

Scientometric Analysis and Mapping of Transit-Oriented Development Studies (1994–2018)

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Abstract

The contemporary debate and research on transit-oriented development (TOD) has continued to progress within the context of sustainable development. At its core, this refers to providing essential transit services with an efficient manner which is achieved by including accessible public transport, mixed land use, and walkable neighbourhoods so as to reduce the volume of private cars on the road. We have analysed the theoretical development of TOD studies. Based on a scientometric analysis, this paper has collected 442 TOD articles through the Web of Science and used VOSviewer to visually map and analyse four main topics of TOD studies, including “correlation among TOD, smart growth and land use”, “TOD financing and the impacts of TOD on housing price”, “impacts of TOD on travel behaviour”, and “correlation among TOD attractiveness, accessibility and ridership”. And we also provide the current status of research and implications for Australia

1. Introduction

Many cities face issues relating to traffic congestion and pollution which are mainly a product of the majority of citizens using private cars as their primary means of transport. Transit-oriented development (TOD) is an important strategy for sustainable urban development, which refers to redevelopment neighbourhoods around major transit stations with mixed land use, job opportunities, high-density and walkable environment design. Convenient and accessible transport systems have the ability to meet people’s travel needs whilst simultaneously reducing the utilisation of private cars. In addition, mixed land use around train stations satisfies the demands of people in terms of recreation and access to other essential services (Ratner & Goetz, 2013). Now, TOD is one the most common urban development strategies for urban growth, especially in metropolitan areas. Each TOD serves as a node in a transit system for a city, often with different characteristics and functions. This paper analyses the main topic distributions of TOD, and the current status of research and implications for Australia.

2. Methodology

The SCIE and SSCI citation index database in the Web of Science (WOS) Core Collection were retrieved as the data sources of this study. A total of 442 pertinent publications were collected, and the latest update of the data was on August 30, 2018. The retrieved results were saved as a “Plain Text” with “Full Record and Cited References”. The VOSviewer based on VOS method (Van Eck & Waltman, 2007) was used to create knowledge domain maps of TOD studies by means of co-authorship analysis and co-occurrence analysis.

There is plenty of literature suggesting that there is a positive relationship between rail transit and housing values across all housing types. Although housing is a way of sustaining TODs, the question is how to balance economic concerns with social equity, and avoid gentrification.

3.1.3. Cluster 3 (blue): the impacts of TOD on travel behaviour

(The co-occurrence keywords: built environment, health, land use, obesity, physical-activity, residential self-selection, travel behaviour, urban form, walking)

Existing research on TODs primarily focus on how the built environment and self-selection impact on people's travel behaviour. TOD walkable neighbourhood encourages physical activity and has positive impact on general health, such as helping to reduce obesity and high blood pressure.

3.1.4. Cluster 4 (yellow): correlation among TOD attractiveness, accessibility and ridership

(The co-occurrence keywords include: accessibility, mode choice, and ridership)

Existing literature on the accessibility of TODs' primarily focused on the spatial analysis from the urban scale down to the neighbourhood level. Increasing the attractiveness of rail station TODs to attract better ridership refers to strengthening the surrounding built environments and increasing accessibility at the station level.

3.2. The current status of research and implications for Australia

Australia ranks third in the Top-10 countries in terms of productivity in TOD studies, accounting for 40 papers and 8.5% of the total number of global TOD studies. Nevertheless, just 29 of these papers present local Australian research. According to the four clusters of major research focus, 12 papers (41.4%) focus on Cluster 1: correlation among TOD, smart growth and land use (Yang & Pojani 2017; Hendrigan & Newman 2017; Mees 2014; Curtis 2012; Newman & Kenworthy 1996; Cervero & Sullivan 2011; Olaru, Smith & Taplin 2011; Oakley 2014; Sipe & Burke 2011; Huang, Xing & Pullen 2017; Nawaz, Somenahalli & Allan 2017; Dovey, Pike & Woodcock 2017). Among these, some interesting findings include: Cervero & Sullivan (2011) proposed a concept of Green TOD and compared experiences in Sweden, Germany and Australia. Olaru, Smith & Taplin (2011) found heterogeneity attitudes of residents in housing characteristics, urban facilities, and transport aspects; Oakley (2014) conducted research on the waterfront redevelopment of TOD; Sipe & Burke (2011) studied a Ferry TOD based on local geographic conditions; and Huang, Xing & Pullen (2017) developed a TOD and energy consumption modelling framework.

