DEVELOPMENT CONTROL TRAFFIC IMPACT ANALYSIS POLICIES IN A NEWLY CHANGED SOUTH AFRICAN TRANSPORT ENVIRONMENT

JP SCHEEPERS and B VAN BILJON

Aurecon (Pty) Ltd, P O Box 905, Pretoria, 0001

ABSTRACT

The methodology and approach towards evaluating land-use applications by means of the Traffic Impact Assessment (TIA) process has recently come under scrutiny within the South African environment. Many of the accepted practices, analysis methods and data sets are being revised, streamlined and adapted. This trend has created a unique opportunity to revisit the methodology and approach in which public transport accessibility and private transport trip reduction (trip-degeneration) is accommodated within the TIA process.

Historically, many practitioners included public transport and the access to public transport from the development site being investigated into the TIA as an afterthought. Some practitioners argued that the presence of public transport in proximity or adjacent to the development site would automatically result in a modal shift and would therefore account for a reduction in private car usage. This reduction in private car dependency would be used to minimise the impact of the proposed development on the adjacent road network thereby mitigating unnecessary and costly road infrastructure upgrades.

Although the inclusion of public transport in the TIA process by South African practitioners is an encouraging sign, indicating the paradigm shift towards sustainable transport in the transportation industry, very little effort has been made to adequately quantify how public transport should be included in the process. In addition to this, with the increased focus on expanding public transport infrastructure and services within South Africa, the importance of effectively incorporating the effect of public transport accessibility within the land-use development and TIA processes cannot be overstated.

This research document provides the framework for the rules and thinking required to understand the factors that are important and the issues that should be accounted for in assessing and evaluating development from a transportation point of view within public transport precincts or Transit Orientated Developments (TODs).

1. INTRODUCTION

It is not possible to change the way commuters decide on mode-choice “overnight” through the implementation of radical measures that for instance prohibits the use of private vehicles in certain areas or alternatively to place high premiums of the use of private vehicles. The fundamental problem with these strategies in the South African context is the availability of feasible alternatives.

With the advent of the Gautrain Rapid Rail (GRR), Bus Rapid Transit (BRT), High Occupancy Vehicle (HOV) lanes and Park-and-Ride (PnR) sites, the land-use and transportation environment has changed where all of the above challenges are overcome to some extent. An environment is created where it is extremely attractive for any kind of

Proceedings of the 29th Southern African Transport Conference (SATC 2010) 16 - 19 August 2010
Proceedings ISBN Number: 978-1-920017-47-7 Pretoria, South Africa
Produced by: Document Transformation Technologies cc Conference organised by: Conference Planners

development, to densify and cluster within precincts surrounding the GRR or BRT stations rarely seen before in South Africa.

The transportation environment is one of the foremost enabling factors, driving new development and changes in existing land-use. The GRR and BRT stations with their unique blend of increased development densities and new transit alternatives, however, requires a complete new set of rules, as the parameters that governed thinking hereto, have changed fundamentally.

This research document provides the framework for the rules and thinking required to understand the factors that are important and the issues that should be accounted for in assessing and evaluating development from a transportation point of view within public transport precincts or Transit Orientated Developments (TODs).

2. PROBLEM STATEMENT

In determining to what extent the changing public transport landscape of South Africa will play a role in changing the trip-making patterns of certain land-use developments as well the methodology applied to evaluating their traffic impacts, it is critically important to understand the following:

- What are the limitations associated with the current land-use development transport impact assessment framework?
- Are the GRR and BRT precincts TODs or merely TADs and hence are they positioned to truly transformed the urban landscape of South Africa?
- What is the definition of accessibility and what is deemed accessible public transport?
- Can a case be made for developing a new / different framework for TIAs associated with land-use development in TODs or potential TOD precincts?
- What factors, parameters, criteria or methods could be applied when assessing public transport accessibility in terms of this newly devised TIA framework?
- To what degree does public transport accessibility influence mode choice, trip generation, parking standards and what private transport trip and parking reduction factors should be applied to various degrees of public transport accessibility?

