (Mod3TR) to demonstrate the proposed methodology. Importantly, they do not necessarily reflect the current status of the rail strategy. The key features of the two options are described in Table 3, and the rail service frequency difference is presented in Figure 3².

Table 3: 2036 Do Minimum and Modified 3 Tier

Option	Key Features
Do Minimum Base Case	Keep sectorisation of the rail network, implementing a Clearways timetable which provides additional peak services for the South and Bankstown lines and travel time savings for the Macarthur and Campbelltown services, constructing the South West Rail Link and the Parramatta Epping Rail Link, but without the North West Rail Link
Modified 3 Tier	Support infill and greenfield development and connect specialised centres by making the most use of existing assets to delay the need for a harbour crossing, implementing the Western Express line, high frequency services (single deck) on Inner West, Bankstown, Hurstville and North Shore Lines, and using double deck for North West Rail Link services, plus the Clearways timetable and new rail links mentioned in the base case

Figure 3: Difference in AM Peak Hour Rail Services

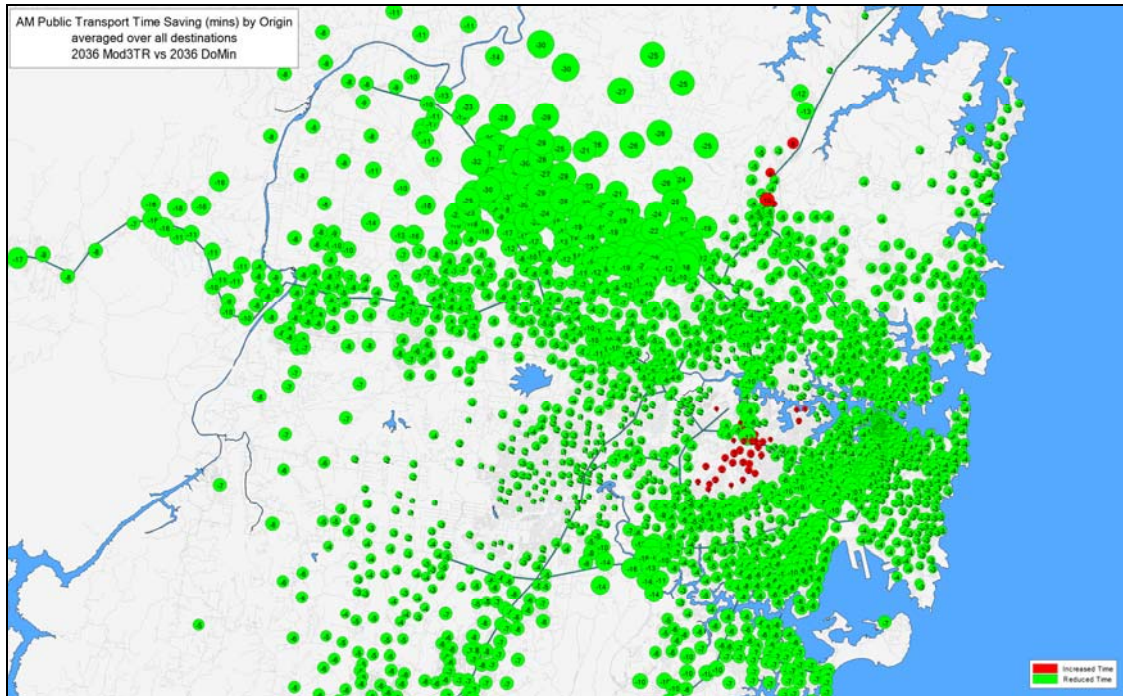


¹ NSW Department of Planning 2011, NSW Statistical Local Area Population Projections, 2006-2036

² For all figures in this paper, the green colour indicates a decrease whilst the red colour indicates an increase.

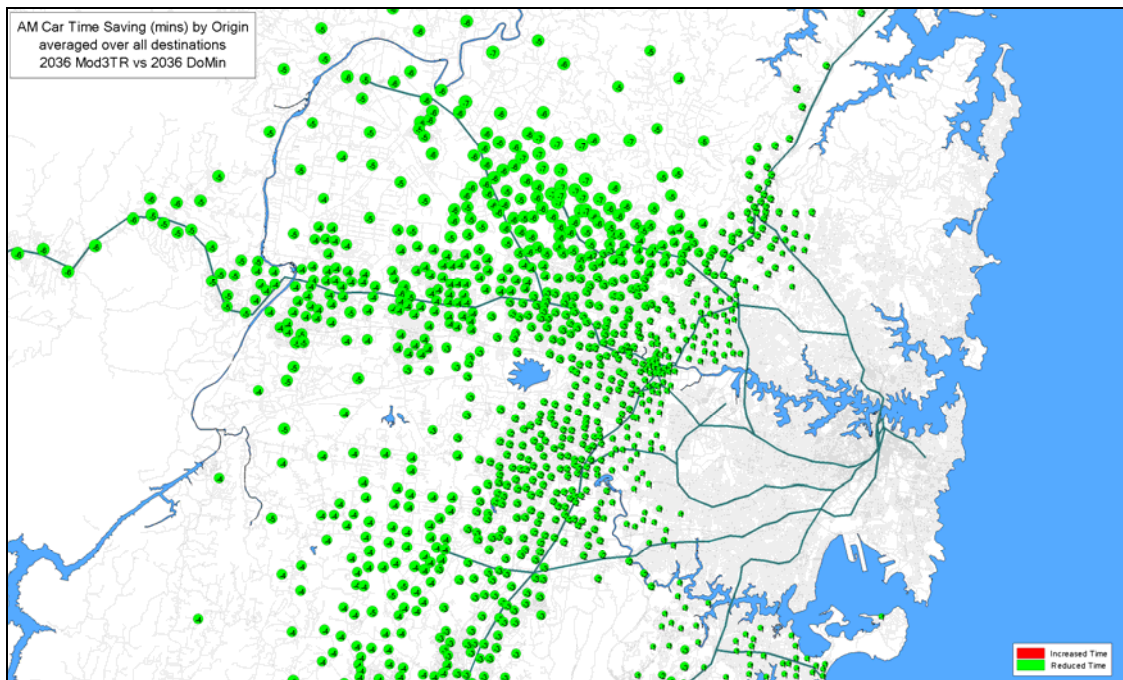
All other things remaining equal, it is expected that the introduction of new lines or services would improve the accessibility in terms of generalised public transport (PT) travel time savings as presented in Figure 4, which is averaged over all destinations. The generalised time includes the weighted access and wait times.

