

Rating the Transport Sustainability of New Urban Developments: a starting point and ways forward

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1 Introduction

Planning agencies across Australia are encouraging land use development forms that create the potential for populations to make shorter journeys, to reduce their reliance on the private motor car and to provide for increased walking, cycling and public transport. Metropolitan strategies are beginning to explicitly recommend increased land use mixing, densification around nodes, as well as a series of urban configurations and built form attributes that are considered conducive to sustainable travel behaviour (Department of Infrastructure (Victorian Government), 2002; Department of Infrastructure Planning and Natural Resources (NSW Government), 2004; Office of Urban Management (Qld Government), 2004). However, not all development proposals display these qualities - or at least not in sufficient measure to suggest they will be superior to previous generations of development.

This paper discusses a project seeking to provide a diagnostic tool to rate the residential travel performance of large urban land use developments. The project aims to measure the extent of travel made and the modes of travel used by residential populations and, with the assistance of accessibility analysis techniques, to use this information as a means to rate the effect of a development's location and design on residential travel. This work is being undertaken to assist in influencing the location and design of urban developments to ensure that their residential travel patterns contribute to sustainability objectives. As a form of shorthand we will refer in this paper to the project as rating a development's 'residential travel performance' for sustainability. The paper discusses current consideration of transport issues within development assessment processes, identifies a gap in current practice and provides meaningful insights as to how a diagnostic tool may be produced.

2 The Planning Problem

It is necessary first to examine current development assessment practice, the emergence of planning interventions such as transit oriented development, and to ask what may be needed to assist planners in identifying the potential of urban development proposals in terms of residential travel performance. An examination of the way in which major land use development proposals are assessed illustrates how little oversight of these matters is presently occurring.

The limitations of traffic impact assessment

A list of the major transport issues assessed within development approvals can be summarised by the main features of a traffic impact assessment (TIA), which are primarily:

- Ensuring streets and access points do not impede the operational performance of motor vehicle movements within or outside the development (including link, intersection and access point design, along with traffic management and signalling),
- Ensuring sufficient on-site parking is provided for motor vehicles,
- Ensuring adequate levels of access for service vehicles, including the issue of off-street loading areas,
- Addressing the potential for public transport provision (especially bus services), if considered relevant to the development,
- Addressing the mobility needs of pedestrians, cyclists, the disabled and others, and
- Ensuring that noise emissions, visual disturbance, run-off and other immediate environmental concerns are addressed, (i.e. see Ashley, 1994; Main Roads, 2000).

These are worthy concerns and their inclusion within planning regimes has generally been successful in preventing traffic-related nuisance resulting from land use development. But a 'gap' can be identified that is not covered by this set of issues. That is, there is little meaningful assessment made of the likely extent and mix of travel that will result due to a development. Only cursory attention, if any, is given to the amount, length and mode of travel associated with the development and the potential of the development to provide for the use of alternative modes. There is simply no efficient and available process or tool to determine the likely travel performance - or even the potential travel performance - that may result.

Land use planning interventions

At the same time a number of planning interventions are being promoted to plan for more efficient, environmentally friendly modes of transport, which can provide both enhanced accessibility and improved mobility. *Transit oriented development* (TOD) advocates more intensive development involving mixed use, higher density buildings and lower parking ratios to facilitate greater use of public transport systems (Markus, 2005). The theory is that more dense and compact development of homes, businesses and stores around public transport stops, in particular rail stations, will cause more people to ride public transport in preference to using motor cars. *New Urbanism* is described in urban design circles as the revival of the lost art of place-making, involving the creation and restoration of compact, walkable, mixed-use neighbourhoods and towns (Leccese, McCormick, & Congress for the New Urbanism., 2000; NewUrbanism.org, 2001). It is often used as a collective term to include concepts such as TOD (Calthorpe & Poticha, 1993), traditional neighbourhood development (Duany et al., 1992) urban villages (Morris, Kaufman, & Qld Dept of Tourism Small Business and Industry, 1996) and responsive environments (Bentley, 1993) and is reflected in the Australian Model Code for Residential Development (Department of Housing and Regional Development., 1995). New Urbanism promotes diverse and compact, mixed-use communities containing housing, work places, shops, entertainment, schools, parks, etc., all within easy walking distance of each other.