3. LIMITATIONS OF CURRENT LAND-USE TRANSPORTATION IMPACT ASSESSMENT FRAMEWORK

Most applications for new developments and rezoning of land-use are done by professional town and regional planners. A formalised process is followed which almost always, includes the inclusion of a traffic impact assessment (TIA) undertaken by a professional traffic engineer or transportation planner. The current make-up of these TIAs is determined by a document that was published by the National Department of Transport , which prescribes:

- The warrants for traffic impact studies;
- The approach to be followed in the undertaking of these studies;
- The required content of a traffic impact assessment;
- The prescribed rates to be used for estimating the number of trips that will be generated by the proposed development;
- The treatment of access requirements, trip distribution and trip assignment methodologies, capacity analysis, parking requirements as well as internal circulation.
- Improvement and expansion of road infrastructure

This manual is augmented by separate data manuals which provide detailed information on prescribed trip generation rates and parking rates. The proposed trip generation rates are based on surveys that were conducted as early as 1980 and which has subsequently been updated in the early 1990's. Since 1993, no new data has been incorporated. The parking standards are even older and are based on rates that were determined in the mid-1980s.

Practitioners that are active in the field of traffic engineering and transportation planning have been struggling with the strict application of these rules since the prescribed rates are perceived by many, not to have been keeping abreast of the latest development trends and realities.

Consultants have undertaken updated parking rate surveys for the some metropolitan areas, and other methods have been applied for the estimation of typical trip generation rates e.g. the extrapolation of data from household surveys that contained information such as employment status, household income, and number of individuals transported to school or work by a particular mode of transport to name a few.

A cause of concern for many practitioners is the lack of proper guidelines related to the incorporation and treatment of public transport trips, pedestrian traffic, traffic safety and the use of person trips as opposed to vehicle trips. At the time of the development of these manuals, the emphasis in the transportation sector did not have the same focus as in recent times. Concepts such as Transit Orientated Development (TOD), Mixed Use Development (MUD) and new urbanism were still in its infancy and had no apparent application in the South African context.

The types of developments covered by these manuals were also restricted to the list of land-uses that were surveyed for these documents. In more recent times, new types of developments with revolutionary new land-use mixes and densities have become more prevalent and many instances exist where the direct application of the guidelines is insufficient and inaccurate.

Therefore, the anticipated land-use mix and densities of the GRR and BRT station precincts is anticipated to change dramatically, coupled with the increased accessibility of high quality public transport infrastructure and services the trip making patterns of residents and workers is similarly expected to change. Therefore it is unlikely that these rates, which were surveyed and developed in an era where private vehicle dependency and urban sprawl (suburbia) were dominant, can be applied directly without taking into account of a number of other factors.

4. GRR / BRT PRECINCTS - TODS OR TADS?

Transit Orientated Development (TOD) refers to an urban entity consisting of mixed land-used (i.e. residential, commercial, education, recreation etc.) developed at high density located around a centrally positioned transport node such as a rail station or a bus station, resulting in a compact "walkable-community". The high density development and centrally located transport node serves to maximise to public transport ridership and walking as primary mode of transport.

True TODs, as apposed to Transit Adjacent Developments (TADs), have many of the following characteristics:

- The transit-oriented development lies within a ***five to ten -minute walk*** of the transit stop. For major stations offering access to frequent high-speed service this catchment area may be extended to the measure of a 10-minute walk.