Figure 4: 2036 AM Average Generalised PT Travel Time Saving by Origin (minutes)



The average car travel time savings are shown in Figure 5, which indicates that outer areas have the greatest benefits where the rail projects would also improve the road conditions in terms of modal shift from car to rail.

Figure 5: 2036 AM Average Car Travel Time Saving by Origin (minutes)



These analyses indicate the accessibility improvement without differentiation by population segment and travel purpose. The rail time savings may be literally “true” to all rail users where rail access can be the same for everyone from the same zone. By contrast, the car time savings could be challenged when the savings are applied to those households who do not own a car. This discussion implies the need for further investigations into the accessibility implications.

6.1. Demand Analysis

STM models the rail plans proposed for the Mod3TR option and forecasts travel demand in the form of 24 hour tours by main mode. The comparison with the demand from the DoMin base case is presented in Table 4. As expected, there is an increase in rail demand by 11% due to the increase in the rail services, while the demands for other modes are slightly reduced. The total demand for the four main modes remains mostly unchanged (with a minor difference of -0.02%).

Table 4: Tour Demand for 24 hours by Main Mode

Mode	Do Minimum	Modified 3 Tier	Change	Change %
Car Driver	4,963,088	4,929,650	-33,438	-0.7%
Car Passenger	1,999,288	1,992,051	-7,236	-0.4%
Rail	430,240	477,746	47,506	11.0%
Bus	468,412	460,200	-8,211	-1.8%
Total	7,861,027	7,859,648	-1,379	-0.02%

As discussed in Section 5, STM models a total of 280 population segments. Limited by the scope of this study, this paper selects 33 segments as listed in Appendix 1, which are characterised by the travel purpose of work, high school, tertiary and shopping, and key socio-economic attributes. The selection attempts to accommodate the range of the variations of the attributes such as the lowest vs highest household / personal income levels, no car vs free access to car use households, to address the biggest difference of travel behaviour.

Whilst the total (tour) demand of the model is assumed to be unchanged, measurable changes of population segment size are identified. That is, with the improvement of rail services and the accessibility by public transport, the model forecasts more demand from those segments without a car, and less demand from those segments with free access to car use. Figures 6 and 7 highlight the difference. Interestingly, the distribution of the changes is roughly matched between the increase and the decrease, and the areas within the precinct of the new line North West Rail Link have the biggest changes.

In fact, the changes in the demand are closely related to the changes of the size of each of the population segments as indicated in Appendix 1. That is, the accessibility improved by the new or additional rail services would reduce the number of high car ownership households in the catchment areas, and increase the number of households without car or attract additional low car ownership households. Obviously such effects are to be viewed from a long term perspective.

Therefore, the demand analysis suggests that the accessibility improvement by public transport would influence key residential socio-economic attributes in terms of the size of population segments, and subsequently the demand for transport.

