INTRODUCTION: PURPOSE AND NEED FOR A TOD RATING SYSTEM

Planners and policymakers working to encourage high-performing transit-oriented development (TOD) that can effectively reduce driving and increase transit ridership have long been working to understand what factors best predict the performance of TOD. The task is even more difficult for those who want to ensure that TOD simultaneously improves social equity. The Dukakis Center for Urban & Regional Policy at Northeastern University, Reconnecting America, and the Center for Neighborhood Technology (CNT) worked in collaboration to create a rating system that measures the capacity for equitable TOD within a transit station area.

Unlike rating systems that assess the quality of individual TOD projects, this proposed eTOD Score rating system seeks to measure the capacity for equitable TOD within a given public transit station area. It identifies easily quantifiable and comparable built, social, and transit attributes that reduce driving, encourage higher transit ridership, and promote transit equity and accessibility.

This research focuses on daily household Vehicle Miles Traveled (VMT) as the key performance metric for transit-oriented development and sees areas with already low VMT as optimal locations for TOD. The eTOD Score was piloted in Massachusetts, where household VMT data was available for use in analyzing which attributes to include in the rating system and in validating the resulting rating system.

The resulting rating system—as well as each of its three sub-scores—has a very strong and inverse relationship to VMT, so regions without available VMT data can adopt this rating system with confidence that it accurately predicts which station areas are likely to demonstrate the best TOD performance as measured by reduced household driving.

CONSTRUCTING THE eTOD SCORE RATING SYSTEM

The eTOD Score rating system is based on the concept that successful and equitable transit-oriented development should focus on all three of the words in the acronym TOD:

- The availability, quality and use of public transit (as well as other non-automobile means of transportation);
- Orientation toward “transit-oriented neighbors” who make up the core of transit ridership;
- The characteristics of development in the neighborhoods surrounding the transit station.

The rating system was built by evaluating different metrics to characterize each of these areas (Transit, Orientation, Development). The goal was to generate a rating system that allows for comparisons of station areas across the region, while also identifying the strengths and opportunities presented within individual station areas.

Transit metrics capture the frequency of service, quality, and use of the available public transportation network, factors that have been shown to influence the success of TOD. Transit service, for example, needs to be sufficiently frequent, fast, and connected to useful destinations. The better the quality of transit, the more interested residents are in making use of the service, resulting in decreased driving.

The least-understood word in the phrase TOD, “Orientation,” raises the question, “What or who is TOD oriented toward?” The Dukakis Center’s research supports the conclusion that TOD should be oriented toward those most likely to use transit, a group the center calls “core riders.” If both “Transit” and “Development” are oriented toward core riders, the resulting TOD would be both high performing and equitable.

The orientation element of this equitable TOD framework builds on prior research identifying a set of “core riders,” i.e., demographic and socioeconomic groups who are over-represented among transit riders compared with their proportion of the population. Core riders are important to TOD performance because they have been demonstrated
both to drive less and use transit more. Station areas with more of these “transit-oriented neighbors” are more likely to produce the travel characteristics associated with successful TOD. At the same time, a number of the socioeconomic and demographic groups who constitute a disproportionate share of transit users are also important from an equity perspective, so ensuring that TOD is “oriented” toward these groups also ensures that the TOD will further the objectives of equitable regional development.

As for development and the built environment, proximity to a station in and of itself does not necessarily encourage less driving or more transit use, which is why some nearby development is simply transit-adjacent rather than transit-oriented. Elements of the built environment, such as walkability and density, can influence the travel choices of both residents and visitors of the station area. This rating system incorporates measures of the types of development in the station area that encourage less driving.

MEASURES

The eTOD Score was piloted in Massachusetts due to the availability of household VMT data for validation. The Massachusetts Bay Transportation Authority (MBTA) transit system mainly consists of three different modes: commuter rail, rapid transit, and bus routes, which allow for the development of a rating system that applies to different types of transit.

All MBTA rapid transit stations as well as select bus stops on high-frequency “key routes” were included in the construction of the eTOD Score. In total, we analyzed 345 station areas, including 276 rapid transit station areas and 69 bus stop areas. Neighborhoods outside of the station areas are not eligible for rating under this system.

Following extensive analysis of a variety of potential scoring attributes, 10 station area attributes (see Figure 1) were selected for inclusion in the rating system based on their relationship to VMT and were divided among three different subscales. In order to create an easily understandable rating system, each attribute received a score of up to five points (for a total possible rating of 50 points across the 10 measures). Points are assigned based on the quintile distribution of that attribute across all of the transit station areas in the system. Those in the lowest quintile received one point, with one point added per quintile, for a maximum of five points.

Transit Subscale

The three selected measures that constitute the transit subscale are:

- **Transit Accessibility**: The Transit Access Shed Index (TAS), developed by the CNT, is a 100-point scale that calculates the size of the area that passengers who board at a given station area can easily access using transit in 30 minutes, scaled by the frequency of transit service at that station;
- **Transit Connectivity**: The Transit Connectivity Index (TCI), also developed by the CNT, is a 100-point scale measuring access to and the frequency of transit service at a bus or rail stop location and within the surrounding neighborhood;
- **Transit Use**: Transit use is considered as non-automobile commuting, measured as the percentage of workers who use transit, bike, or walk to work in the station area, as reported by the American Community Survey (ACS).