- A balanced ***mix of land-uses*** generates 24-hour ridership and TODs are places to work, to live, to learn, to relax and to shop for daily needs.
- A place-based zoning code generates buildings that shape and define memorable streets, squares, and plazas, while allowing uses to change easily over time.
- The street block sizes are reduced to a human scale resulting in a fine-grained network of streets, dispersing traffic and allowing for the creation of quiet and intimate thoroughfares (high pedestrian permeability).
- Minimum parking requirements are abolished.
- Maximum parking requirements are instituted such as for every 1,000 workers, no more than 500 spaces and as few as 10 spaces are provided.
- Parking costs are "unbundled," and full market rates are charged for all parking spaces. The exception may be validated parking for shoppers.
- Major stops provide Bike Stations, offering free attended bicycle parking, repairs, and rentals. At minor stops, secure and fully enclosed bicycle parking is provided.
- Transit service is fast, frequent, reliable, and comfortable, with headways of 15 minutes or less.
- Roadway space is allocated and traffic signals timed primarily for the convenience of walkers and cyclists.
- Automobile level-of-service standards are met through congestion pricing measures, or disregarded entirely.
- Traffic is calmed, with roads designed to limit speed to 50 km/h on major streets and 30 – 35km/h on lesser streets.

It is evident from the list of TOD characteristics above that a degree of evolution or hierarchy is associated with this list. It is unlikely that all the characteristics listed above are present from the onset of the TOD and that the catalytic factor sparking the other characteristics into being is most probably the transit stop or rather the accessibility of surrounding land-use to the transit stop.

Clearly once the transit stop has been established and the public transport services present are of a high quality, suitable frequency, acceptable level of convenience and comfort, and accessible to residents and workers of the precinct, one can assume that either organically or through interventions by authorities the remainder of the TOD characteristics will be put in place.

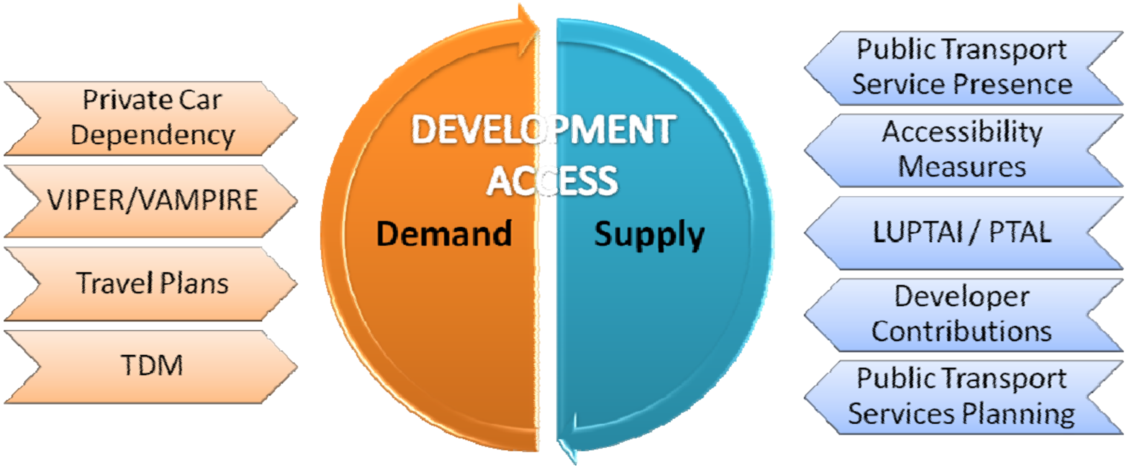
Therefore, in answering the question whether South Africa's GRR and BRT stations have the potential to be TODs, judging from the characteristics such as public transport quality, frequency, convenience, comfort and accessibility, it certainly seems to be the case. The critical factor associated with their successful transformation for merely TADs to true TODs is linked to determining how accessible the surrounding land-uses are to the transit stops and in so doing implementing a different set of rules or interventions which will see the precinct evolve and take on the remaining TOD precinct characteristics listed above.