Figure 6: Tour Demand Difference for Selected 11 No-Car Segments

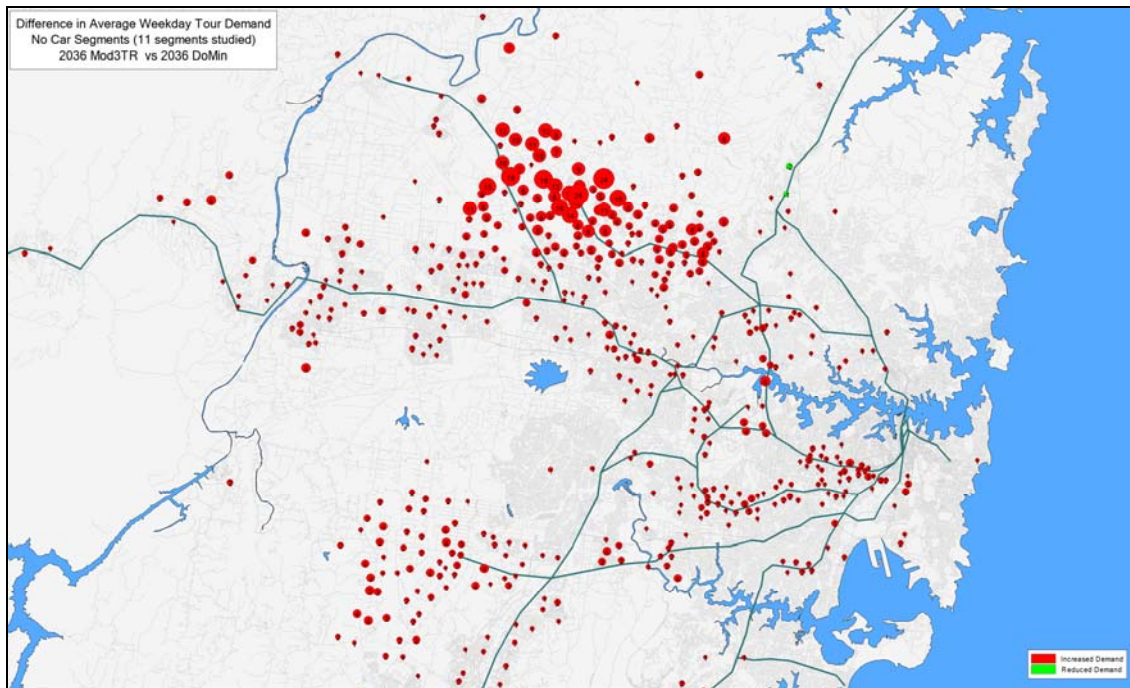
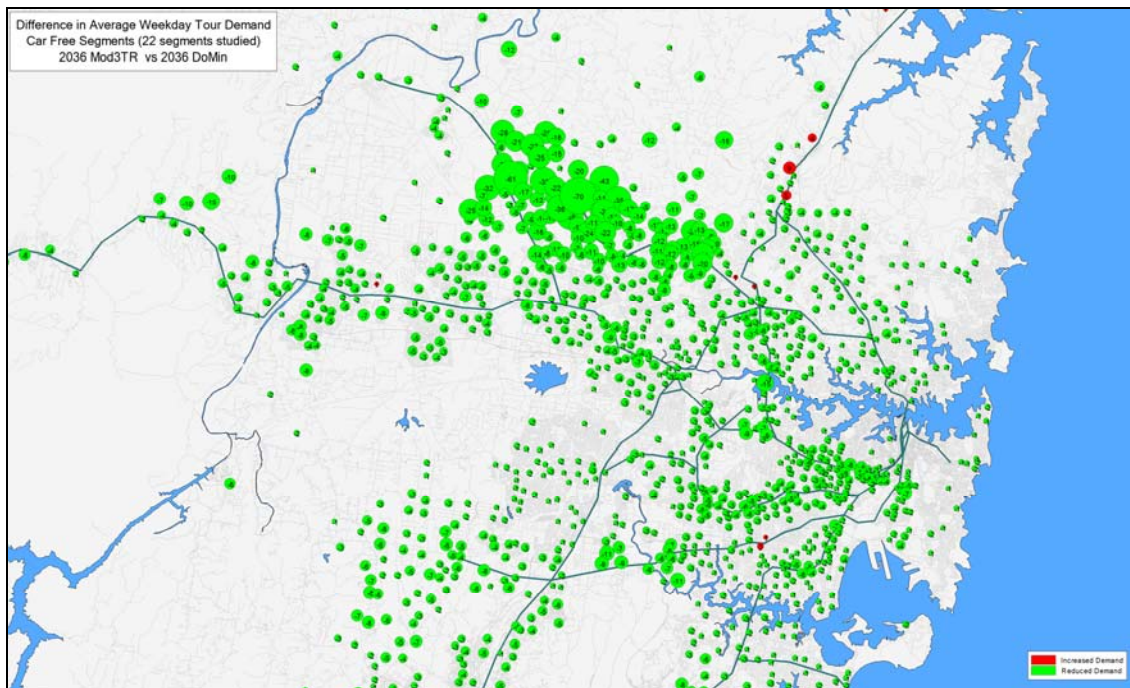


Figure 7: Tour Demand Difference for Selected 22 Free-Car-Use Segments



6.2. Utility Measures

To break down the analysis further, this section focuses on the logsum difference as a proxy for the accessibility improvement by travel purpose and population segment. Instead of using the logsum directly, the logsum difference has been converted into equivalent rail travel time by applying the rail time coefficient of -0.012616 suggested from the STM.

6.2.1. Travel Purpose - Work

For the fulltime, manufacturing and low income segments, Figure 8 indicates the result for the segment without a car, while Figure 9 presents the result for the segment with free access to car use. The accessibility improvement is represented in equivalent rail travel time savings.

