State Smart Transportation Initiative

ACCESSIBILITY AND TRIP-MAKING

An Introduction for Practitioners

State Smart Transportation Initiative, July 2017

Transportation and land-use decision makers need tools and standards to inform planning choices and to assess success. Conventional transportation planning practice has focused on identifying roads experiencing traffic delay, using travel demand models to predict where traffic will get worse, and investing strategically in new road capacity. By focusing on vehicle speeds and road capacity, this approach often ignores fundamental questions about where people are trying to get to and how easy is it for them to get there, particularly when we're interested in people who use other means of travel like public transit, walking, or biking.

New data sources and analytical methods, as well as an increasing focus on performance-based and scenario planning, provide a path toward a more holistic, modern approach to transportation decision-making – one that reflects key lessons learned during the past several decades of transportation research and practice. While there are many valuable new approaches, this brief focuses on two specific tools – accessibility analysis and trip-making data – which let us analyze entire trips rather than speeds at arbitrary points in the system, evaluate non-automobile modes, and consider land use solutions as well as road infrastructure.

Accessibility metrics describe how easily people can reach destinations, either now or in some future scenario, by different modes. The popular website Walk Score[1] presents some basic accessibility metrics, but groups like Renaissance Planning Group[2], the Washington Metropolitan Area Transit Authority (WMATA), the University of Minnesota's Accessibility Observatory[3], and MIT's Mobility Futures Collaborative[4] have developed more advanced approaches that can tie directly into decision-making processes. Now, with new products from Citilabs and other software developers, agencies with basic GIS capabilities can conduct their own accessibility analyses.

Trip-making data describes where and how people travel based on data from cellphones, GPS-enabled vehicles, and mobile apps. The information can replace or augment data that traditionally comes from traffic studies, travel surveys, and travel demand models, often with far less effort or resources. Some agencies rely on similar data sources such as Bluetooth[5] or Strava Metro[6], but those only capture parts of trips or certain types of trips. Data now available from providers INRIX[7],

1 Walk Score, http://www.walkscore.com.
2 Renaissance Planning Group, http://www.citiesthatwork.com/mma.
3 Accessibility Observatory, http://access.umn.edu.
4 Mobility Futures Collaborative, "CoAXs," http://coaxs.mit.edu.
5 Madhav Chitturi et al., "Validation of Origin-Destination Data from Bluetooth Reidentification and Aerial Observation," Transportation Research Record 430 (2014): 116-123, https://doi.org/10.3141/2430-12.
6 Peter Walker, "City planners tap into wealth of cycling data from Strava app," The Guardian, May 9, 2016, https://www.theguardian.com/lifeandstyle/2016/may/09/city-planners-cycling-data-strava-tracking-app.
7 INRIX Traffic, http://inrix.com/products/traffic.

StreetLight Data[8], Teralytics[9], and AirSage[10] represent entire trips, with details about route choices and other trip characteristics. Some also offer user-friendly online interfaces for working with the data.

Working with SSTI, the Commonwealth of Virginia recently began using both tools to help prioritize its transportation investments and the Sacramento Council of Regional Governments (SACOG), along with other local agencies, explored their use for a variety of planning applications. The following sections provide a general introduction to each tool, based on lessons learned from those projects and others.

ACCESSIBILITY ANALYSIS

Accessibility metrics describe how efficiently a transportation and land use system lets people reach jobs, schools, stores, parks, and other important destinations. Accessibility analyses typically require information about the layout of roads, sidewalks, and bike paths, vehicle speeds during different times of day, transit routes and schedules, and how different land uses are laid out. They also involve calculating the best path from point A to point B for all origins and destinations in a study area – these could be Census blocks, parcels, or individual buildings – which can be computationally demanding. Fortunately, there are now several open source tools available for certain types of analyses and at least one commercial tool, Sugar Access by Citilabs, that includes most of the necessary data and cloud computing capabilities within a simple GIS interface.

The following examples highlight specific applications of the metrics in decision-making.

Conducting a needs assessment, for example by scanning existing conditions to identify transportation network deficiencies across transportation modes.

The *Connecting Sacramento* study, led by SSTI, demonstrates how accessibility metrics can be used to scan for missing first- and last-mile connections to light rail stations by walking. Similarly, accessibility analyses can scan for food desserts, areas with poor access to jobs, or other gaps in the transportation system.

Estimating project impacts for prioritization, development review, or scenario planning.

The Virginia Department of Transportation currently prioritizes all major transportation investments based partly on how much they improve multimodal accessibility, in a process called *Smart Scale*.[11] This lets highway, transit, and pedestrian projects compete on equal footing and helps ensure that the state can make the most of its limited dollars. Similarly, local land use authorities can use these metrics to set and enforce development standards.

