# TOD Decision Support Tool

Werner Pretorius
werner.pretorius@aecom.com

# TRANSPORTATION 2021 CONFERENCE
# TOD Decision Support Tool: Practice Paper

**(This paper has not been peer reviewed)**

## Introduction

A key goal of urban and regional planning is to better utilise the land around stations for housing, employment and other urban functions. In the last decade, the 'First and Last Mile' problem around transit stations and Transit Oriented Development strategies have increased in popularity. With the increasing focus on housing shortages and sustainability in recent years, these ideas are becoming more important as transit stations provide an opportunity to tackle these problems.

In an urban context, one of the most universally agreed approaches to achieving a sustainable transport system is the integration of land use and transport planning. As local or central government have limited power to develop land themselves, 'integrated transport and land use planning' involves influencing development to achieve overarching goals through enabling higher levels of development in the right places, restricting development in the wrong places, and further encouraging development in places with good transport access (i.e. Transit Hubs). Whether labelled 'Transit-Oriented Development' (TOD), 'Accessibility Based Planning' or 'New Urbanism', the underlying premise is the encouragement and enablement of environmentally friendly habits - such as the use of Public Transport or Active Transport – through enabling and planning for higher-intensity development near urban centres and transit hubs.

This integrated sustainable development approach – whether labelled Transit Oriented Development (US context), or simply Railway Station Redevelopment (EU context) – offers exciting opportunities to address various transport and land use issues simultaneously.

Investment and energy put into improving the 'performance' of transit stations provides an opportunity to increase housing supply, and offers wider opportunities to improve public spaces, active travel and the station area 'ecosystem' of economic activity around these hubs.

The relationship between transport options and land use surrounding transport hubs is strong; it has direct and indirect influences on sustainable mobility. Well-functioning and sustainable urban environments surrounding transit hubs have high quality first and last leg connections, multimodal access and ample facilities to foster sustainable travel. Transit Stations are about more than just movement; the place value around a station is also critical to its success. The density and diversity of land use activities should dance with a level of transport access, creating a place where home, work, and play converge and integrate seamlessly.

Quality transit hubs are more than just the station, tracks and timetables. Although useful and necessary, that's just the building blocks. Quality transit hubs don't just happen organically; it requires relentless cross-sector integration between movement and place extending beyond the immediate station facilities. A transit hub is a place where different modes of transportation meet and a variety of urban activities take place - if we plan for them. Improving the integration between the low-carbon transport network and the urban space and its land uses can be very rewarding for decarbonising transport in various direct and indirect forms (Ye et. Al 2018; Smart Growth America 2020; Ministry of Housing and Urban Development 2020).

## New Zealand Context

Despite all the opportunities available and the international consensus on the efficacy of TOD, adoption in the New Zealand context has thus far been limited. One reason argued is that the land use legislation in New Zealand is limiting and the planning practices are fragmented with a considerable amount of governance and institutional barriers, making delivering better outcomes

through integrated planning challenging (Murray & Weerappulige n.d.; Ministry for Housing and Urban Development 2020; Ministry for the Environment & Ministry of Housing and Urban Development 2020).

More recently, the National Policy Statement on Urban Development 2020 came into effect, unlocking the potential for a new era, where height and density can reflect the level of accessibility of transport. This change triggered the need to develop more structured and integrated decision making to work together seamlessly despite all our governance and institutional differences.

## Objective:

The paper explores how New Zealand could use a 'decision support tool' developed in the Netherlands to better understand the transport and land use deficiencies and opportunities at key transit hubs.

The present research focused on two main objectives:

(i) Review the 'decision support tool' developed in the Netherlands

(ii) Explore if the 'decision support tool' developed in the Netherlands would work in New Zealand

## Review the 'decision support tool' developed in the Netherlands:

In a North Holland context, a so-called 'Butterfly Model decision support tool' was developed to streamline integrated decision making and to advance land use and transport planning and investment surrounding transit hubs.

