Possible performance measures for bicycle and pedestrian investments

There are a number of goals that cities, states, or even the federal government have set for their transportation system. Measuring performance to evaluate how policies and investments are contributing to these goals is critical to ensuring progress towards them. However, determining how to measure the performance of bicycle and pedestrian policies and investments is uniquely challenging. Because the focus on bike and pedestrian transportation is a relatively recent phenomenon, there is little agreement about what the goals for these types of policies and investments should be, much less on how progress towards these goals should be measured.

Transportation agencies have been under pressure for years to document the benefits and efficiency of their investments in highways and transit, and they have developed a variety of performance metrics to document their progress towards several widely accepted goals—reducing congestion, reducing emissions, lowering transportation costs, and promoting personal mobility. In the current era of fiscal constraint and uncertain future funding, all levels of government are searching for a way to show that they are making wise choices but the absence of agreed upon goals and performance metrics for bicycle and pedestrian policies and investments makes documenting progress extremely difficult.

FHWA, USDOT, EPA, and a host of local and state departments and agencies have set goals to increase such things as quality of life, sustainability, livability, universal access to the transportation system, and economic development. However, many of these goals are either difficult to measure or difficult to tie to specific policies or investments in the bicycle and pedestrian infrastructure.

System wide goals that are easily measured for other transportation modes – congestion relief, air quality improvements, or reduction in commute times – are more difficult to measure for non-motorized transportation.

During our interviews with subjects about their opinions and practices with regard to performance measures, their answers often were colored by their normal sphere of influence or area of interest. Engineers focused on how infrastructure works for non-motorized users, but not always the outcomes of infrastructure changes. Planners focused on the environment for walking and biking, whether the transportation system was easy to use, and the overall “friendliness” or feel of the transportation environment. Few interview subjects had ideas about how standard transportation metrics could be applied to biking and walking investments.

Although MAP-21 does not require performance measures for projects funded via the Transportation Alternatives Program, FHWA is very interested in developing metrics for bicycle and pedestrians projects. NACTO includes performance measures for bike and pedestrian projects as part of their Urban Street Design Guide, and cities, MPOs, and states have set goals for funding projects. However, few have developed metrics for evaluating projects after they have been completed.
The metrics listed below fall into two broad categories according to whether they are based on outputs—e.g. total number of bike lane miles—or outcomes—e.g. reductions in pedestrian fatalities. Some of these are currently in use, while many others are under consideration.

**Output-based Metrics**

Metrics based on outputs allow governments to measure their efforts to achieve their goals by quantifying the projects or policies that have been implemented. Output-based metrics rest on the assumption that the output being measured, such as total miles of bike lanes in a community, is associated with goals that are being pursued, such as improved bicyclist safety or a more sustainable community. It is often difficult to gauge how well these output-based metrics track with the relevant outcomes. However, one primary benefit of output-based metrics is that they are usually relatively easy to measure, making them a useful first step for agencies developing a performance management program.

**Quantity of Infrastructure.** Many municipalities measure their bicycle and pedestrian transportation performance by measuring the number of miles of new bike paths, bike lanes, sidewalks, or other bike and pedestrian infrastructure. This metric is predicated on the assumption that people will walk and bike more if there is more bicycle and pedestrian infrastructure. This assumption is not without merit; indeed, most cities that have improved the quality and extent of their infrastructure have seen increases in walking and biking. However, infrastructure projects that fail to advance the community towards its bicycle and pedestrian transportation goals are not good investments.

**Infrastructure Ratings.** Over the years, a number of systems have been developed to rate facilities based on how well they meet the needs of bicyclists. Pedestrian facility rating systems are less researched, partly because the importance of sidewalk coverage looms so large above other pedestrian considerations.

If one or more of these metrics were used to rate existing infrastructure, bicycle and pedestrian infrastructure investments could then be measured by how much they improve the rating.

