



U.S. Department of Transportation
Federal Highway Administration

GUIDEBOOK

FOR DEVELOPING PEDESTRIAN & BICYCLE PERFORMANCE MEASURES



MARCH
2016

TECHNICAL REPORT DOCUMENTATION PAGE

FORM APPROVED OMB NO. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY	2. REPORT DATE March 2016	3. REPORT TYPE AND DATES Final Report	
4. TITLE AND SUBTITLE Guidebook for Developing Pedestrian and Bicycle Performance Measures		5. PROJECT ID NUMBER	
6. AUTHOR(S) Conor Semler, Adam Vest, Karla Kingsley, Susan Mah, Wayne Kittelson, Carl Sundstrom, Kristen Brookshire			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) UNC Highway Safety Research Center, 730 Martin Luther King Jr. Boulevard, Suite 300, Campus Box 3430, Chapel Hill, NC 27599-3430 Kittelson & Associates, Inc., 610 SW Alder Street, Suite 700, Portland, OR 97205		8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Department of Transportation Federal Highway Administration Office of Human Environment 1200 New Jersey Ave SE Washington, DC 20590		10. SPONSORING/MONITORING AGENCY REPORT NUMBER FHWA-HEP-16-037	
11. SUPPLEMENTARY NOTES			
12a. DISTRIBUTION/AVAILABILITY STATEMENT This document is available to the public on the FHWA website at: http://www.fhwa.dot.gov/environment/bicycle_pedestrian		12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) This guidebook is intended to help communities develop performance measures that can fully integrate pedestrian and bicycle planning in ongoing performance management activities. It highlights a broad range of ways that walking and bicycling investments, activity, and impacts can be measured and documents how these measures relate to goals identified in a community's planning process. It discusses how the measures can be tracked and what data are required, while also identifying examples of communities that are currently using the respective measures in their planning process. This report highlights resources for developing measures to facilitate high quality performance based planning.			
14. SUBJECT TERMS Pedestrian, bicycle, bike, performance measures, active transportation, nonmotorized		15. NUMBER OF PAGES 100	
		16. ACCOUNTING DATA	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT



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Project Number
FHWA-HEP-16-037

ACKNOWLEDGEMENTS

The Guide was prepared for the Federal Highway Administration (Task Order DTFH61-11-D-0035/5002) by the University of North Carolina (UNC) Highway Safety Research Center and Kittelson & Associates, Inc.

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CHAPTER 1

PROJECT CONTEXT

THE NEED FOR PEDESTRIAN AND BICYCLE PERFORMANCE MEASURES

As more agencies plan, fund, and implement transportation projects that enhance walking and bicycling, they are seeking methods to aid in objectively planning and prioritizing their investments. In a constrained funding environment, it is critical to be able to identify the projects and investments that will provide the highest level of benefit. More agencies are using multiple transportation performance measures to track progress, develop effective solutions to needs, and prioritize needs and investments.

Transportation agencies use performance measures to assess the effectiveness of a wide range of activities, and all are fundamentally oriented toward understanding how a transportation system works and impacts users. No single measure can fully describe the nuances of transportation experience across all travel modes, so many agencies consider multiple measures throughout the transportation planning process.

Performance measures can be used in a variety of applications and at a variety of scales. Some performance measures are targeted at prioritization. For example, a local jurisdiction could use bicycle level of service to identify the designated bicycle routes with the greatest need for improvements. State agencies may use performance measures to benchmark annual progress towards statewide policies and goals. For example, “pedestrian fatalities” are often monitored annually to determine whether statewide policies are improving pedestrian safety.

This guidebook is intended for practitioners and is designed to help local, regional, and State agencies select and apply performance measures for a variety of purposes. Many of the transportation performance measures included are useful for tracking and measuring progress towards complimentary goals such as health and economic development. The performance measures are organized in a toolbox that includes definitions, data sources, context, and examples of applications.

PROJECT CONTEXT

Performance management techniques promote informed decisionmaking by relating community goals to the measurable effects of transportation investments. Key steps in performance management are to decide what to measure in order to capture the current state of the system, to set targets to improve those measures, and to use the measures to evaluate and compare the effects of proposed projects and policies. This guidebook is intended to help communities develop performance measures that can fully integrate pedestrian and bicycle planning in ongoing performance management activities.

It highlights a broad range of ways that walking and bicycling investments, activity, and impacts can be measured and documents how these measures relate to goals identified in a community's planning process. It discusses how the measures can be tracked and what data are required, while also identifying examples of communities that are currently using the respective measures in their planning process. This report highlights resources for developing measures to facilitate high quality performance based planning.

The purpose is to highlight the “universe of possibility” for pedestrian and bicycle performance measures so that communities at the local, regional, and State level can, by selecting from amongst these measures, develop a performance management strategy that is tailored to their context and unique needs.



NATIONAL POLICY CONTEXT

U.S. DOT announced the *Safer People, Safer Streets*¹ initiative in 2014. It consists of three components (Safer Streets, Safer Communities, and Safer Policies) and includes a broad range of activities to improve nonmotorized safety. The initiative includes a *Mayors' Challenge for Safer People, Safer Streets*,² which challenges mayors and local elected officials to take significant action to improve safety for bicycle riders and pedestrians of all ages and abilities.

Performance management plays a central role in Federal, State, regional, and local transportation planning and funding. The Fixing America's Surface Transportation (FAST) Act was signed into law in December 2015. It authorizes Federal transportation funding and retains funding eligibility for pedestrian and bicycle projects.

1 U.S. Department of Transportation. Safer People, Safer Streets: Pedestrian and Bicycle Safety Initiative. Washington, D.C., October 28, 2015. <https://www.transportation.gov/safer-people-safer-streets>, accessed February 11, 2016.