5. NEW CONCEPTS FOR REVIEWING TODS TRAFFIC IMPACTS

In Section 3 of this paper, reference was made to the limitations of the current methodology for assessing the traffic impact of new land-use developments in a changing South African transportation landscape. Owing to the fact that the GRR and BRT station precincts (quasi TODs) are fundamentally different from the rest of the urban landscape in terms of land-use densities, availability of public transport services and mix of land-use types, it is unlikely that a blanket trip rate per land-use type will be an appropriate methodology for assessing the impact of land-use developments in these precincts (as is the case for the current methodology).

For this reason a departure needs to be made from the existing trip rate tables and a new framework for assessing the traffic impact of land-use developments within the GRR and BRT precincts (Refer to Figure 1).

Figure 1: New Framework for Assessing Land-use Development in TOD Precincts



The basic premise of the framework rests on the fact that new vehicle trips cannot be accommodated on the road network indefinitely and furthermore, road capacity cannot be increased at the same rate as trip-making demand. For this reason the new framework will focus to a large degree on person trips and to a lesser degree vehicle trips. Consequently the requirements surrounding the submissions that has to be made for approval will also change to address both the demand side as well as the supply side of the development.

Land-use developments will in the future still undoubtedly generate private vehicle trips, however, given the current and anticipated future levels of congestion on regional connector routes and distributor and access routes within the GRR and BRT precincts, the primary transport mode to which person trips are allocated in future must increasingly shift towards public transport modes.

The crux of the new framework therefore rest on determining the new mode choice mix or percentage breakdown between private vehicles and the available public transport modes in a precinct. Given the emphasis on public transport, the inclination may be for practitioners to assign an unreasonable percentage of person trips to public transport modes in order to guarantee a successful evaluation and approval of their traffic impact assessment.

The demand for travel is affected by a number of parameters which find their origin from the various stages of a trip, namely the mode choice, where you are going to travel, the congestion on the road where you are travelling, why are you travelling, how will you interact with your destination, what happens to your mode when you reach your destination etc. Table 1 quantified the way in which land-use affects per capita vehicle kilometres travelled in the urban TOD environment.

Table 1: Land-use Parameters Affecting Travel Demand

Factor	Definition	Travel Impacts
Density	People or jobs per unit of land area (m^2 or hectare).	Increased density tends to reduce per capita vehicle travel. Each 10% increase in urban densities typically reduces per capita Vehicle Kilometres Travelled (VKT) by 2-3%.
Land-use Mix	Degree that related land uses (housing, commercial, institutional)	Increased land use mix tends to reduce per capita vehicle travel, and increases use of alternative modes, particularly walking for errands. Neighbourhoods with

Factor	Definition	Travel Impacts
	are mixed.	good land use mix typically have 5-15% lower vehicle-kilometres.
Regional Accessibility	Location of development relative to regional urban center.	Improved accessibility reduces per capita vehicle kilometres. Residents of more central neighbourhoods typically drive 10-30% fewer vehicle-kilometres than residents of more dispersed, urban fringe locations.
Centeredness	Portion of commercial, employment, and other activities in major activity centers.	Increased centeredness increases use of alternative commute modes. Typically 20-50% of commuters to major commercial centres drive alone, compared with 80-90% of commuters to dispersed locations.
Connectivity	Degree that walkways and roads are connected and allow direct travel between destinations.	Improved roadway connectivity can reduce vehicle kilometres, and improved walkway connectivity tends to increase walking and cycling.
Roadway Design and Management	Scale, design and management of streets.	More multi-modal street design and management increases use of alternative modes. Traffic calming tends to reduce vehicle travel and increase walking and cycling.
Walking and Cycling Conditions	Quantity and quality of sidewalks, crosswalks, paths and bike lanes, and the level of pedestrian security.	Improved walking and cycling conditions increases non-motorised travel and can reduce automobile travel, particularly if implemented with land use mix, transit improvements, and incentives to reduce driving.
Transit Quality and Accessibility	Quality of transit service and degree to which destinations are transit accessible.	Improved transit service quality increases transit ridership and can reduce automobile trips, particularly for urban commuting.
Parking Supply and Management	Number of parking spaces per building unit or Gross Leasable Area (GLA), and how parking is managed.	Reduced parking supply, increased parking pricing and increased application of other parking management strategies can significantly reduce per capita vehicle travel. Cost-recovery parking pricing (charging motorists directly for the cost of providing parking) typically reduces automobile trips by 10-30%.
Site Design	The layout and design of buildings and parking facilities.	More multi-modal site design can reduce automobile trips, particularly if implemented with improved transit services.
Mobility Management	Various programs and strategies that encourage more efficient travel patterns.	Mobility management policies and programs can significantly reduce vehicle travel by affected trips. Vehicle travel reductions of 10-30% are common.

