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Advance transit oriented development typology: case study in Brisbane, Australia

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ABSTRACT

Internationally, transit oriented development (TOD) is characterised by moderate to high density development with diverse land use patterns and well connected street networks centred around high frequency transit stops (bus and rail). Although different TOD typologies have been developed in different contexts, they are based on subjective evaluation criteria derived from the context in which they are built and typically lack a validation measure. Arguably there exist sets of TOD characteristics that perform better in certain contexts, and being able to optimise TOD effectiveness would facilitate planning and supporting policy development. This research utilises data from census collection districts (CCDs) in Brisbane with different sets of TOD attributes measured across six objectively quantified built environmental indicators: net employment density, net residential density, land use diversity, intersection density, cul-de-sac density, and public transport accessibility. Using these measures, a Two Step Cluster Analysis was conducted to identify natural groupings of the CCDs with similar profiles, resulting in four unique TOD clusters: (a) residential TODs, (b) activity centre TODs, (c) potential TODs, and (d) TOD non-suitability. The typologies are validated by estimating a multinomial logistic regression model in order to understand the mode choice behaviour of 10,013 individuals living in these areas. Results indicate that in comparison to people living in areas classified as residential TODs, people who reside in non-TOD clusters were significantly less likely to use public transport (PT) (1.4 times), and active transport (4 times) compared to the car. People living in areas classified as potential TODs were 1.3 times less likely to use PT, and 2.5 times less likely to use active transport compared to using the car. Only a little difference in mode choice behaviour was evident between people living in areas classified as residential TODs and activity centre TODs. The results suggest that: (a) two types of TODs may be suitable for classification and effect mode choice in Brisbane; (b) TOD typology should be developed based on their TOD profile and performance matrices; (c) both bus stop and train station based TODs are suitable for development in Brisbane.

1. Introduction

Transit Oriented Development (TOD) is a relatively recent neighbourhood development model which has been conceptualised as urban development with a combination of nodes (e.g. transit station) and places (e.g. neighbourhood) (Bertolini, 1999; Renne, 2009a). The place criterion has generally been characterised by: moderate to high density development that supports public transport (PT) services at the nodes; a mix of land uses (e.g. residential, commercial, recreational, and institutional) to facilitate and attract activity participation within the places; and well-connected street networks so that activities can be integrated with active transport (AT) (Cervero and Kockelman, 1997; Lin and Gau, 2006). This proximate and connected arrangement of land uses, therefore, reduces the need for motorised travel of people living within a TOD area. However, if people need to travel to access goods and services in other parts of a city (e.g. in other TODs), then they can choose fast, frequent, and well-connected PT services available at TOD nodes. As a result, a TOD is not just a transit station to catch PT services, but it is importantly a place to live, shop, recreate, and socialise. It is a human interaction point and an urban development process characterised by centralised decentralisation (Bertolini, 1999). These qualities of a TOD make PT services a logical alternative to private transport (Bertolini et al., 2009), and as a result, TODs have been identified as a key policy tool to discourage car-based travel to reduce greenhouse gas emissions and traffic congestion, thereby enhancing quality of life, social inclusion, health and well-being (Transportation Research Board, 2001).

The provision of land uses and transport services for a TOD requires long term planning both at the regional and local levels.

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Planning at the regional scale sets the spatial structure of TODs (e.g. hierarchical distribution of transport nodes, link, and activities), whereas local planning articulates the detailed plan and concentrates on the precise contents of land use types, densities and facilities (Bossard, 2002). However, city planning rarely starts from an empty space, and existing land uses are an important determinant of future development (Atkinson-Palombo and Kuby, 2011). Therefore, a thoughtful analysis of today's built environment can ease facilitation of tomorrow's TOD. For example, the formation of overlay zoning in metropolitan Phoenix in 2000 facilitated TOD development after the opening of a light rail transit (LRT) in 2008 – an approach referred to as advanced TOD planning (Atkinson-Palombo and Kuby, 2011).

Zemp et al. (2011) argue that the identification of TOD potential relies on the performance assessment of the existing built environment. However, traditional assessment of the built environment for a TOD employs a binary approach focusing around train stations – i.e. whether a station area is suitable or not for a TOD (see, Bossard, 2002). This approach has been criticised for two reasons. First, it excludes other potential "development oriented transit" sites. Given that TODs are a function of both nodes and places, all neighbourhoods in a city possess some qualities for a potential TOD, irrespective of the availability of train services (Thomas and Deakin, 2008). Second, there is no "one-size-fits-all" approach to TOD development (Center for Transit-Oriented Development, 2010). Researchers are increasingly recognising that TODs can take a variety of forms (Belzer and Autler, 2002); and individual TODs can serve different but complementary functions within a system (Atkinson-Palombo and Kuby, 2011). Therefore, the question is not whether a site is suitable or not, but rather for what type of TODs (if any) or not. Belzer and Autler (2002, p.30) argue that "it may be possible to develop a general typology of places to account for a variety of different scales (large city, small city, town), locations in the metropolitan area (central city, peripheral city, commuter town), transit type (commuter rail, frequent light rail), and other key attributes".