The model aims to measure and better understand the relationship between the transport network (movement) and land use (place), their functions within the public realm and how to shape multi-modal transport and planning policy interventions.

The relationship between transport and land use surrounding transport hubs is strong, however there are some more subtle and complex facets to this relationship which are often poorly understood. Figure 1 below provides some of the more obvious direct and indirect influences.

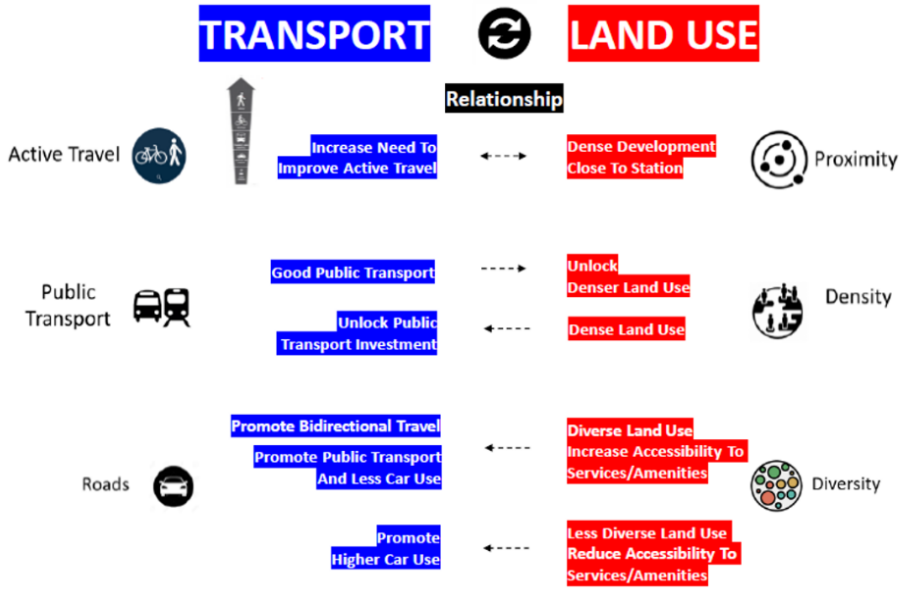


**Figure 1:** Basic Transport and land use interactions

The ‘Butterfly Model decision support tool’ is centred around creating a butterfly radar plot underpinned by quantitative transport and land-use data. Shown in form of movement and place metrics. Figure 2 below provides an overview of how the transport and land use metrics are segmented.

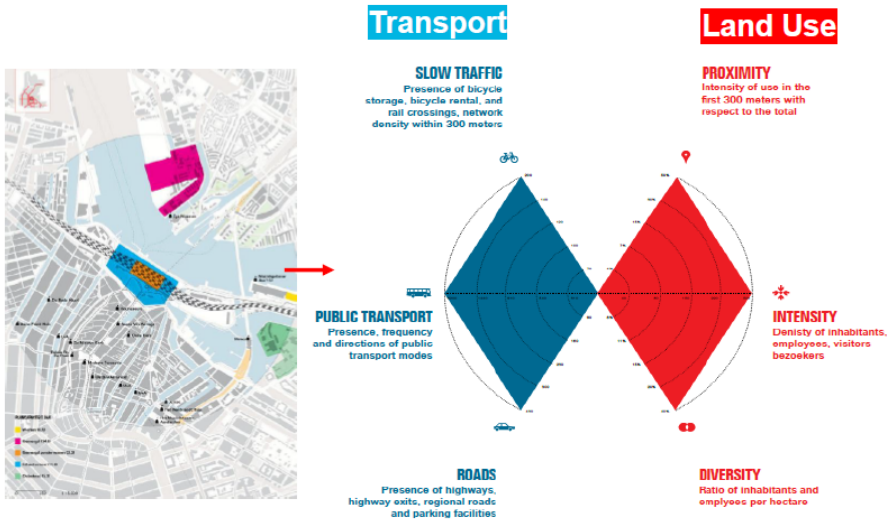


**Figure 2:** Butterfly Model – Maak Plaats

The basic idea of the 'butterfly model’ has been developed to obtain a greater understanding of three distinctive features for multimodal transport and three distinctive features on place or physical space.