As mentioned in previous sections the effect of individual land-use factors tend to be cumulative and as such each land-use parameter should be measured on its own merits to determine what the reduction in vehicle kilometres travelled is or what the number of person trips will be allocated from the reduction in private vehicle trips to public transport modes.

Nelson/Nygaard (2005) use the results of various studies to develop a model which predicts the impacts of various “Smart Growth” and TDM on per capita vehicle trip generation and related emissions, including land use density, mix, transit service, walking and cycling conditions, affordable housing, parking management and pricing, transit service discounts, and other TDM programs. The results of these studies indicated that significant reductions can be achieved relative to ITE trip generation estimates (or the NDoT trip generation estimated used in South Africa currently).

On inspection of the Table 1, it becomes evident that many of the travel demand impacts are achieved through policy interventions on the land-use planning and urban design realm which lie outside the realm of the TIA process and furthermore, some of the travel demand impacts are difficult to quantify in real terms. For this reason, the New Approach to TOD TIAs sets out to focus on two short-term achievable outcomes as a prerequisite to reviewing land-use applications in TOD precincts:

- Mobility management policies in the form of "*Travel Plans*"
- Measuring or quantifying public transport quality and accessibility per land-use pocket as input to the TIA process

6. ADDITIONAL TIA REQUIREMENTS FOR EVALUATING LAND-USE APPLICATIONS IN TOD PRECINCTS

6.1 Travel plans

The City of London has done extensive work on the assessment and evaluation of development within the City. A process was developed that requires from prospective developers to develop a travel plan in addition to the normal traffic impact assessments that are required. Travel plans are seen as a natural extension to the traffic assessment and needs establish how impacts identified by the traffic assessment are to be addressed.

The traffic assessment therefore has to provide a clear trigger for the undertaking of a travel plan. A travel plan is required to have a realistic purpose. Travel Plans seek not only to reduce vehicle demand created by developments but also to enable and encourage trips to be made by modes other than cars.

6.2 Travel plan content and development process

Amongst other more technical differences between a Traffic Impact Assessment (TIA) and a Travel Plan (TP), the primary difference between these two concepts are that TIAs are generally once-off studies submitted to an authorities to quantify the impact of developments as well as recommend mitigating measures for these impacts, and a TP is an ongoing plan which is designed, implemented, monitored and adjusted as time goes on. The TP development process is characterised by eight stages as shown in Figure 2.

The stages can be briefly summarised as follows:

- Stage 1: Secure Tenant / Senior Management Support by entrenching travel demand management as part of the corporate culture, budgeting, flexible management approaches and incentive schemes.
- Stage 2: Specification of Roles and Responsibilities in particular appointing a "Travel Plan Co-ordinator" responsible for planning, execution and management of the travel plan.
- Stage 3: Undertake a Site and Facilities Assessment to determine what facilities and services are currently available at your site to support travel by different modes, as well as to identify barriers to non-motorised transport use.
- Stage 4: Undertake Staff Travel Survey in order to develop an effective travel plan it is critical to understand how staff travel, from where they travel and what is the motivating factors for their exiting mode choices.
- Stage 5: Undertake Other Travel Audits by recognizing that significant travel demand is generated by their businesses that cannot only be attributed to their staff or employees travelling to and from work. For this reason additional travel audits are required for Business travel, Travel by visitors and Fleet vehicle arrangements.