These notions are now dominant in much discourse and policy-making, and in specific proposals, in both the transport planning and urban planning fields - though they are not without their sceptics and the base of empirical research measuring their success or otherwise is problematic (see Ewing & Cervero, 2002; Rodriguez & Joo, 2004). A number of New Urbanist design guidelines exist that promote better transport/land use design, such as Western Australia's *Liveable Neighbourhoods* and Queensland's *Shaping Up* (Queensland Transport, 1999; Western Australian Planning Commission, 2000). These include some measures to improve performance, but also fail to assess the likely travel performance of the development. And they are not statutory documents. As a result, the majority of developments - however large - receive minimal scrutiny in terms of their residential travel performance. And opportunities to improve that performance by making changes to either the location or design of development may be lost.

Improving development assessment

Underpinning TOD, New Urbanism and other related planning interventions is the belief that both the location and design of urban developments will reduce vehicular travel, encourage shorter journeys, and increase the utilisation of green transport modes (walking and cycling) and public transport. The *location* (or siting) of a large-scale development in relation to other elements of the urban area, such as shopping or employment centres, is known to influence travel patterns, particularly for trips such as journeys to work (Horner, 2004). The *design* of a development, including such matters as density, land use mixing and connectivity, is also now generally understood to influence travel patterns, especially for local trips such as journeys to shops or to schools (Ewing & Cervero, 2002). By altering either location or design choices, whether via changes to siting and other land use decisions, or via changes to the street network and public transport system, it may be possible to increase the opportunities that future populations will have to access the goods and services they need.

The focus of our project is on providing a tool for planners and decision-makers to evaluate development proposals on their residential travel performance in accordance with these notions. This potential is to be measured through accessibility indicators, for use as land use performance indicators for planning purposes.

An end-product of this research could be used in a variety of specific planning contexts, not only in assessing development proposals directly, but also in testing development scenarios or in the development of structure plans, as demonstrated in Figure 1.