Each of the following infrastructure rating systems can help communities measure the improvement of their bicycle and pedestrian transportation systems. However, all have significant limitations and may require information that is not readily available for many routes favored by bicyclists, such as local residential streets.

In addition, these rating systems do not assess connectivity and overall accessibility of the network, as they only rate roadways or even roadway segments, not routes to destinations.

**Bicycle Level of Service (BLOS).** Developed in 2007 and being used by several states and cities, BLOS provides useful ratings for arterial and collector routes. However, this rating system has several significant shortcomings. It requires voluminous data, which may not be readily available and it measures only on-street mid-block conditions and does not provide ratings for bike paths, cycletracks, or even bike lanes. In addition, the
BLOS does not work well for a bicycle network composed of a grid of low-volume streets and bicycle boulevards.

**Bicycle Compatibility Index.** This metric, developed by FHWA in 1998, relies on visual preference surveys of bicyclists as they view films of various street segments. The Bicycle Compatibility Index does not involve actual testing of bicyclists riding the segments and, like the BLOS, it was developed to rate on-street mid-block cycling conditions and cannot be used to rate bike paths, cycletracks, or bicycle boulevards.

Neither of the above two measures assess intersections, as they only rate the midblock conditions. This is a serious flaw, since navigating an intersection, especially with heavy traffic and turning vehicles, is often one of the most difficult and intimidating aspects of bicycling.

**Bicycle Level of Stress.** This methodology, published in 2012, measures how well connected the network is via bicycle facilities the average person—the 66 percent classified as “interested but concerned” by Roger Geller—would feel comfortable using. It provides a more holistic measure of bicycling conditions than BLOS and the Bicycle Compatibility Index because it is based on stress levels of intersections as well as the midblock sections of roadways and bikeways. Although it was not developed as a performance measure, it could be used to measure the contribution of an infrastructure project to the overall bikeability of a city.

The level of stress measure also facilitates the identification of bike accessibility gaps, barriers, and islands – i.e. isolated areas of the city. This information would allow decision makers to more accurately determine the degree to which a facility would reduce the isolation of a particular area of the city, especially one containing schools, dense residential areas, shopping districts, or employment centers.

Because Bicycle Level of Stress also rates intersections as well as street segments, it has been used to rate the overall bicycle network and whether an average bicyclist can access areas of the city without undue detour.

**Pedestrian Environmental Quality Index** serves a similar function for pedestrians. It does not assess the city-wide pedestrian network, but does allow planners to identify problem areas and locations within neighborhoods. Following the completion of a project, a re-assessment could be used to assess its impacts on an area, neighborhood, or intersection. Since walking distances tend to be short, a neighborhood-based metric may be adequate when enough areas of the city are assessed.

**Accessibility.** *Walk Score*—which scores cities, neighborhoods, and specific addresses based on access to destinations by foot, transit, and bike—is considered the standard for accessibility data. These on-line tools rate how far one would have to travel from a given location for trips to schools, shops, restaurants, parks, grocery stores, and other destinations. Walk Score does not factor in the presence of sidewalks or the safety of the trip—perceived or real—although the overall density of the neighborhood, block length, and general connectivity of the neighborhood
is included in the score. Walk Score’s bicycle access rating system, Bike Score, is based on the same factors that Walk Score uses for pedestrian access along with the availability of bicycle paths and lanes and the prevalence of hills.

Changes in these ratings could be used as a metric for non-motorized accessibility and a proxy for the ability to walk or bike to most daily needs. However, Walk Score sometimes inappropriately rates bike- and pedestrian-unfriendly locations such as suburban big box clusters highly due to the density of destinations within a small area.