The transport value of a station in the butterfly model is quantified using indicators to measure the value of the public transportation network, road network and slow traffic network (active modes). The land use value of a station in the butterfly model is quantified using indicators to measure the value of the inhabitants, employees and visitors in the form of proximity, density and diversity.

The butterfly model positions these six characteristics in relation to each other with the movement value on the left wing, and the place value on the right wing. The butterfly functions best when both wings are in balance with each other, particularly the ‘Density’ and ‘Public Transport’ parts of the diagram.

Ensuring clear separation of these metrics means that identification of deficiencies can be pointed; for example, measuring public transport by looking at number of jobs reachable within a timeframe may indicate deficiencies in land use on other parts of the network, not necessarily poor quality public transport at the hub in question.

To obtain a greater understanding of how it can be applied at a station, corridor and strategic level, Figure 3, Figure 4 and Figure 5 below provides an overview of how it was applied in the Netherlands.

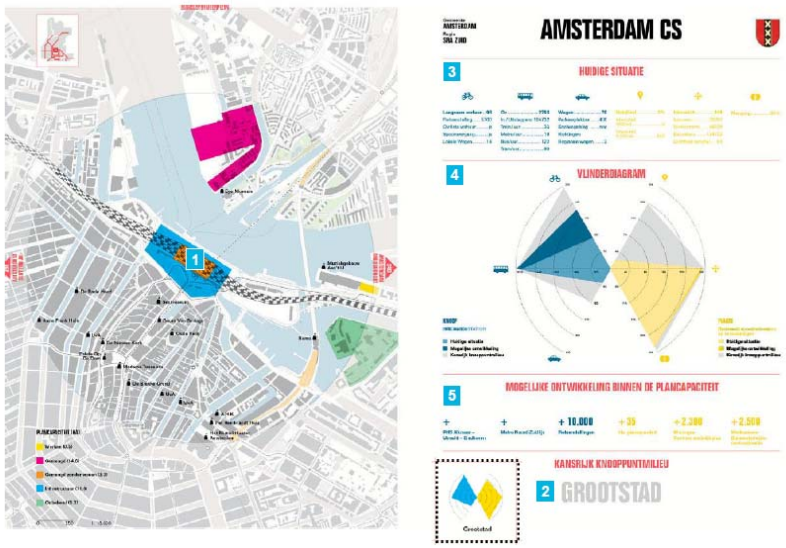


**Figure 3:** Application of Butterfly Model on Amsterdam Central Station (Provincie Noord-Holland & Vereniging Deltametropool 2013).