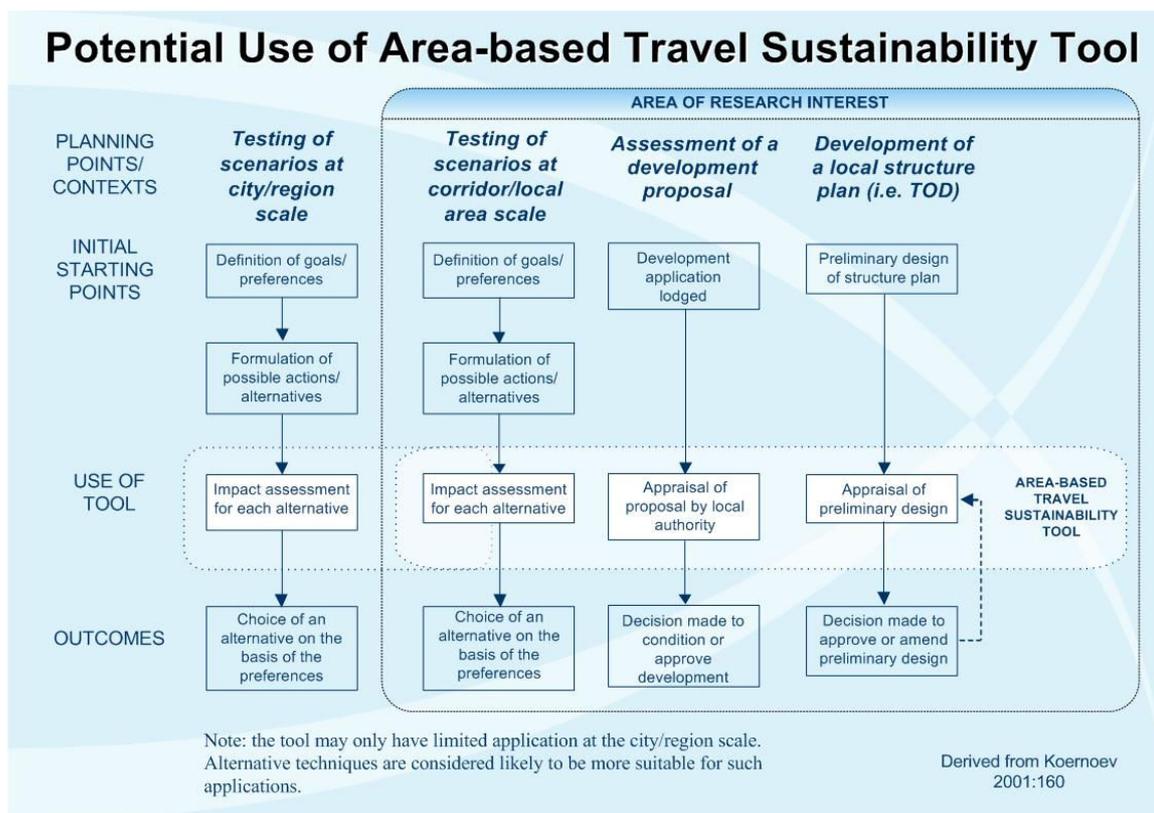


Figure 1. Use of proposed tool in various planning contexts

3 Preliminary approach

We are seeking to develop a process that can provide and display measures of the likely residential travel performance of a development proposal using accessibility analysis. We will do this in a way that can be applied as part of development's assessment/approval process. The output of the research will be a new tool for use by local and state authorities.

A small number of tools have been developed for similar purposes in the past, though their take-up rate has been poor. Previous attempts at developing decision-support tools have focused on only few approaches.

Regression modelling of previous household travel survey and environmental datasets has been used to create tools to estimate the average motor vehicle and public transport use of a development proposal's population (i.e. CMHC, Natural Resources Canada and IBI Group 2000). While the interactions of environmental factors with travel behaviour, identified through statistical regression, can assist in estimating the contribution of *design* to residential transport performance, regression-based approaches unfortunately ignore most of the contributions of *location* and therefore provide only limited value to decision-makers.

Alternatively, accessibility analysis has been used to predict and model future trip patterns created by a development proposal, estimate the amount of travel that is likely to be generated by particular modes and to assess the sustainability of these

developments in terms of travel-related energy consumption and emissions. Perhaps the most valuable accessibility-based tool currently available, the Bartlett School of Planning (2000) *Estimation of Travel, Energy and Emissions Model* (ESTEEM), uses accessibility analyses to predict the trip patterns of purely residential developments for a limited number of trip purposes using an origin-constrained gravity model. While seeking to avoid some of ESTEEM's limitations, we have selected the accessibility-based approach as it allows for interactions between both the *location* and *design* of a development proposal and its residential travel performance to be considered.

Scale

The developments of interest to this research are those that with the greatest contribution to regional residential travel sustainability. This is generally conceived as being residential or mixed-use developments comprising more than 100 dwellings, as well as larger retail, education or commercial developments that service more than just a local catchment. Development proposals at smaller scales generally have less influence on a region's travel sustainability and are not as easily modified to achieve improved transport performance.

Within the set of developments of interest are smaller in-fill mixed use and residential developments, however the principal concerns are master-planned communities, transit oriented developments and large conventional suburban subdivisions.

Use of accessibility analysis

Accessibility can be used as a policy tool in various ways, for instance measuring 'remoteness' (Department of Health and Aged Care & National Key Centre for Social Applications of Geographical Information Systems (GISCA), 1999) or undertaking regional transport and land use planning exercises (Bertolini, le Clercq, & Kapoen, 2005) amongst others. However, quantitative measures of accessibility have had a chequered performance in the history of transport and urban modelling. After reaching a peak in the 1980s, enthusiasm about accessibility diminished because of the difficulty in developing performance measures for city-wide analyses.