31.0% of Australia's TOD studies (nine papers) have a focus on Cluster 3: the impact of TOD on travel behaviour (Kamruzzaman et al. 2013a; Kamruzzaman et al. 2013b; Botte & Olaru 2012; Kamruzzaman, Baker & Turrell 2015; Griffiths & Curtis 2017; Olaru & Curtis 2015; Kamruzzaman et al. 2015; Kamruzzaman et al. 2016; Johnson, Andrews & Warner 2017). The majority of these illustrated land use and travel behaviour. Griffiths & Curtis (2017) and Olaru & Curtis (2015) studied travel behaviour and accessibility but placed a greater emphasis on travel behaviour. Johnson, Andrews & Warner (2017) identified transport challenges facing outer suburban residents. Although no published research has been found addressing housing prices, one paper developed a Transit Tax Increment Financing framework for TOD (McIntosh, Trubka & Newman 2015). Thus, Cluster 2: TOD financing and the impact of TOD on housing prices accounted for 3.5% of Australia TOD studies. Additionally, some studies of travel behaviour mentioned accessibility, although there is less research focused on Cluster 4: the correlation among TOD attractiveness, accessibility and ridership.

24.1% of Australia TOD studies (seven papers) focused on other dimensions. Two different

research projects concentrated on the application of TOD projects. Martin & Rice (2014) analysed the deficiency in infrastructure investment for TOD projects; Searle, Darchen & Huston (2014) discussed obstacles to TOD implementation and key factors contributing to a successful TOD. Furthermore, (Kamruzzaman et al. a 2014) examined relationships between social capital and TOD. Kamruzzaman et al. (2014) also conducted a TOD typology study on Brisbane. Barter (2011) analysed parking requirements in several major Asian cities and argued that these are specifically relevant to North America and Australia. Moreover, Nematollahi, Tiwari & Hedgecock (2016) focused on attitudes concerning a desirable urban density by residents. Lastly, Kamruzzaman, Deilami & Yigitcanlar (2018) looked closely at the heat island effects of TOD.

In summary, 41.4% of TOD studies in Australia focus on the correlation among TOD, smart growth and land use; 31.0% on travel behaviours, 3.4% on TOD financing and 24.1% on other dimensions (such as social capital and heat island effects). While several studies mentioned accessibility, a greater number focused on travel behaviours, though rarely on housing factors of TOD. It should be noted that Australia is different from Europe in terms of its high traffic density, and also from North America where TOD is more likely to occur. Australia has low-density environment suburbs and many local people are opposed to the idea of TOD. Given the above, future TOD studies in Australia should look at TOD site selection and the detailed improvement of existing TOD projects. One or two good examples can become exemplars that help local people to gradually accept this new lifestyle, particularly with regard to gaining support amongst the younger generation. Additionally, strong government intervention is essential, especially in terms of providing public transit infrastructure and in developing density in a supportive way.

4. Conclusion and future work

The scientometric analysis presented in this paper analysed TOD studies with annual article distributions for identifying four major clusters. After providing an overall review of previous literature, we found that strong policies are essential for improving the performance of TODs. There is limited research working on the relationship between schools and TODs, and health dimension of TODs. Similarly, future TODs should involve hospitals and other relevant facilities to benefit a future aging demographic world which potentially helps deal with older driver challenges. In addition, targeting different age groups, meeting their associated housing needs represents a big gap in the literature in need of further study. Moreover, the specific improvements of TODs are imperative for increasing their performances, such as elements of station characteristics, more transit bus services nearby, and limited parking supply. Due to various geographic contexts, more improvements need further validation. Furthermore, as autonomous vehicles become a future trend, there are issues about how to involve it into the design of future TODs. For example, autonomous community feeder buses could be deployed to increase the accessibility of micro-transit. Another topic of growing importance is sharing bikes, which could help expand the traditional catchments of TODs. For Australia context, this literature review raises some questions below:

- How the success of TOD in Australia context can be measured considering specific characteristics of local projects and local planning legislation;
- How some advanced methodologies like behavioural theory or micro-economics can be applied to validate the success of TOD projects;
- Is it possible to develop an applicable toolkit to measure TOD success in order to assist planning practitioners or developers; and how we can suggest an integrated framework

that brings all stakeholders (government, developers, public etc) together to achieve highest shared benefit.

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