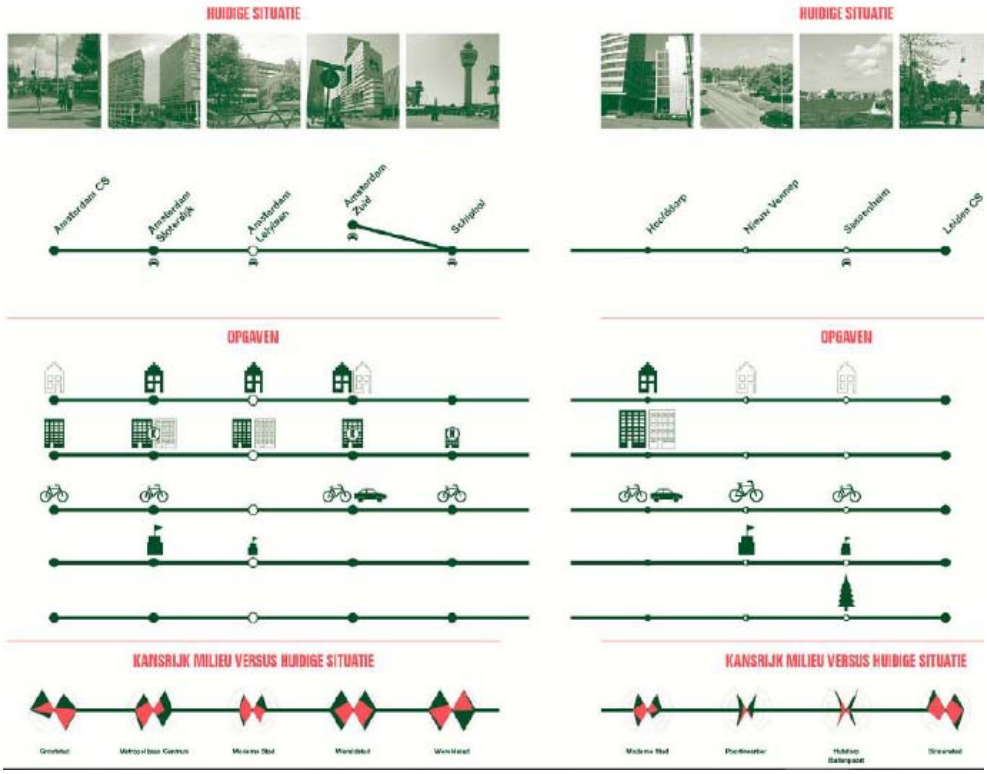


**Figure 4:** Application of Butterfly Model on a corridor level (Provincie Noord-Holland & Vereniging Deltametropool 2013).

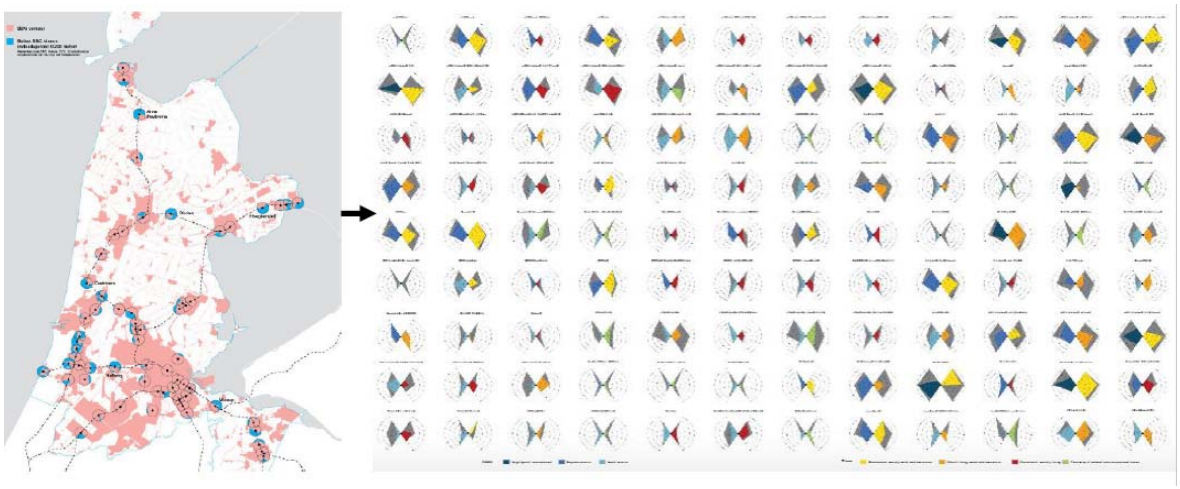

**Figure 5**: Application of Butterfly Model on a strategic level (Provincie Noord-Holland & Vereniging Deltametropool 2013).