Recent advances in computing power and the emergence of Geographic Information Systems (GIS) have changed this. The spatial analysis capabilities of GIS allows for data integration and display that takes into consideration the complex spatial dimension of transport networks and land use locations necessary for use in accessibility planning. This paves the way to re-visit the use of accessibility analysis as a tool for transport and land use planning.

The approach we are currently taking to develop a tool to rate a development proposal's residential travel performance is to estimate the demand for travel that will be generated by the new development, the potential to satisfy these demands within the proposed development (i.e. demands for schooling or local shopping) and the demands that will need to be satisfied, city-wide, outside the development.

We are then seeking to estimate the level of access, by all transport modes, to all potential locations at which these demands may be satisfied. The best means to conceptualise the level of access from an origin to a land use destination has been the subject of considerable academic debate. Generally accessibility measures for transport and land use modelling purposes may be classified into distinct groups, including opportunities measures, location-based measures (such as distance-based and gravity-based measures), and utility-based measures (for further information on accessibility measures see Geurs and van Wee 2004; Halden 2002; Handy and Niemeier 1997).

We require accessibility measures that may assist in modelling travel behaviour and must select measures according to their capacity to best represent trip-making for each trip purpose including at the local scale (i.e. journeys to school) and the regional scale (i.e. journeys to employment). We are presently developing location-based measures, including both distance-based and gravity-based measures, for use within our tool.

This requires marrying *local* land use and transport information in a highly disaggregated form, and at the same time synthesising and analysing *city-wide* land use and transport information available in an aggregated form, of the type more conventionally used in urban transport and land use models in general.

Conceptually this requires the development of data for three specific geographical areas: the area covered by the development itself ('within development') the local area immediately surrounding the development ('peri-development') and the metropolitan area ('city-wide'), as illustrated in Figure 2.