- Stage 6: Identification of Objectives, Targets and Indicators to specify measurable targets to assess the success of implementation of the plan.
- Stage 7: Identification of Measures – Incentives and disincentives to promote certain travel choices relating to car sharing, using public transport, travelling by non-motorised transport.

Figure 2: Travel Plan Development Process

6.3 <u>Typical thresholds for implementation of travel plans</u>

It is proposed that the revised TOD TIA process requires all land-use development applications to submit travel plans in addition to a normal traffic assessment according thresholds shown in Table 2.

Table 2: Indicative Land-use Development Thresholds requiring Travel Plans

Land use	Use/ Description of Development	Size	Travel Plan
A1 Food and Non-food retail	Retail sale of food goods to the public – food superstores, supermarkets, convenience food stores.	GFA	>800 sq. m
	Retail sale of non-food goods to the public; but includes sandwich bars – sandwiches or other cold food purchased and consumed off the premises, internet cafés	GFA	>1500 sq. m
A2 Financial and professional services	Financial services – banks, building societies and bureaux de change, professional services (other than health or medical services) – estate agents and employment agencies, other services – betting shops, principally where services are provided to visiting members of the public.	GFA	>2500 sq. m
A3 Restaurants and cafés	Restaurants and cafés – use for the sale of food for consumption on the premised, excludes internet cafés (now A1)	GFA	>2500 sq, m

Land use	Use/ Description of Development	Size	Travel Plan
A4 Drinking establishments	Use as a public house, wine-bar or other drinking establishment.	GFA	>600 sq. m
A5 Hot food takeaway	Use for the sale of hot food for consumption on or off the premises.	GFA	>500 sq m
B1 Business	Offices other than in use within Class A2 (financial and professional services) Research and development – laboratories, studios Light industry	GFA	>2,500 sq. m
B2 General industry	General industry (other than classified as in B1). The former ‘special industrial’ use classes, B3 – B7, are now all encompassed in the B2 use class.	GFA	>4000 sq. m
B3 Storage / Distribution	Storage or distribution centres – wholesale warehouses, distribution centres and repositories.	GFA	>5000 sq. m
C1 Hotels	Hotels, boarding houses and guest houses, development falls within this class if ‘no significant element of care is provided’.	Bedroom	>100 bedrooms
C2 Residential Institutions	Hospitals and Nursing homes: Used for the provision of residential accommodation and care to people in need of care	Beds	>50 beds
	Residential Education: Boarding School and training centres	Students	>150 students
	Institutional Hostels: Homeless shelters, accommodation for people with learning difficulties and people on probation	Resident	>400 residents
C3 Dwelling houses	Dwelling for individuals, families or not more than six people living together as a single household. Not more than six people living together includes – students or young people sharing a dwelling and small group homes for disabled or handicapped people living together in the community.	Dwelling units	>80 units
D1 Non-residential institutions	Medical and health services – clinics and heath centres, crèches, day nurseries, day centres and consulting rooms (not attached to the consultant’s or doctor’s house), museums, public libraries, art galleries, exhibition halls, non-residential education and training centres , places of worship, religious instruction and church halls	GFA	>1000 sq. m
D2 Assemble and leisure	Cinemas, dance and concert halls, sports halls, swimming baths, skating rinks, gymnasiums, bingo halls and casinos, other indoor and outdoor sports and leisure uses not involving motorized vehicles or firearms	GFA	>1500 sq. m
Others	For example: stadium, retail warehouse clubs, amusement arcades, launderettes, petrol filling stations, taxi businesses, car/vehicle hire businesses and the selling and displaying of motor vehicles, nightclubs, theatres, hostels, builders’ yards, garden centres, POs travel and ticket agencies, hairdressers, funeral directors, hire shops, dry cleaners	TBD	Discuss with appropriate highway authority

The requirement for a travel plan, irrespective of the thresholds suggested in the above table, should be subject to the discretion of the planning authorities.