Few studies to date have empirically identified TOD typology in a quantitative way, despite the many associated benefits (as discussed in Section 2.1). Most of the previous classifications are based on subjective evaluation criteria of the context in which they are built (e.g. city centre, activity centre, specialist, urban, suburban, neighbourhood, commuter town centre, residential) (Calthorpe, 1993; Dittmar and Poticha, 2004; Queensland Government, 2009). These types of classifications provide for specialist functions for TODs, yet fail to take into account the built environmental characteristics that surround the TOD. As such, this generalisation of TOD functions based on subjective judgment may not be an accurate guide to the design and building of TODs (see for example, Schlossberg and Brown, 2004). We argue that a careful selection of built environmental factors and their standards for different areas in a city provide an important context for TOD development to supplement and inform a more generalised approach to a TOD typology.

The need for further research to develop typologies for TODs has also been highlighted in the literature (Jenks, 2005). Unlike train station based TOD typologies of previous studies, research has identified that TODs are equally effective in cases of bus and train services, and in particular in cities where bus rapid transit (BRT) systems operate (Kamruzzaman et al., 2013). In addition, previous studies rarely validate their generated typologies using performance indicators. Belzer and Autler (2002) have mentioned that despite having good place and node characteristics, many TODs do not function well (when measured by performance). As a result, the typology needs to be verified based on TOD outcomes (e.g. mobility choices, transit ridership, auto ownership, transportation costs, vehicle miles travelled (VMT), journey time to work, shop within the same neighbourhood) (Center for Transit-Oriented Development, 2010; Renne, 2009b). Although TOD typologies have traditionally been derived from existing built environment indicators, TODs are actually planned well in advance (for example, the case in Phoenix) (Atkinson-Palombo and Kuby, 2011). Different types of TODs should be planned as a part of the strategic future of a city, and incorporated into the long term vision. As a result, TOD typology planning cannot only be based on environmental indices because the future environment of an area is not known for planning; but should be based on other policy indicators as well – indicators that are readily available and can be projected to plan for future TOD typologies.

Based on the above discussion, the objective of this research is threefold: first, to develop a typology for existing neighbourhoods in order to understand the potential for different types of TODs in Brisbane, Australia; second, to validate the typologies with performance indicators; and third, to support the planning of advanced TOD typologies based on readily available policy indicators. Section 2 reviews the literature on the typology of TODs, aiming to develop a robust method for the development of typologies of neighbourhoods for TOD potential using Brisbane as a case study. The data and method used to derive and validate the typologies are discussed in Section 3. Results of this research are presented in Section 4, and Section 5 concludes, with implications for urban policy.

2. Literature review

2.1. TOD typology and their benefits

Developing a typology is a way to group together areas that have a common set of characteristics. Therefore, a TOD typology contains several combinations of node and place types, and all of the areas within one combination have some elements in common (Center for Transit-Oriented Development, 2010). Categorisation of TODs into typologies enhances their planning, design, and operational activities in many ways. For example, the similarities within a type allow policy makers and stakeholders to create common sets of strategies to plan or to improve performance (e.g. gentrification might be an issue in urban but not suburban TODs) (Center for Transit-Oriented Development, 2010; Jenks, 2005; Reusser et al., 2008). Classifications also support the identification of general development potentials and necessary future adaptations of whole classes and within classes. Each TOD type has a desired density, land-use mix, connectivity, and transit system function, and therefore, the typology supports the design of an optimal TOD at a given site (Zemp et al., 2011). As a result, the typology helps answer questions such as "what mixtures of uses will optimize effective mixed-use development and support location efficiency under specific conditions (for example, in areas with different levels of density)?" or "what densities and level of transit service are necessary?" (Belzer and Autler, 2002). The answers to such questions are important for effective TOD planning and design. For example, increased density has the potential to increase ridership but at the same time degrades social equity and quality of living, and therefore, a balance between these factors are important for a successful TOD (Lin and Gau, 2006). Classification also reduces management complexity for infrastructure companies by enabling the application of standards in operations and development, and securing consistency of actions across large portfolios and geographic regions. Similarly, it enables the identification of sites and actors with comparable challenges or experiences for spatial planning. Classification enables comparisons and performance assessments within the station classes, identifying successful benchmarks or highlighting needs for action (Zemp et al., 2011). Without a benchmark there will be no way to judge the quality