Figure 8: Work – full time, manufacturing, low income and without a car

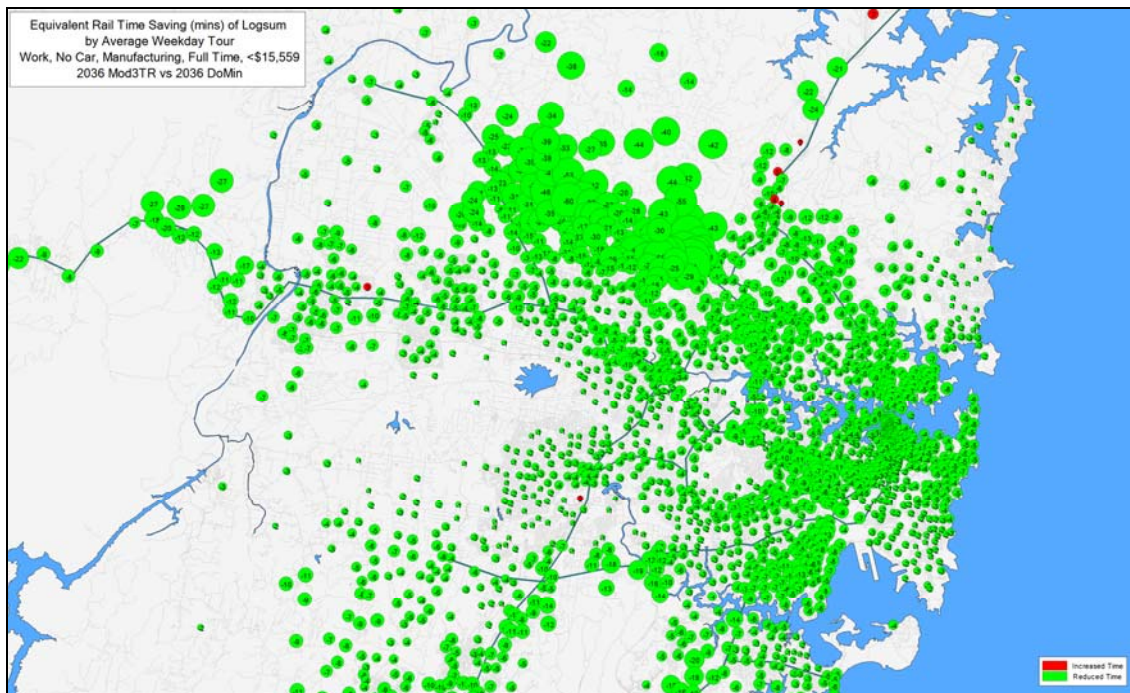
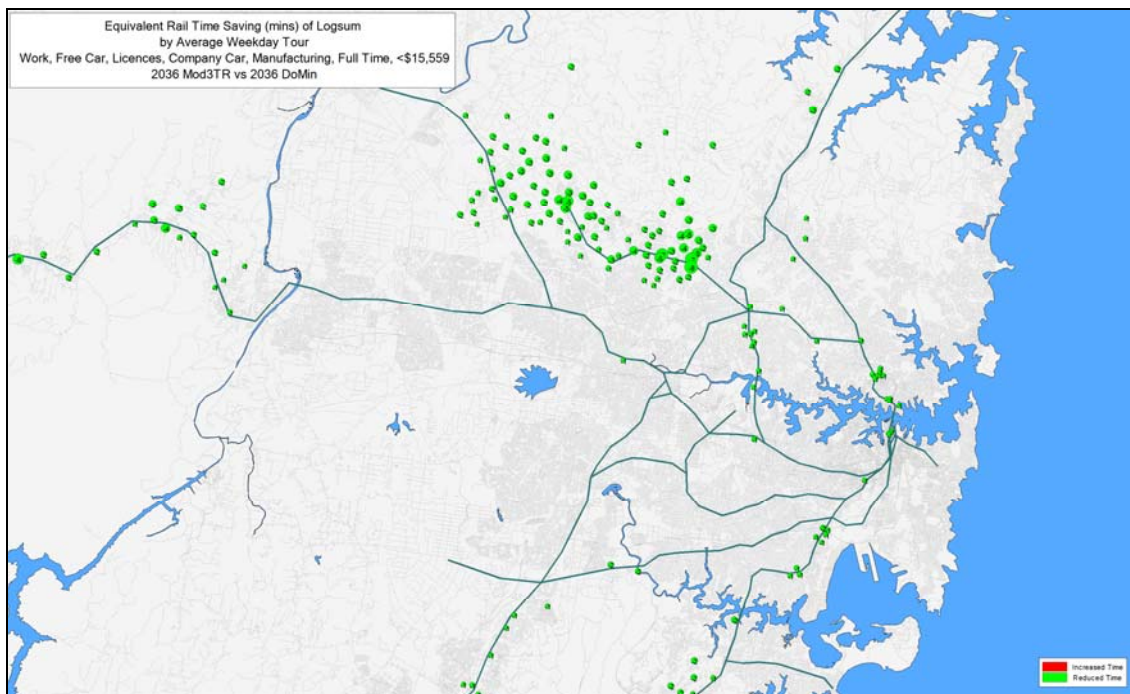


Figure 9: Work – full time, manufacturing, low income and with free access to car use



For the fulltime, non-manufacturing and high income segments, Figures 10 and 11 display the results for the segments with and without car respectively.

Figure 10: Work – full time, non-manufacturing, high income and without a car

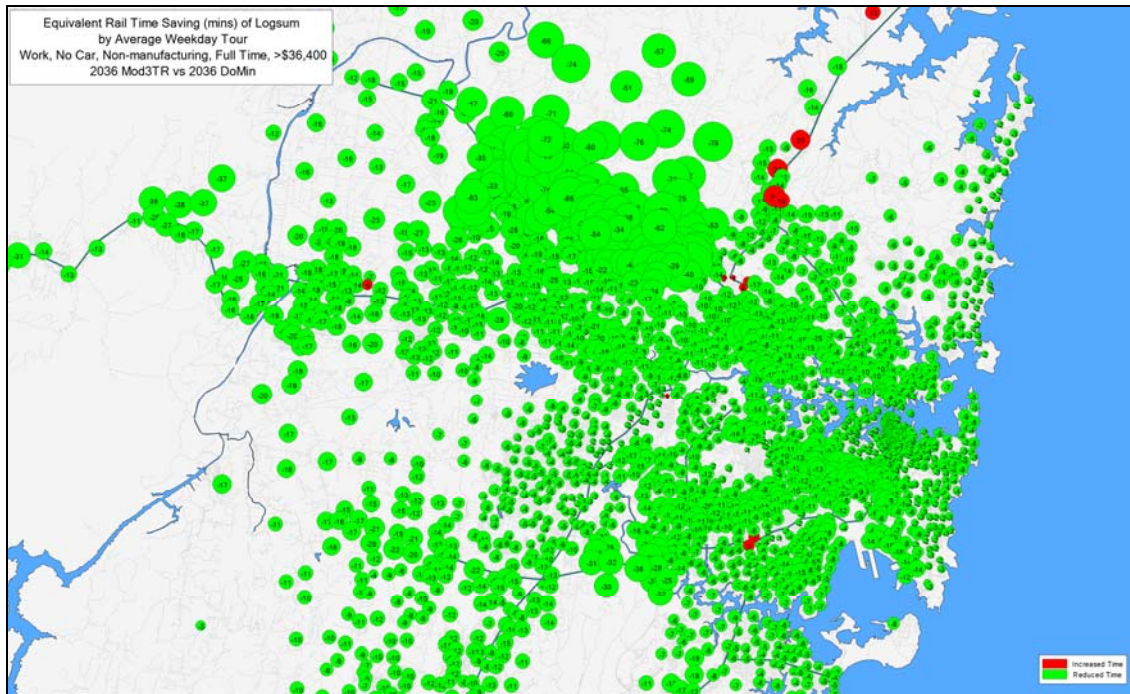
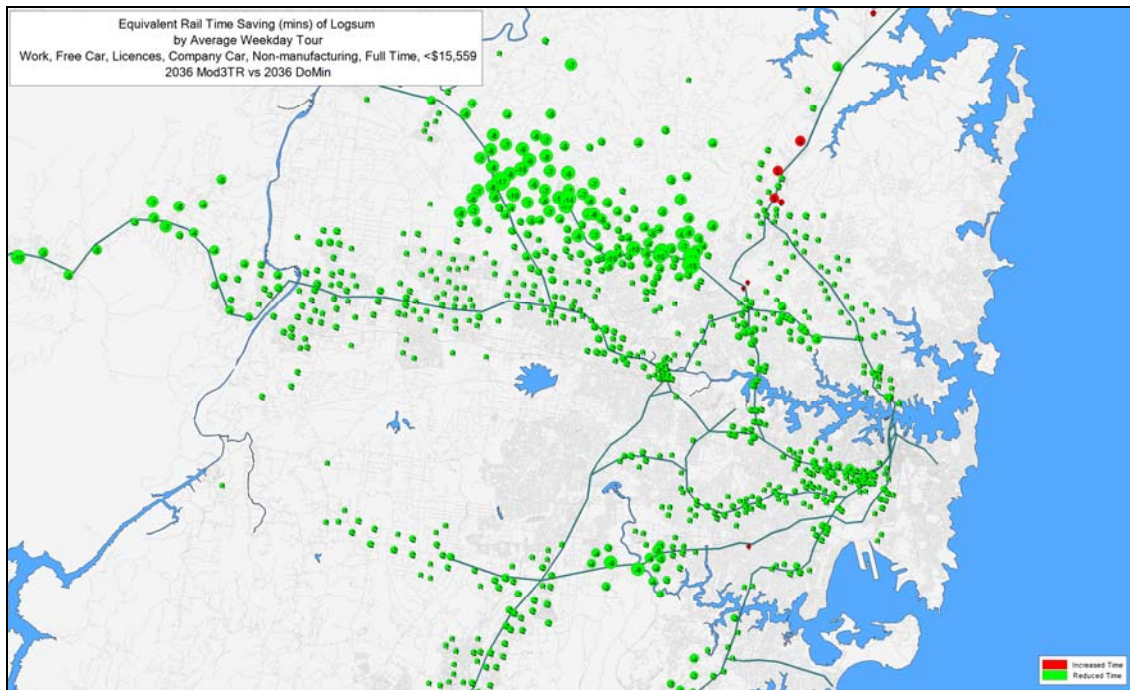