**Outcome-based Metrics**

Communities are motivated to make investments in walking and biking to improve economic development, quality of life, public health, aesthetics, or social justice. Measuring these impacts—the outcomes of bicycle and pedestrian policies and investments—directly, rather than measuring outputs assumed to be associated with them, yields data that is more clearly linked to bike/pedestrian program goals. However, gathering data on outcome-based measures is often much more difficult than gathering it on output-based measures. If a city is trying to promote a modal shift from cars to bicycles, it is not enough to measure the number of bicycles per day in a corridor. They need to know what mode bikers would have been using if they were not on bicycles—a much more difficult task. Further complicating the issue is the need to connect changes, such as increased bicycle mode share, to specific policies and infrastructure improvements. New York City, a leader in the use of outcome-based measures, measures performance, such as retail sales growth, in places with new infrastructure against similar unimproved comparison sites and against borough averages in order to isolate the effects of their projects.

While collecting the data for outcome-based performance measurement is often more difficult than for output-based measurement, measuring performance based on outcomes is generally superior because it provides a clearer link between new policies or investments and community goals.

**Economic development.** A number of communities have done studies of corridors before and after making investments in biking and walking infrastructure. Some of these were done to allay fears that removing parking or restricting motor vehicle lanes would not have an adverse effect on property values, business revenues, or customer access. In other cases, investments in biking and walking were part of a larger strategy to improve a neighborhood, and studies were done to document the results. Economic development indicators include changes in property values, sale tax receipts, and other measures associated with economic activity. The relationship between infrastructure improvements and economic effects can be determined either by measuring changes at unimproved comparison sites or by identifying the contributions of bicyclists and pedestrians to total sales revenue. For example, in communities with a Bicycle Benefits program, where participating businesses offer discounts to customers arriving by bike, data from businesses about their sales to customers arriving by bike would allow more targeted measurement of bicycle-related economic activity. Observational surveys of a corridor can also capture pedestrians and bicyclists entering businesses.
**Public health.** Many communities have goals to increase physical activity, lower chronic disease rates, or improve other metrics of the general population. Surveys of public health before and after a program or infrastructure investment can show correlation between biking and walking investments and public health indicators, such as minutes of daily physical activity or rates of obesity, diabetes, or asthma among residents. A number of communities are using this approach to assess their investments.

**Quality of life.** Quality of life encompasses a wide range factors, such as public perceptions about the community, aesthetics, crime, and others. Although some of these factors seem unrelated to transportation policy and infrastructure pedestrian and bicycle investments, particularly streetscaping, can play a part in overall quality of life. Along with community surveys, usage rates for public infrastructure, such as benches and parks, can give planners insight into the livability impacts of pedestrian and bicycle investments.

**Mode shift.** Shifting trips from single-occupancy vehicles to alternate modes is a goal of many communities and states. Modal shift can reduce congestion during peak periods, improve air quality, and lessen the need for costly roadway maintenance and new capacity. Since many trips are within easy walking and biking distances, investments in infrastructure and programs for non-motorized transportation can pay big dividends, in terms of reduced automobile infrastructure costs. However tying modal shift to specific projects and policies is difficult.

Many communities lack accurate information about walking and biking trips and rely instead on American Community Survey (ACS) mode split data. However, the ACS only measures the trip to work and does not allow respondents to report the use of multiple modes for a single trip. In addition, ACS data does not provide data at the corridor or neighborhood level that could be used to assess the impacts of a particular investment.

While ACS data is the easiest source for information about traveler mode choice, there are other ways to collect more nuanced information at a finer level of detail. Two existing options are to use traveler surveys or to simply count the number of persons traveling by each mode at a given location. With the near universal adoption of cellular phones, it is now possible to track the movement of people throughout the day using cellular phone signal information. This is an emerging field and the companies that provide this data have thus far focused on driving patterns and trips. However, by filtering this information to separate drivers from bikers, walkers, and transit passengers, the share of travelers using each mode in a certain corridor could be determined. This would allow communities to see changes in travel mode share over time and to more quickly and accurately assess the impacts of new policies and infrastructure.