The ‘strategic level’ scale has a focus on a wider strategic and economic agenda typically managed by regional bodies or at the Council level with different scales of housing and infrastructure delivery. For the ‘corridor level’ scale, the emphasis is placed on the operational efficiency of an individual transit route which is generally operated through franchise agreements and likely crosses multiple regions. At a ‘local planning’ level, planning practices are more complex with various stakeholders involved, such as local district councils, unitary authorities, developers, the public, business communities and planning practitioners.

## Butterfly Model applied in New Zealand Context

One of the primary concerns about applying the Butterfly Model in the NZ context is the availability of suitable data. Given the volume of quantitative transport and land-use datasets required to produce these indicators, a large part of this research focused on finding suitable datatypes to measure the transport and land-use value of transit stations.

One of the significant findings to emerge from the research is that NZ has ample data available to reproduce a similar study with modification. In fact, the data available allows for improvements to the model, and adjustments to better reflect the NZ context; these contextual adaptations to the model were made in first attempts at applying the model in NZ.

While the land use metrics remain largely unchanged, some of the transport indicators need adjustment to reflect the NZ context. One of the overarching differences is that the original study covers a region with multiple cities and towns with a focus on intercity rail stations, where distances between adjacent cities and towns is smaller and travel between towns and cities for work is common. The application in NZ focuses on Rapid Transit networks in urban areas that cover significantly more population and area. This means that intercity rail and long-distance car access become less important, and levels of local accessibility and frequent PT networks have more emphasis. Another key difference is the state of active modes infrastructure in New Zealand; where the Dutch can measure cycling accessibility by measuring the density of all local streets (as nearly all streets are designed to be cyclable), a more precise measurement only counting safe cycling infrastructure needs to be applied here.