Figure 11: Work – full time, non-manufacturing, low income and with free access to car use



The work analysis indicates that the segments without a car would achieve more accessibility improvement from the rail projects than the segments with a car. This finding is equally true to the non-manufacturing and manufacturing segments. Compared with Figure 4, the generalised rail travel time savings would underestimate the accessibility improvement for those segments without a car.

6.2.2. Travel Purpose – Shopping

For the segments of “over age of 15” and “without a car”, Figures 12 and 13 indicate the results for the segments of full fare and concessionary fare respectively. The analysis suggests that the rail improvements would have more influence on concessionary fare segments than full fare segments. When compared with the work purpose, the shopping purpose is less sensitive to the rail improvements in terms of the size of changes.

Figure 12: Shopping – age 15-19, full fare, and without a car

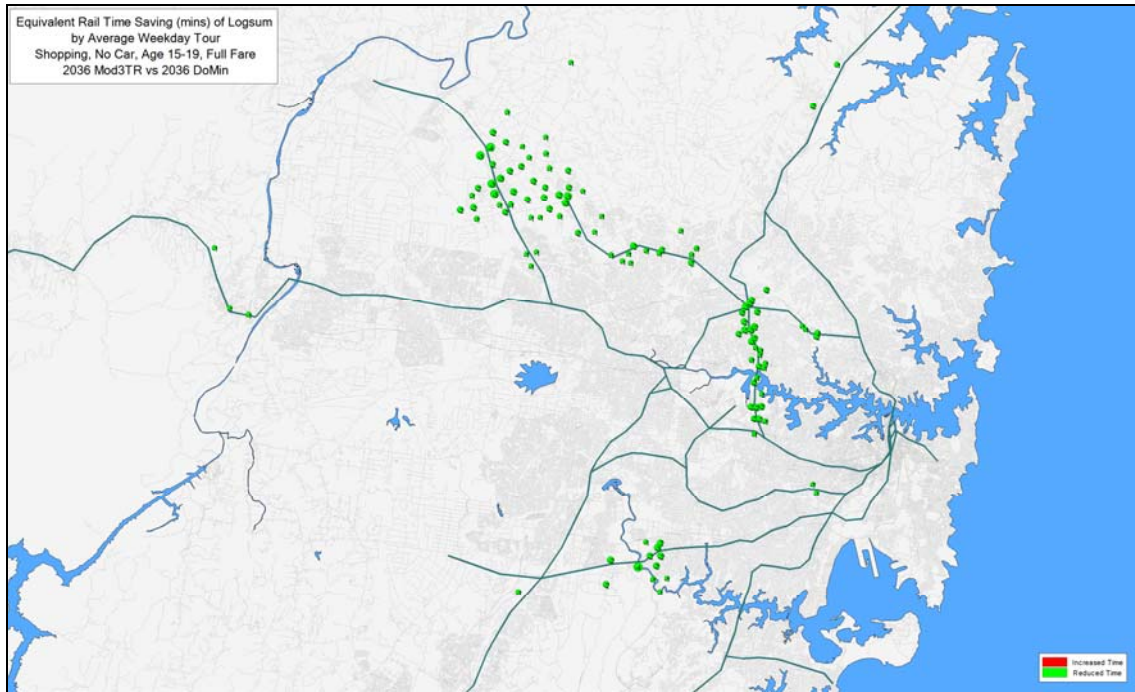
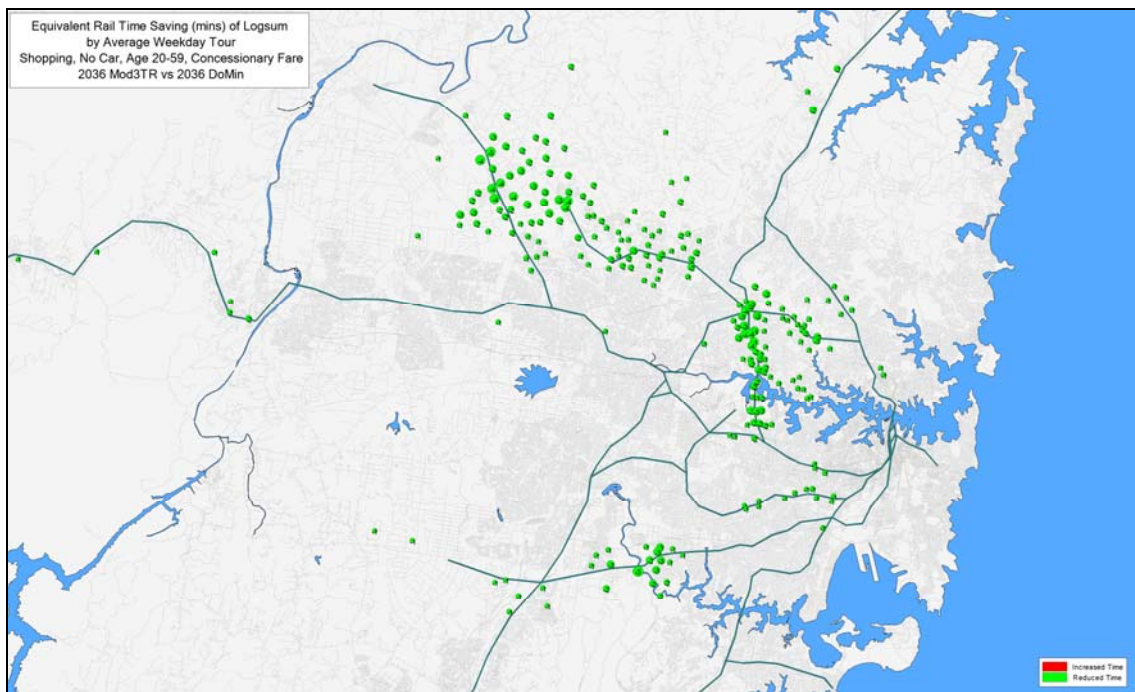