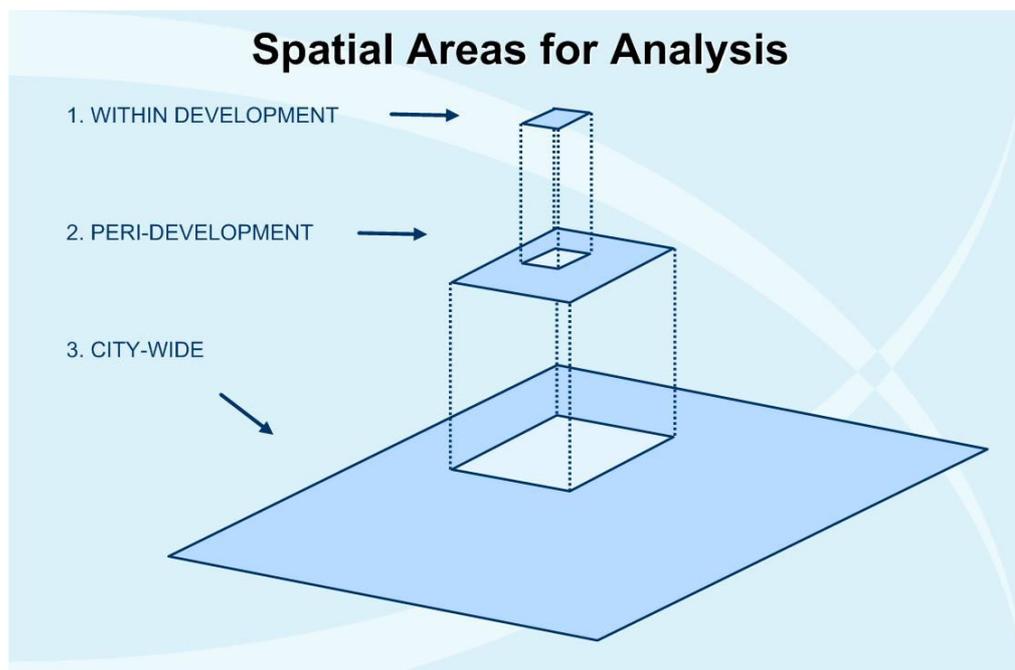


Figure 2. Three geographical areas for analysis

Use of structure plans

As noted earlier, we are interested primarily in proposals of significant size and influence, such as master planned communities, TODs, large subdivisions or in-fill developments. All such developments invariably require a coordinated *structure plan* that provides clear directions as to the location of the critical infrastructure, services and development patterns within the site, as well as the linkages to the surrounding area. Such plans guide the future development of the site into the long term and must generally be approved by local and state authorities prior to development proceeding.

Structure plans normally provide information on the number of dwellings proposed for each lot within the development. And they also provide detail on the proposed location of key services, including fixed public transport sites and routes. The information contained within and developed as part of a structure plan, including street/path networks and land use information, may well be sufficient to provide a rating for the proposal in terms of residential travel performance (based on the outcomes of an accessibility analysis) - if this information can be entered, manipulated and modelled appropriately as the 'within development' element in our model.

4 Issues to be confronted

There are a number of problems that emerge at this point. These include problems involving the complexity of travel demand models, the identification of the set of tests that really matter in terms of identifying differences in travel behaviour across urban environments, the potential use of multiple indices and the issue of calibrating any tool to the city-region for which it is proposed for application. To summarise some of these issues:

- Developing travel demand models is problematic as these require considerable resources in terms of data, computing capacity, modelling capabilities and skill. The outputs of these techniques may be questioned by developers given the number of assumptions and generalisations that underpin them.
- The way in which the public transport system is conceived in the modelling presents numerous issues. While we wish to allow for a range of interactions between land use and mode choice, it is not possible to include for the full range of issues that comprise public transport operations (i.e. locations of stops, routing, service frequencies, travel times, hours of operation, fares, comfort levels). Yet these issues influence mode choice decisions and residential travel performance.
- There is a tension between the number of tests (and therefore the number of variables) included within any model and the complexity of the information eventually provided. Yet it is important that disaggregate tests are performed to identify important impacts for particular groups of people, for particular trip purposes (Halden, 2002).
- It is not yet understood what set of 'tests' really matter in terms of residential travel performance. It is not yet certain which particular population groups, times of day and trip purposes are those that are most sensitive in affecting a development's performance in particular areas. Further research is necessary to confirm which sets of tests the tool should focus upon.

- There is the capacity to investigate residential travel performance in terms of a number of specific indicators. We are interested in the sensitivity of the location and design of developments to such matters as vehicular energy consumption, which relates to both the distance travelled by each travel mode, and to greenhouse gas emissions. Given the recent policy focus towards the health implications of urban environments in terms of transport/land-use relationships to human physical activity we have also determined to include an additional index focused more directly at this concern. Estimating the contribution of location and design to physical activity, defined as human energy consumed during either walking or cycling trips, will be an important contribution of the tool.
- There is a need to calibrate any model to the city-region within which it is proposed for use. This is especially true if decision-makers should seek to use this tool within planning approvals processes. Research is therefore needed to identify what the current levels of accessibility are within these parameters in present urban environments, across a range of varying urban forms and locations, including TODs.

How might it look?

Figure 3, below, suggests a possible output display of the information provided by an assessment, illustrating how a development's attributes may be used to develop multiple indices, and how modelling could be used to identify the impacts of modifications to a development's location or design.