**Figure 6** below provides a snapshot of applying the Butterfly Model on Britomart Auckland using local data.

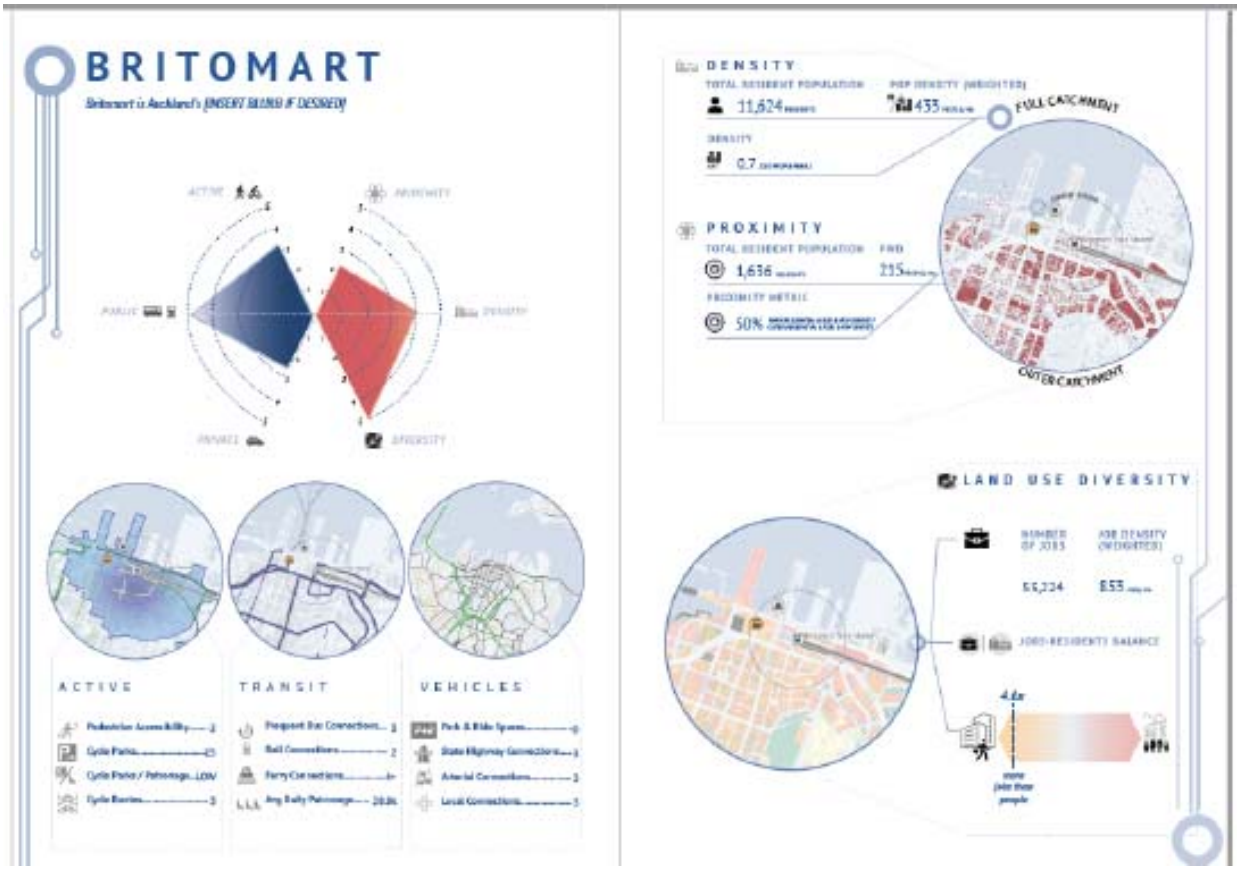


**Figure 6:** Application of Butterfly Model on Britomart Auckland (credit: Fred Smithers)

## Conclusions

Final consideration and conclusions of this paper are the following:

- Improving the integration between the network and the urban space around transit hubs can be very rewarding for decarbonising transport in various direct and indirect forms
- The 'decision support tool' developed in the Netherlands (butterfly model) seems to have many synergies useful to understand the relationship between the transport network (movement) and land use (place), their functions within the public realm and how to shape multi-modal transport and planning policy interventions,
- With the National Policy Statement on Urban Development 2020 coming into effect, the butterfly model shows potential as a tool to support decision-making on land use-transport integration
- One of the significant findings to emerge from the research is that NZ has ample data available to reproduce similar studies

In sum, despite all the perceived limitations and barriers, the application of the Butterfly model in a NZ context is within reach and is a superb tool to support the NPS-UD Intensification Process and delivering better outcomes.

It offers exciting opportunities to improve the understanding, evaluation and integrated planning for transit stations and provides useful insights into the planning processes required for decarbonising transport, orchestrating sustainable and integrated planning. While not a panacea, tools such as this are critical for getting the most out of our transport investment and delivering good outcomes in our urban areas.

## References

Ministry for the Environment and Ministry for Housing and Urban Development 2020, *Regulatory Impact Assessment: National Policy Statement on Urban Development*, viewed on 21 April 2021, https://environment.govt.nz/assets/Publications/national-policy-statement-urban-development-regulatory-impact-statement.pdf

Ministry of Housing and Urban Development 2020, *Improving how our cities respond to growth to enable improved housing affordability and community wellbeing,* viewed 23 April 2021, https://www.hud.govt.nz/assets/Urban-Development/NPS-UD/National-Policy-Statement-on-Urban-Development-expected-outcomes.pdf

Murray, A. & Weerappulige, A. 2021, *Transport challenges – how integration of land use and planning can lead to carbon neutrality,* viewed on 23 April 2021, https://www.beca.com/ignite-your-thinking/ignite-your-thinking/march-2021/transport-challenges-how-integration-of-land-use

Smart Growth America, 2020, Driving Down Emissions: Transportation, land use, and climate change, viewed 22 April 2021, https://smartgrowthamerica.org/wp-content/uploads/2020/10/Driving-Down-Emissions-FINAL.pdf

Ye, Y., Wang, C., Zhang, Y., Wu, K., Wu, Q. and Su, W. 2018, 'Low-Carbon Transportation Oriented Urban Spatial Structure: Theory, Model and Case Study', *Sustainability,* vol 10, no. 19.