Figure 13: Shopping – age 20-59, concessionary fare, and without a car



6.2.3. Destination – CBD

When the accessibility improvement to a destination is investigated, the logsum difference is calculated to the destination specifically. Figures 14 and 15 display the results for the two work segments respectively. They show the accessibility improvement to CBD is stronger than the averages as shown in Figures 8 and 11.

Figure 14: Work in CBD – full time, manufacturing, low income and without a car

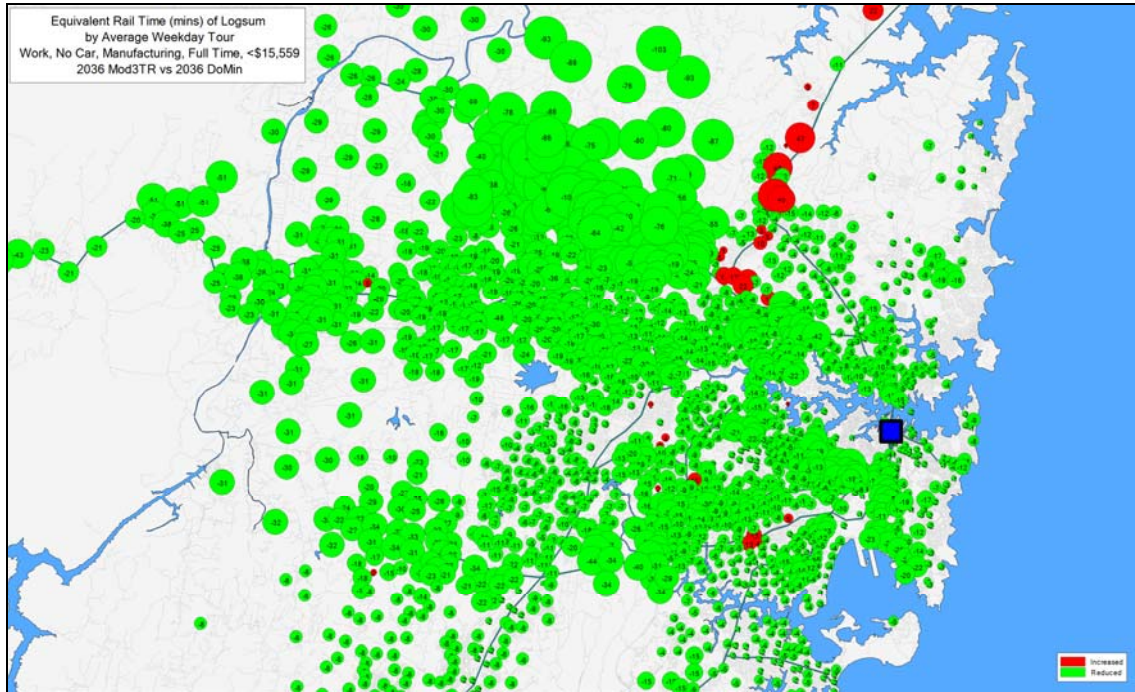
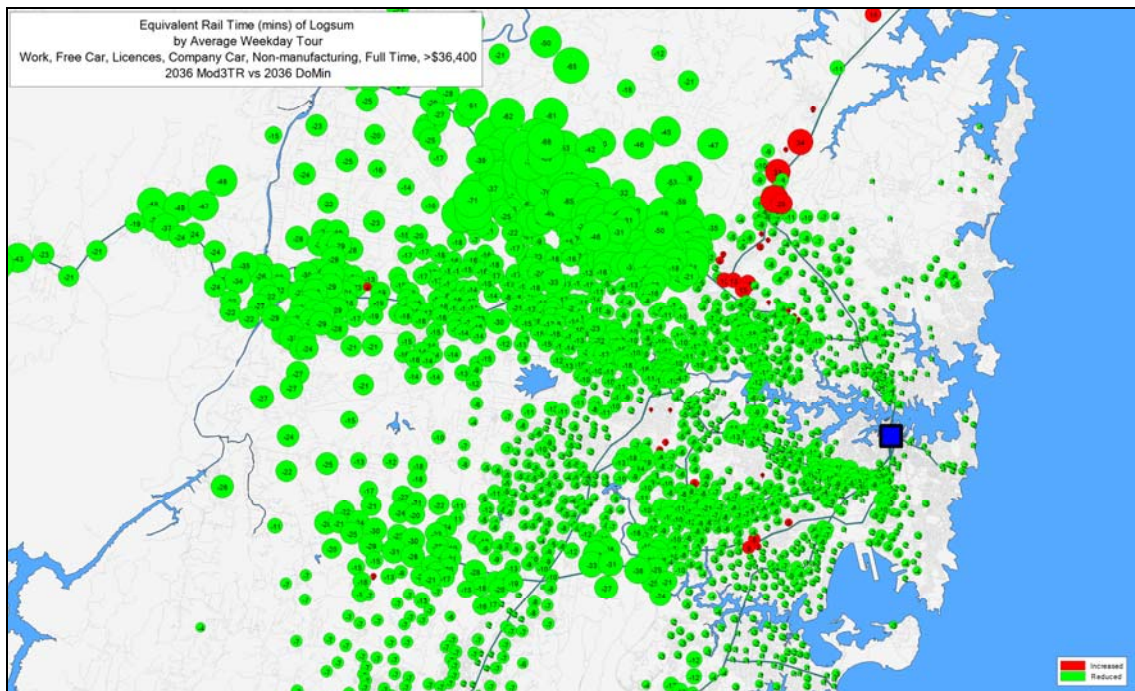