Even with reliable information about the number of travelers using each mode in a corridor, the accurate assessment of a policy or project’s impact on traveler mode choice is difficult. For example, there is evidence from bike share systems that many of the new bicycle trips occurring after system installation were shifted not from car trips, but from transit. Therefore, an increased number of new bicycle trips is not necessarily an indication of a reduction in car trips in the same corridor.
**Congestion and air quality.** Motor vehicle congestion is fairly easy to measure and is often measured in real time. Air quality is also monitored in most urban areas, and improvements in these metrics, particularly in air quality nonattainment areas, are usually a top priority.

Increased levels of bicycling and walking often fail to translate into discernibly lower levels of congestion, since drivers who switch to an alternate mode will normally be replaced by drivers that would have traveled by a different route or at a different time. However, a number of cities and states are undertaking efforts to model how changes in biking and walking patterns might forestall actual declines in these metrics. This is the basis of the claim in Portland, OR that if all the bicyclists that cross the Hawthorne Bridge were driving, another bridge would be needed.

**Safety.** Although reducing crashes is a goal in most communities, the total number of crashes involving bicyclists and pedestrians is so small that it is usually impossible to find a statistically significant change in crashes in any one location. In addition, bicycle crashes are often underreported, making the overall numbers unreliable. Despite these limitations, crash rates can serve as a useful safety metric, but only over the long time periods that allow for comparison between rolling averages. It is critical that the number of crashes or injuries be tied to overall non-motorized VMT and/or the number of non-motorized trips in order to develop a meaningful crash rate statistic.

Performance measurement for bicycle and pedestrian safety has recently received renewed attention. While the number of traffic fatalities for drivers has been declining steadily for decades, there has been an alarming jump in bicyclist and pedestrian fatalities. This has led to a bipartisan bill to direct U.S. DOT to set safety goals based on non-motorized vehicle miles traveled. As noted by the bill’s sponsors, bicycling has become increasingly popular over the last decade, so the rise in crashes could simply be a result of more exposure. However, while pedestrians and bicyclist constitute 16 percent of fatalities nationwide, only one percent or federal safety funds are spent on these modes.

The rate of speeding among drivers is one safety measure that is easy to obtain and crucial for bicycle and pedestrian safety. Reducing average speeds, especially near schools and parks, can reduce the frequency and severity of crashes while also increasing the perception of safety on the street for non-motorized users. Measuring the Street, put out by New York City DOT provides examples of how New York has used these metrics to evaluate their pedestrian-bicycle improvements.

**Considerations when developing performance measures**

**Trip to work vs. other trips**

Although commuting to and from work is estimated to only account for 20% of trips, the mode chosen for work trips often sets the stage for non-work trips. Because workers often trips chain on the way to and from work, if the commute trips is made by one mode, all those additional trips before and after work are likely to be made via that mode as well. In addition, if an
employment area and trip is not transit, pedestrian, or bicycle friendly, any lunch trips, mid-day errands, or trips for meetings are difficult to make via this mode as well.

The importance of major destinations

Again, although work trips are not all trips, some bicycle/pedestrian metric—Walk/Bike Score, Bicycle Stress Level or Level of Service, walkability, etc.—should be assigned to major employment areas because of the number of people that need to access them regularly. In addition, other destinations that regularly attract large numbers of people such as schools, shopping districts, parks, and sports arenas should receive special attention when metrics are being considered. It is especially important to consider connections to destinations that are likely to attract children, the elderly, people with disabilities, low-income populations, and other groups unable or less likely to drive.

Individual locations vs. systematic measures

It may be easier to measure performance and outcomes at an individual locations, intersections, or segments than overall systematic changes. For instance, a problem intersection can be changed and safety improved by adding paint, traffic signals, signage, or other measures. If there has been a high-crash location, a change could easily be seen after the changes have been made.

Spot improvements may indeed have an effect on the overall system. If an intersection is considered very dangerous for pedestrians and bicyclists, a spot improvement may allow more people to access whole sections of the city or network, thus changing travel patterns or mode share. However, in most cases these smaller changes are not going to show overall system changes.