Setting goals and tracking performance over time.

The Accessibility Observatory releases regular reports, called *Access Across America*, ranking cities based on access to jobs by driving, transit, and walking, and letting those cities track

8 StreetLight Data, https://www.streetlightdata.com.
9 Teralytics, https://www.teralytics.net.
10 AirSage, http://www.airsage.com/Industries/Transportation.
11 "Smart Scale," Virginia Department of Transportation, http://vasmartscale.org.

changes over time.[12] PeopleForBikes recently announced a similar open source tool, the *Bike Network Analysis (BNA) Score*, which compares access to a variety of destinations by bike for 300 cities.[13] With tools like these, agencies and local governments can set accessibility-related goals and evaluate their progress toward meeting those goals on a regular basis.

Engaging stakeholders and communicating among departments or agencies.

Accessibility metrics can help relate information about transportation performance and the benefits of transportation system investments in legible and intuitive ways. Heat maps, like those presented by Walk Score and the Accessibility Observatory, can effectively communicate how accessibility varies throughout a city or region, while more advanced tools like Remix[14] and CoAXs[15] let users test different transit route configurations and model the accessibility impacts in real-time.

Past work also shows that accessibility metrics, like Walk Score, can tell a lot about other important outcomes such as travel behavior, physical health, and land values.[16]

Getting started

Before running accessibility analyses, it's important to think about how accessibility metrics will fit into specific decision-making processes, like those described above. The responsible agencies can then begin building the necessary capacity to run those analyses. Planning agencies with sufficient GIS expertise may be able to analyze accessibility with the available data and tools, including open source options like OpenTripPlanner[17] or UrbanAccess[18]. Agencies without those resources might need a more complete package like Sugar Access.

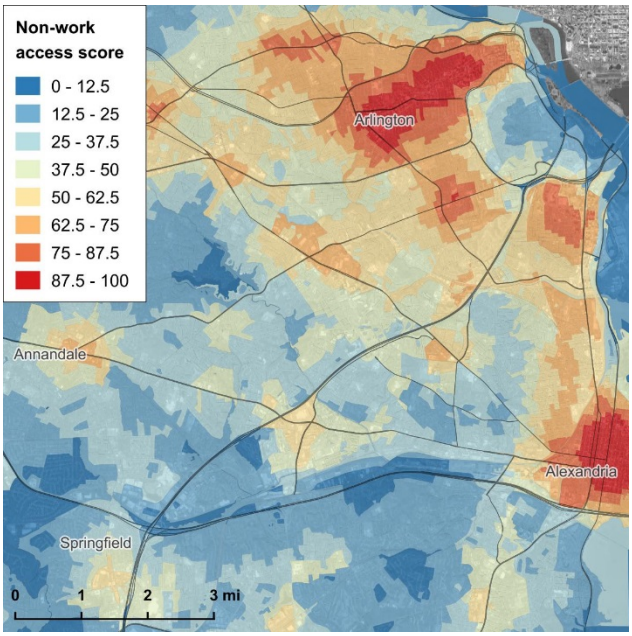

Figure 1.
Sample accessibility analysis showing access to non-work destinations by walking in Northern Virginia (using Sugar Access).

TRIP-MAKING DATA

Trip-making data is an emerging form of "big data" that lets us understand how people move around without complex travel demand models or costly travel surveys. Many vehicles and mobile devices now have programs running in the background that generate massive amounts of location information all the time. Several providers compile the anonymous information, clean it, and turn it

12 "Access Across America," Accessibility Observatory, http://access.umn.edu/research/america.
13 "PlacesForBikes Bike Network Analysis (BNA) Score," PeopleForBikes, https://bna.peopleforbikes.org.
14 Remix, https://www.remix.com.
15 Mobility Futures Collaborative, "CoAXs," http://coaxs.mit.edu.
16 "Walkability Research," Walk Score, https://www.walkscore.com/professional/walkability-research.php.
17 OpenTripPlanner, http://www.opentripplanner.org.
18 UrbanAccess, https://github.com/UDST/urbanaccess.

into meaningful, easy-to-understand metrics. In many cases, the information can be more accurate, more robust, and more current than traditional sources.

Cellphones are a popular source of data for understanding regional travel patterns, due partly to the large quantity of cellular data available. Higher resolution GPS data, however, can provide more specific details about where the trips begin, where they end, routes, trip lengths, travel times, and even what mode people are using. Data providers can also incorporate Census data and land use information to infer trip purpose (e.g., work or non-work) and traveler demographics.

The following examples highlight specific applications of the data in decision-making.

Evaluating and justifying highway projects.