Figure 15: Work in CBD – full time, non-manufacturing, high income and with free access to car use



Greater accessibility improvement is also found for the shopping segments to CBD as shown in Figures 16 and 17. The longer distance from CBD, the more the accessibility improvement, even for the shopping segments with free access to car use.

Figure 16: Shopping in CBD – age 20-59, concessionary fare, and without a car

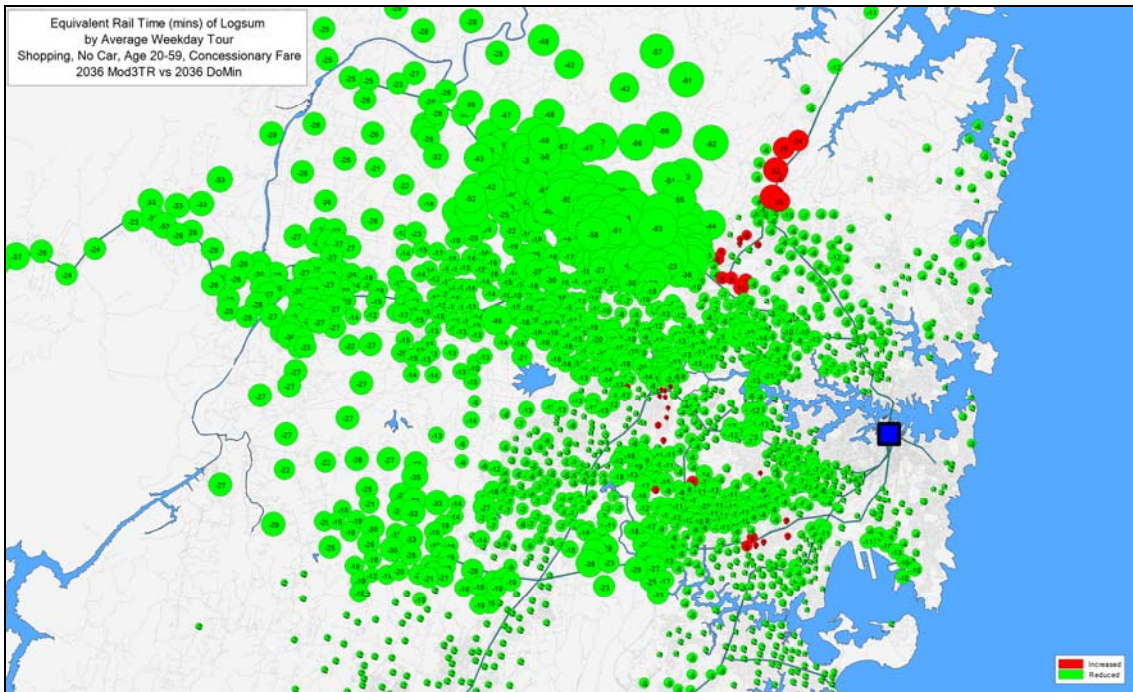
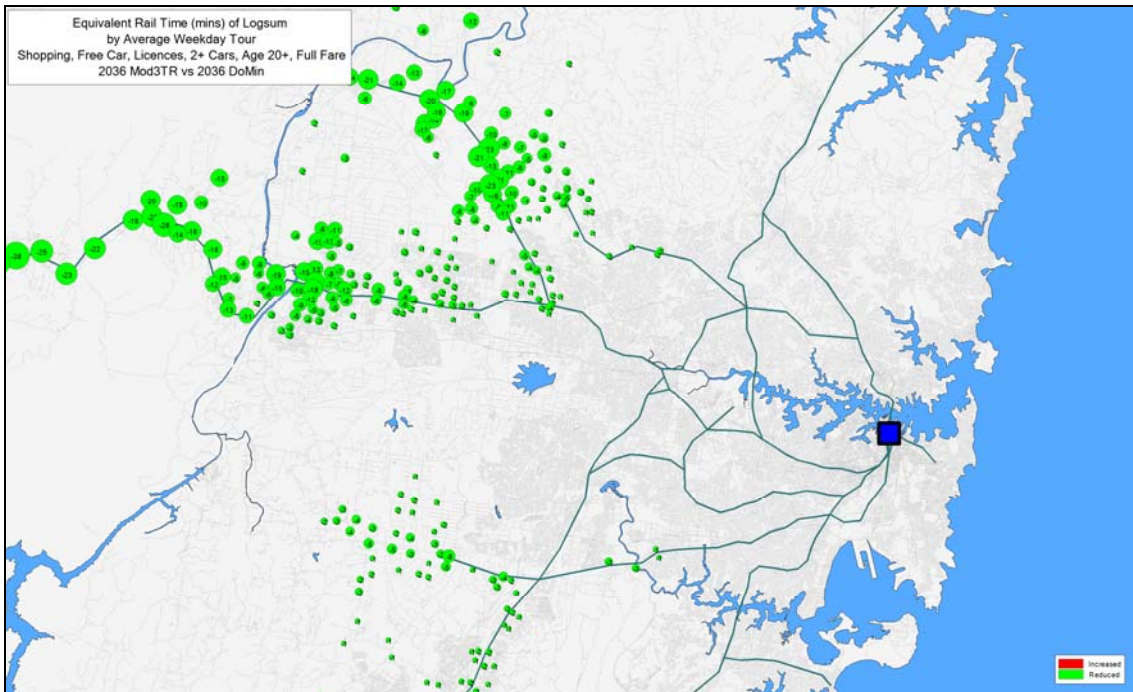