6.4 Measurement of public transport accessibility

In Section 5 certain parameters were listed that would result in a reduction of private car usage and subsequent mode shift from private to public transport. However, it is unreasonable to expect that the reduction in private vehicle trips and subsequent mode shift will be the same for all developments within a precinct.

A major additional component to determining the degree of vehicle trip reduction and modal shift pertains to the "friction of distance" related to the walking trip associated with accessing of public transport modes. In other words, the propensity to utilise a public transport mode relates directly to the distance to be travelled on foot to the closest point of access to the public transport mode (i.e. the station, bus stop, taxi rank etc.)

Therefore, vehicle trip reduction (trip-degeneration) should be based on the various land-use and other parameters listed, whereby it is then discounted further by the relative distance to various modes of transport. Similarly, detail and complexity of travel plans should increase as the level of accessibility to public transport stops and services increases.

Therefore, in order to account for the friction of distance and service frequency, transportation planners from a number of countries assess the access level of geographical areas to public transport by means of a variety of GIS-based methodologies. These models could typically be used in determining the necessity for travel plans and their content or the required parking restrictions and development densities. The following models will be discussed:

- Isochronic-based / Cumulative Opportunity Indices
- Gravity-based Indices
- Place Rank Accessibility Measure
- Public Transport Accessibility Levels (PTAL)
- Land Use and Public Transport Accessibility Index (LUPTAI) (Refer to Figure 3)