The North Carolina Department of Transportation used cellular data from AirSage to assess the need for a bypass to handle traffic on U.S. 1 through Aberdeen. The data showed that more than 85 percent of the traffic is local, suggesting a bypass might not be the best solution.[19]

Identifying opportunities to manage travel demand.

Working with the Virginia Office of Intermodal Policy and Development, SSTI used GPS data from StreetLight Data to identify opportunities to reduce car trips.[20] Some key findings include:

- Roughly one-third of vehicle trips to George Mason University begin within three miles of the campus, suggesting a need for better bicycle and pedestrian connections.
- Several thousand people drive less than one mile to Van Dorn Metro station each weekday, due partly to a lack of pedestrian infrastructure.

Understanding transit use and identifying potential transit riders.

The *Connecting Sacramento* study uses two data sources to understand how Sacramento's light rail transit is being used and how to potentially improve ridership. Cellphone data from Teralytics helped explain the share of trips made by transit from any given neighborhood and where those trips end. GPS data from StreetLight Data revealed trips made by driving that could potentially be made by light rail.

Understanding bicycle and pedestrian travel patterns.

The *Connecting Sacramento* study also demonstrated how GPS data could help explain people's walking patterns to light rail stations. StreetLight Data will soon offer bicycle and pedestrian metrics in its online interface.

---

19 David Sinclair, "Cellphone Data Could Help in Developing Transportation Plan," The Pilot, July 31, 2013, http://www.thepilot.com/news/cellphone-data-could-help-in-developing-transportation-plan/article_fefd73be-fa3d-11e2-9c43-0019bb30f31a.html.

20 State Smart Transportation Initiative and Michael Baker International, "Trip-making data, TDM, and connectivity in Northern Virginia," March 30, 2016, http://www.ssti.us/2016/04/trip-making-data-tdm-and-connectivity-in-northern-virginia.

Calibrating travel demand models.

Transportation planners typically rely on many unrelated data sources to develop travel demand models. Trip-making data now provide robust, consolidated information for calibrating and validating those models.[21]

Getting started

Data providers typically do most of the heavy lifting to help make sense of the data, but working with the data still requires certain background knowledge, technical skills, and a clear understanding of what it will be used for. Some key points to consider before purchasing any trip-making data are:

- Familiarize yourself with and consider a range of data sources, including more traditional data for some applications.
- Ask a specific question to address a planning need, then find the most appropriate data.
- Enlist the right people to help interpret the data – i.e., transportation planners with basic GIS and analytic skills.
- Aggregate big data appropriately to leverage its full potential, instead of focusing in on too many details.

While it may be tempting to begin by asking for as much information as possible, this can make interpretation more difficult and drive up costs. Instead, it helps to have a simple question in mind and start with a modestly sized test case, then scale up as needed. StreetLight Data has a user-friendly interface called *StreetLight Insight*® that makes simple requests easy. Other providers should be willing to work with new users to get familiar with the data.

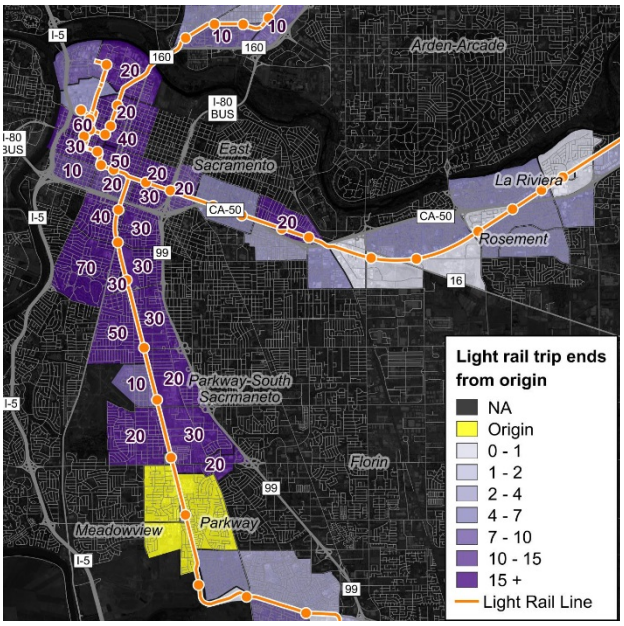

Figure 2.
Sample trip-making data showing the destinations of light rail trips beginning near Meadowview station in Sacramento (using Teralytics data).

LEARN MORE

More information about each tool, including technical details and example applications, can be found in the *Connecting Sacramento* study at www.ssti.us/2017/07/connecting-sacramento.

21 Richard J. Lee et al., "An evaluation of emerging data collection technologies for travel demand modeling: from research to practice," Transportation Letters 8, no. 4 (2016): 181-193, http://dx.doi.org/10.1080/19427867.2015.1106787.