Figure 17: Shopping in CBD – age 20+, full fare, and with free access to car use



The research on the travel purposes of high school and tertiary also results in similar findings for the segments without a car or with free access to car use.

7. Conclusion

This paper investigates the accessibility improvement measured from the behaviour-based utility in terms of the logsum difference weighted by travel demand between a base case and an option case. The case study introduces a new rail line and additional services into the option. The modelling results indicate that the utility measure is a valid proxy for transport accessibility improvement with some key findings below:

- The utility measure has the capability to represent the difference of accessibility improvement by population segment and travel purpose; whilst a generic measure of (generalised) travel time savings could result in either over-estimation or under-estimation of the accessibility improvement for each segment or purpose.
- The accessibility improvement represented by equivalent travel time savings is the result of the utility function incorporating various factors influencing the mode and destination choice such as competition of available modes and activity centres in addition to (generalised) travel time, so that the accessibility improvement represents the travellers' response to the changes of transport supply, land use patterns and policy. Therefore, it is feasible to assess the effectiveness of transport policy.
- The equivalent travel time savings vary by the segment and purpose. The benefits for a transport project in terms of equivalent travel time savings summed over all the population segments and travel purpose from a transport model would be superior over a single travel time saving assumption for all population. The sum of the equivalent travel time savings weighted by the travel demand in each segment becomes a valuable item in project evaluation.
- The relationship between the accessibility improvement and the distribution of the residential segments would be useful information for decision-makers to understand the winners (or losers) from a transport project, specifically by how much, and for what travel purposes. With the information in hand, it would be possible to check if the distribution of the project benefits meets the intent of the project sponsors.

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Appendix 1 List of Selected Population Segments

Segment	Purpose	Description	Tour Demand Difference	Population Difference
Segment 1	Work	no car, manufacturing, fulltime, <\$15,559	2	3
Segment 2	Work	no car, manufacturing, fulltime, >\$36,400	72	91
Segment 3	Work	no car, non-manufacturing, fulltime, <\$15,559	60	118
Segment 4	Work	no car, non-manufacturing, fulltime, >\$36,400	628	807
Segment 5	Work	free car use, manufacturing, fulltime, <\$15,559	-1	-1
Segment 6	Work	free car use, manufacturing, fulltime, >\$36,400	-39	-59
Segment 7	Work	free car use, non- manufacturing, fulltime, <\$15,559	-16	-40
Segment 8	Work	free car use, non-manufacturing, fulltime, >\$36,400	-299	-568
Segment 9	Work	free car use, licences, comp car, manufacturing, fulltime,<\$15,559	-1	-2
Segment 10	Work	free car use, licences, comp car, manufacturing, fulltime,>\$36,400	-119	-184
Segment 11	Work	free car use, licences, comp car, non-manufacturing, fulltime, <\$15,559	-8	-24
Segment 12	Work	free car use, licences, comp car, non-manufacturing, fulltime, >\$36,400	-641	-1,326
Segment 13	High School	no car, <\$78,000	140	247
Segment 14	High School	no car, >=\$78,000	13	24
Segment 15	High School	no licence, 1+ car, <\$78,000	-146	-227
Segment 16	High School	no licence, 1+ car, >78,000	-13	-23
Segment 17	High School	licence, 1+ car, <\$78,000	-12	-20
Segment 18	High School	licence, 1+ car, >\$78,000	-1	-2
Segment 19	Tertiary	no car, full time	107	178
Segment 20	Tertiary	no car, part time	236	5,188
Segment 21	Tertiary	free car use, one car, full time	-10	-27
Segment 22	Tertiary	free car use, one car, part time	-38	-2,974
Segment 23	Tertiary	free car use, licences, 2+cars, full time	-65	-169
Segment 24	Tertiary	free car use, licences, 2+cars, part time	-209	-16,363
Segment 25	Shopping	no car, age 15-19, full fare	38	247
Segment 26	Shopping	no car, age 20-59, concessionary fare	57	241
Segment 27	Shopping	no car, age 20+, full fare	597	3,064
Segment 28	Shopping	free car use, one car, age 15-19, full fare	-8	-39
Segment 29	Shopping	free car use, one car, age 15-59, concenssionary fare	-20	-56
Segment 30	Shopping	free car use, one car, age 20+, full fare	-428	-1,737
Segment 31	Shopping	free car use, licences, 2+ cars, age 15-19, full fare	-84	-486
Segment 32	Shopping	free car use, licences, 2+ cars, age 15-59, concenssionary fare	-89	-291
Segment 33	Shopping	free car use, licences, 2+ cars, age 20+, full fare	-2,700	-12,683