Measuring transportation equity
SSTI Working Paper

INTRODUCTION

Cities, regional planning agencies, and state departments of transportation are growing more interested in evaluating the equity impacts of transportation planning, design and regulation. Early work looking at transportation equity focused mainly on the economic impacts of transportation spending. This focus eventually broadened to include the negative externalities of transportation and, more recently, the accessibility impacts of transportation related decision-making.

This paper presents a framework for evaluating the equity-related impacts of transportation, which accounts for all of the considerations described above, and outlines many of the tools and data sources available for conducting equity analyses using this framework.

EQUITY FRAMEWORK

Equity analyses focus on evaluating how proportionately, or disproportionately, costs and benefits are distributed across different segments of the population. For example, we may be interested in whether one group of people has poor access to jobs and amenities compared to another group, or whether transportation is less safe or more costly for one group of people compared to another.

First, we must identify population groups—environmental justice (EJ) groups—that might be considered disadvantaged or disproportionately affected, depending on particular circumstances. Conventional EJ groups include women, racial or ethnic minorities, low-income households and immigrants. Other transportation-specific groups that may be disproportionately affected include the physically disabled, children and seniors, non-drivers or non-car owners, and those living in rural areas.

Once EJ groups of interest are identified, it is important to consider each of four equity dimensions: accessibility, affordability, health and safety, and procedural equity (Table 1). Whenever possible, it is important to evaluate each of these dimensions by comparing how EJ groups compare to non-EJ groups. This can highlight important inequities in the way that particular groups are served or affected by transportation systems, and point the responsible agencies toward appropriate actions to address those inequities.

Each of these equity dimensions is described below—including commonly available data, tools, and calculation methods for each—followed by examples of how this framework can be implemented to address equity-related issues.

Table 1. Equity framework and dimensions

Equity dimension	Sample metric	Desired outcome	Description
Accessibility	Travel time	Down	Average travel time to selected destinations
	Cumulative opportunities	Up	Number of amenities and services within a given travel time
	Composite access score	Up	Accounts for transportation network, cumulative opportunities and travel time decay functions

Affordability	H+T® Affordability Index	< 45%	Housing and transportation costs as a percent of income
Health and safety	Speed suitability	~ 1.0	Actual speeds / speed limit
	Serious and fatal crashes	Down	Crashes per person (by neighborhood or by mode)
	Exposure to traffic	Down	Average daily traffic near home location
Procedural equity	*Undefined*	–	–

EQUITY DIMENSIONS, DATA AND METHODS

Accessibility

Transportation planners and designers are accustomed to measuring vehicle throughout in order to evaluate system performance. Unfortunately, common mobility metrics such as delay or level of service typically do not properly reflect equity issues and other community interests. For example, measures of traffic flow through a particular community do not necessarily reflect how easily community members can get to work, or what the impacts of traffic flow are on their health and well-being.

Accessibility measures, in contrast, measure the ease of reaching meaningful destinations (e.g., work, school, shopping, health care and services) from a particular location within a particular time or cost threshold. Accessibility, which is the primary function of a transportation system, improves as the number of nearby destinations increases or as the time and distance to reach to individual destinations decreases.

Data and methods

Past practice focused primarily on accessibility to jobs, which provides a limited but important understanding of travel patterns and obstacles. At a minimum, this information can be accessed from the U.S. Census' American Community Survey, which provides data on worker travel times, means of transportation and worker flows, or from travel surveys. Emerging sources of travel data, such as GPS data from mobile phones, navigational devices and wearable fitness devices, promise to offer even more information about travel to work and to other destinations by multiple modes.

Without actual travel data, however, a growing number of tools provide measures of accessibility based on the number of destinations (or "opportunities") that can be reached from a particular location by various modes within a given travel time, giving greater weight to nearer opportunities. Walk Score™, which measures the number of opportunities within walking distance from a given location, is the most widely known example, but is not particularly helpful as a transportation planning and decision-making tool. Three other promising tools include:

- *Accessibility Observatory* – The Accessibility Observatory, based at the University of Minnesota, offers a broad view into regional transportation accessibility using metrics based on the number jobs accessible within a given time threshold by automobile and by transit.
- *Renaissance Planning Group* – The Renaissance Planning Group has developed and calibrated a tool for the Washington, DC area, which measures accessibility to jobs and

other non-work destinations by automobile, transit and walking at various geographic scales.

- *Sugar Access*™ – Sugar Access is a GIS-based application available for purchase from Citlilabs, Inc. The tool comes preloaded with basic data about transportation networks, travel times, transit schedules and points of interest. It produces a variety of accessibility metrics at essentially any geographic scale.

Each tool has its own range of uses. The Accessibility Observatory, for example, promises an easily understood tool that can be used to compare accessibility within and among metropolitan regions throughout the U.S., but may not yet be the most comprehensive tool for transportation planning purposes or detailed project analyses. The Renaissance Planning Group has demonstrated how its accessibility tool can be used in project planning, testing it along a proposed bus rapid transit corridor in Montgomery County, Maryland. The tool, however, still is not widely available for use outside of the Washington, DC area. Sugar Access, in contrast, is ready for use in many areas throughout the U.S. but relies on a number of general assumptions and basic data unless calibrated to local conditions using available local data sources.