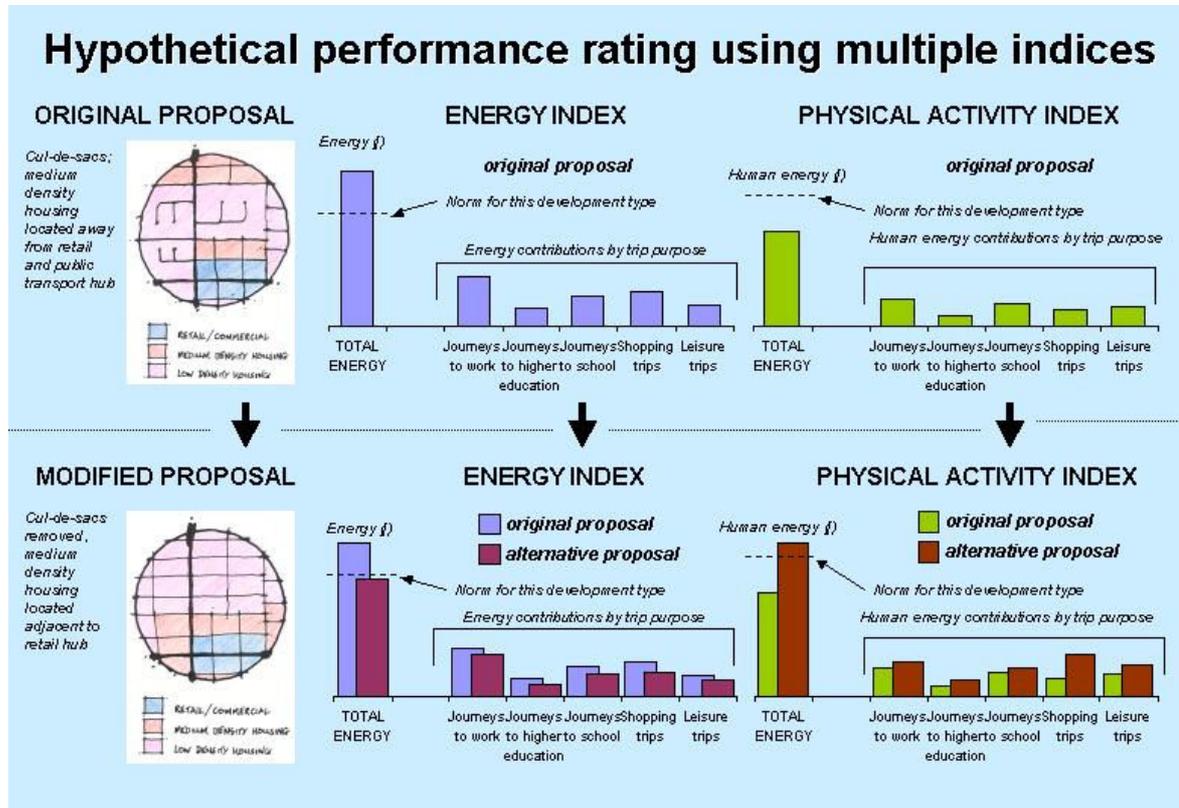


Figure 3. Possible outputs of accessibility analysis

This shows how two separate indices, representing vehicular energy consumption and physical activity, can be used to rate a development proposal. The display provides the energy contributions by trip purpose and the sum total of the energy consumed (across all trip purposes).

When the development proposal is modified, say by introducing a grid-network street system or by including more medium density housing within the development, it is possible to identify changes in energy consumption for individual trip purposes, and in turn in the sum total. In this way, opportunities to modify the development proposal so as to increase its residential travel performance may be identified and tested.

A 'normative' level is also identified in the display that may be calibrated via household travel survey data for developments of a particular type. This may be compared with the development proposal's residential travel performance, if desired.

5 Conclusion

Our project is not seeking to attempt a grand study to identify and measure all the relationships between built form and travel behaviour. We simply seek to produce a means to identify a development proposal's expected residential travel performance, via the process of looking at the contribution of particular trip purposes. And we hope the end-product of our research might also be used as a diagnostic tool to identify means to improve that expected performance.

The project may eventually provide a significant benefit in equipping local and state government planners to respond more appropriately to major urban development proposals. It is also hoped that increased knowledge of land use and accessibility relationships will feed back into future urban policy formulation, through experience of the use of such a tool and experience of the measurable contribution different locations and designs of urban development can make to the achievement of the new imperatives in transport/land-use planning.

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