Transit ratings for MBTA station areas vary from a low score of 3 (in the bottom quintile of station areas for all

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**FIGURE 1**

Final eTOD Score Attributes

<table>
<thead>
<tr>
<th>Category</th>
<th>Metric</th>
<th>Measure</th>
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<tbody>
<tr>
<td>Transit</td>
<td>Transit Accessibility</td>
<td>Transit Access Shed Index (TAS)</td>
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<td></td>
<td>Transit Connectivity</td>
<td>Transit Connectivity Index (TCI)</td>
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<tr>
<td></td>
<td>Transit Use</td>
<td>Percentage workers who use transit, bike, or walk to work (ABC)</td>
</tr>
<tr>
<td>Orientation</td>
<td>Transit Dependency</td>
<td>Percentage of zero-car households</td>
</tr>
<tr>
<td></td>
<td>Lower Income</td>
<td>Percentage of households with income &lt;$25,000</td>
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<tr>
<td></td>
<td>Rental Housing</td>
<td>Percentage of renters</td>
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<tr>
<td></td>
<td>Affordability</td>
<td>Percentage of income spent on transportation</td>
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<tr>
<td>Development</td>
<td>Walkability</td>
<td>WalkScore®</td>
</tr>
<tr>
<td></td>
<td>Residential Density</td>
<td>Households per acre</td>
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<tr>
<td></td>
<td>Employment Gravity</td>
<td>Employment gravity measure</td>
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three measures) to a high score of 15 (top quintile for all three measures). The 36 station areas scoring the maximum possible transit score consist mostly of rail and bus station areas located in the downtown core. The 48 station areas scoring the minimum possible transit score are all commuter rail stations. By selecting only the key bus routes, our methodology overemphasizes the “well-performing” bus areas. Nonetheless, it is notable that the best-performing bus station areas are indistinguishable from the best-performing rail station areas on these three measures.

Orientation Subscale
The four selected measures that constitute the orientation subscale are:

- **Transit Dependency:** The percentage of zero-vehicle households in the station area (because persons living in households without a car are far more likely to use transit than those in households with cars, and because serving transit-dependent populations is an important component of equity);
- **Lower Income:** The percentage of households with incomes under $25,000 in the station area (because lower-income households are more likely to use transit, and because serving lower-income residents is an important component of equity);
- **Rental Housing:** The percentage renters in the station area (because renters are more frequent users of public transportation than home owners).
- **Affordability:** Affordability is derived from the H+T® Index developed by CNT, which measures the percentage of income spent on transportation in the station area.

Orientation ratings for MBTA station areas vary from a low score of 4 (mostly commuter rail stations but also several stations on the Green “D” Line in affluent suburbs) to a high score of 20 (found at many bus stops, as well as surface Green “B” and “E” Line station areas). On average, bus stop areas have more residents in zero-vehicle households, more low-income residents, and more renters than rail station areas.

Development Subscale
The three selected measures that constitute the development subscale are:

- **Walkability:** The independently developed WalkScore® of the station’s location (using latitude and longitude), because it measures important destinations within walking distance of the station as well as urban form, and because it correlates well with lower household driving;
- **Residential Density:** The number of households per acre in the station area is used as a measure of how many people live in the station area;
- **Employment Gravity:** The Employment Gravity measure, developed by the CNT, assesses the quantity of and the distance to all employment destinations, relative to any location within the region.

The development rating varies between MBTA station areas, from a low score of 3 to a high score of 15. Most of the lowest-scoring areas are commuter rail station areas, and the highest-scoring are mainly bus stop areas.

THE RATING SYSTEM AND RESULTS
The three subscales can also be added together into a final combined score, establishing a comparable eTOD Score for each station area. The overall score ranges from a minimum of 10 points to a maximum of 50 points. The score is then divided into four groups, which correspond to changes in average VMT measures (see Figure 2).

Using these measures, it is possible to compare a given area’s performance relative to other stations by comparing the scores. The final combined score of each station area reflects its quality of transit, its orientation toward transit users, and the development of the station area. Figure 3 presents a map of the Boston region that shows how the station and stop areas break out by their eTOD Score, and Figure 4 provides examples of each type of station area.
The highest-rated Transit-Oriented station areas share a combination of built, social, and transit attributes that reduce driving, increase transit ridership, and promote equity. Given the rating system’s strong correlation with average daily household VMT within station areas, the combined eTOD Score provides a holistic measure of those conditions that contribute to less driving and more transit ridership, both now and likely into the future.

While the combined scores provide important information about the suitability of the station area for high-performing equitable TOD, the three separate subscales on Transit, Orientation, and Development can be used to clarify the strengths and weaknesses of different station areas and focus attention on the types of measures that can improve an area’s eTOD Score and thereby the performance and equity of TOD in that station area.

While this rating system focuses on transit station areas rather than individual TOD projects or proposals, it can be used to determine whether a TOD project provides what is “missing” in a station area. For example, the Lynn station area shown below is well-oriented toward core transit riders but scores poorly on transit (as it is commuter rail rather than more frequent bus or rapid transit service) and has a mixed record with respect to development/built environment attributes. TOD projects that build on the identified strengths or address the weaknesses in a station area should “rate” highly as equitable transit-oriented development.