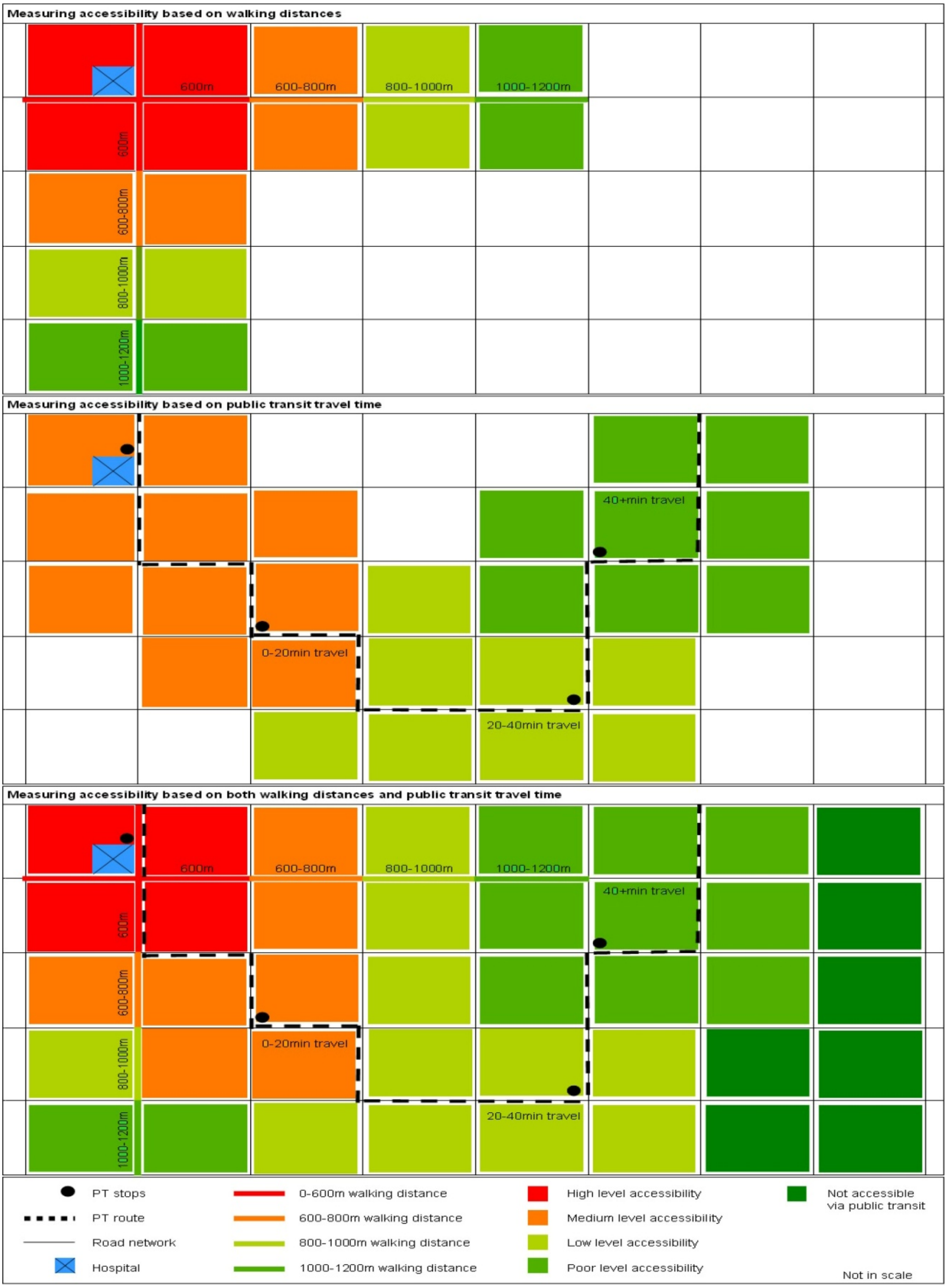
7. CONCLUSIONS

The purpose of this paper was to create awareness of the importance and potential value addition of accessibility measurement and travel plans as transportation and land-use performance management tools within the South African transportation planning environment with specific reference to public transportation precincts. International experience suggests that the importance of understanding accessibility through its measurement as a public transport and land-use planning tool is undeniable.

South Africa is currently undertaking large scale public transport and land-use interventions to the value of billions of Rands. The topic of accessibility measurement, travel demand management (through the introduction of Travel Plans) and transport / land-use system performance measurement should receive equal attention and investment within the public arena in order to ensure that transport system interventions serve to establish a democratised transport system with a high level of accessibility for all.

It is the view of the authors that the mandatory introduction of public transport accessibility indices and Travel Plans to the land-use development and traffic impact evaluation process will have far reaching effects in promoting higher public transport usage, reducing congestion and associated carbon emissions and improving the sustainability of road infrastructure and public transport investment within the South African urban environment.

Figure 3: Example of Calculating a LUPTAI Index



8. REFERENCES

National Department of Transport, (1990). Guidelines for Traffic Impact Studies, Pretoria.

National Department of Transport, (1994). South African Trip Generation Rates (2nd Edition), Pretoria.

National Department of Transport, (1985). Parking Standards (2nd Edition) Pretoria.

Victoria Transport Policy Institute, (2007). Land Use Impact on Transport: How Land Use Patterns Affect Travel Behaviour. Viewed 5 May 2007, <http://www.vtpi.org/tdm/tdm20.htm>

Nelson\Nygaard (2005), Crediting Low-Traffic Developments: Adjusting Site-Level Vehicle Trip Generation Using URBEMIS, Urban Emissions Model, California Air Districts <www.urbemis.com>.

Department of Transport (UK), The travel plan resources pack for employers (2006), Department of Education. Viewed 14 May 2007, < http://www.dft.gov.uk/pgr/sustainable/travelplans/work/resourcepackemployers/>.

Guidance on Transport Assessment, Department of Transport, March 2007

Matthew Pitot, T. Y. (2005). Land Use & Public Transport Accessibility Index (LUPTAI) Tool - The development and pilot application of LUPTAI for the Gold Coast. Brisbane: The State of Queensland.