In an equity analysis, no matter what tool or data source is used, it may be necessary or useful to parse out accessibility metrics in terms of particular destination types of travel modes. For example, equity analyses commonly measure access to jobs by transit. However, equity concerns may focus on access to groceries, education, services or other opportunities, and may be interested in a wider range of travel modes, including walking or driving.

Affordability

Affordability measures reflect actual out-of-pocket travel costs in monetary terms rather than as time spent or distance traveled. While it is tempting to think of accessibility entirely in monetary terms, that can be problematic in this context for two reasons: 1) doing so makes it difficult to parse out specific accessibility issues, and 2) there is great risk of concealing travel time disparities by assigning different values of time to different income groups.

Data and methods

Currently, one of the most useful tools for measuring transportation affordability is the Housing and Transportation Index (H+T Index), developed by the Center for Neighborhood Technology (CNT). The tool provides estimates of combined household housing and transportation spending as a percent of household income down to the census block level. The H+T accomplishes this using readily available federal data, state, and local data on transportation and housing.

The H+T Index can determine total household transportation costs for both auto and transit modes. The ability of the H+T to drill down to the census block level allows for a comparative analysis of affordability across census blocks in a metro area or a region, if desirable. A comparison of transportation costs among census blocks that are lower income or part of another EJ group and census blocks that have higher annual incomes may reveal equity concerns that should be addressed – for example, in locations where combined housing and transportation costs are greater than 45 percent of median income.

Health and safety

It is not sufficient to measure accessibility or affordability in an equity framework if a transportation system poses considerable health and safety risks to its users or to non-users. This

is particularly true if one particular group puts another group at greater risk, such as by traveling at high speeds through their neighborhood or exposing them to harmful emissions. Sample metrics include:

- Serious and fatal crash rates (by neighborhood or by travel mode)
- Speed suitability (travel speeds divided by speed limits)
- Traffic exposure or related impacts (e.g., air quality)

Data and methods

The most readily available data on safety impacts comes from the Fatal Accident Reporting System (FARS) provided by the National Highway Reporting Safety Administration. This database indicates the location of all fatal crashes in the U.S., whether a non-motorized road user was involved, and the home location of drivers by ZIP code. Due to the relatively rare occurrence of fatal crashes, the inclusion of crashes involving serious injuries offers more robust information about where the greatest safety risks are, when these types of crashes occur, and who is involved. This information may be available in local crash databases, but the quality and content of these databases will vary.

Data related to other traffic impacts might be available from local sources or might need to be collected. This includes local emissions and air quality data, local decibel readings (to account for noise impacts).

Procedural equity

Although we identify procedural equity as a key component in an equity framework, we do not define a metric for this component. In part this reflects the difficulty in identifying proper metrics and the even greater difficulty in actually collecting data to reflect those metrics—for example, public participation rates by race, gender, or income—it also points to the fact the procedural equity is, above all else, a process.

Existing data may provide helpful insight. The entire transportation project delivery process requires constant and deliberate involvement of community members to ensure equitable outcomes. Project staff or team will likely need to be creative to improve participation among historically marginalized groups. This may entail accommodating non-traditional work schedules, holding meetings in transit-accessible locations or in conjunction with already-planned community meetings, soliciting the help and guidance of community leaders, or providing accommodations such as meals or childcare. Some possible ways to measure this involvement include documenting the percent of community members living in a project area that attend meetings, noting if the ethnic/gender/age make up of participants reflects the impacted community.

IMPLEMENTATION

Example: Infill development to eliminate food deserts

One purpose of an equity analysis might be to determine how access to grocers and other food outlets varies among different populations within a given area. A typical finding could be that access is limited in certain neighborhoods (e.g. “food deserts” low-income neighborhoods). A proper response, rather than mobility improvements, might then be to encourage mixed-use infill development near residential areas to introduce new food options in those areas.

Example: Increased transit frequency and/or service hours

An accessibility analysis might reveal that a particular community has poor access to jobs thereby causing individuals to endure long commutes or travel by automobile or other more expensive means when they otherwise would not choose to. This may be addressed increasing transit frequency, implementing transit priority on high traffic routes, expanding service areas, or extending service hours, particularly when those individuals work non-traditional schedules. In additional to increasing travel options for the general population, these measures can greatly reduce transportation costs for certain individuals.

Example: Safer connections for bicycles and pedestrians

An analysis of crashes might reveal that certain neighborhoods experience a disproportionately high number of crashes involving people walking or biking, particularly in proportion to bike and pedestrian mode shares, indicating that facilities are insufficient or crossings are unsafe. Targeting those areas for infrastructure improvements such as crosswalks, bike lanes and traffic calming measures could improve the safety for those already choosing to walk and bike, encourage more individuals to use those modes, and improve accessibility options for those communities.