2 U.S. Department of Transportation. Mayor's Challenge for Safer People, Safer Streets. Washington, D.C., January 25, 2016. <https://www.transportation.gov/mayors-challenge>, accessed February 11, 2016.

State DOTs and Metropolitan Planning Organizations (MPOs) are required to consider nonmotorized users in long-range statewide transportation plans (LRSTP) and metropolitan transportation plans (MTP). It stipulates that LRSTPs and MTPs must include a description of the performance measures and performance targets used in assessing the performance of the transportation system and a system performance report evaluating the condition and performance of the transportation system (23 U.S.C. 134(i)(2)(B) and 23 U.S.C. 135 (f)(7)).

The planning process needs to support the National Goals of Safety; Infrastructure condition; Congestion reduction; System reliability; Freight movement and economic vitality; Environmental sustainability; and Reduced project delivery delays. Within this environment, transportation agencies are increasingly applying performance-based approaches to decisionmaking. Pedestrian and bicycle performance measures help prioritize projects that support the National Goals.

The emphasis on performance management and pedestrian and bicyclist safety builds on work that has been underway for several years. Transportation Performance Management (TPM), is a strategic approach that uses performance data to support decisions to help achieve desired performance outcomes.

*Transportation Performance Management*³ improves project and program delivery, informs investment decisionmaking, focuses staff on leadership priorities, and provides greater transparency and accountability to the public. FHWA's *Performance-Based Planning and Programming Guidebook*⁴ and *Model Long-Range Transportation Plans: A Guide for Incorporating Performance-Based Planning* provide guidance and direction on measuring progress towards goals and using performance trends to inform decisions and investment. These documents and other resources are noted in Table 2 Performance Management Resources on Page 9.

3 U.S. Department of Transportation, Federal Highway Administration. Transportation Performance Management. Washington, D.C., February 23, 2016. <http://www.fhwa.dot.gov/TPM/index.cfm>, accessed March 3, 2016.

4 Grant, M., D'Ignazio, J., Bond, A. & McKeeman, A. (2013). Performance-Based Planning and Programming Guidebook. Federal Highway Administration, Washington, D.C., Sept. 2013.



The performance management approach is addressed in Title 23 of the United State Code (U.S.C.). It emphasizes performance management in all facets of transportation. It notes that at the statewide and MPO level the transportation planning process *shall* provide for the establishment and use of a performance-based approach to transportation decisionmaking to support the National Goals. The performance measures and targets established *shall* be considered by a State when developing policies, programs, and investment priorities reflected in the LRSTP and MTP and statewide transportation improvement program. These performance measures are developed cooperatively by the State and the MPO and detailed in the LRSTP and MTP.

TABLE 1 COMPANION DOCUMENTS

THIS GUIDEBOOK:	THE TRANSPORTATION ALTERNATIVES PROGRAM (TAP) PERFORMANCE MANAGEMENT GUIDEBOOK:
<ul style="list-style-type: none"> • Documents ways that walking and bicycling investments, activity, and impacts can be measured. • Highlights data requirements and examples of communities that are currently using the respective measures. • Links transportation investments to community goals. • Is intended to be a resource for communities as they develop a performance management strategy that is tailored to their context and unique needs. 	<ul style="list-style-type: none"> • Is a resource targeted to TAP program managers and project sponsors. • Focuses on helping to implement a performance-based approach as program managers and project sponsors administer, implement, and evaluate the TAP and program outcomes. • Highlights best practice examples and case studies.

“And we’re challenging you to ask what you can do to help communities measure and visualize how well a project increases connectivity for all residents and be a thought leader for solutions that connect Point A to Point B, without forgetting the points and people in between.”

– Secretary Anthony Foxx

KEY ASPECTS OF TITLE 23

Section 134 – Metropolitan Transportation Planning

The plans and Transportation Improvement Programs for each metropolitan area shall provide for the development and integrated management and operation of transportation systems and facilities that will function as an intermodal transportation system for the metropolitan planning area and as an integral part of an intermodal transportation system for the State and the United States.

Section 135 – Statewide and Nonmetropolitan Transportation Planning

The statewide transportation plan and the transportation improvement program developed for each State shall provide for the development and integrated management and operation of transportation systems and facilities that will function as an intermodal transportation system for the State and an integral part of an intermodal transportation system for the United States.

Section 109 – Standards

A design for new construction, reconstruction, or resurfacing of a highway on the National Highway System shall consider access for other modes of transportation, in addition to other factors.

Section 150 - National Goals & Performance Management Measures

The Secretary of Transportation must establish performance measures in several areas, including fatalities and serious injuries on all public roads. On March 16, 2016, FHWA issued the Safety PM Final Rule (23 CFR 490) which includes a non-motorized safety performance measure. All States and MPOs will annually establish a target for the number of combined non-motorized fatalities and non-motorized serious injuries on all public roads in the State or MPO planning area. This performance measure encourage all States and MPOs to address pedestrian and bicycle safety; recognizes that walking and biking are modes of transportation with unique crash countermeasures distinct from motor vehicles; and addresses the increasing trend in the total number of pedestrian and bicyclist fatalities in the United States. In addition to this requirement, State DOTs, MPOs, and other agencies are encouraged to consider additional pedestrian and bicycle performance measures included in this guidebook to help them plan and manage their transportation system.



This guidebook is intended to help communities specifically account for walking and bicycling in their performance management approach. It will help them achieve connected networks, improve safety, and promote equity, while also encouraging people of all ages and abilities to walk and bike for transportation.

In doing so, it will support the U.S. DOT's current *Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations*,⁵ which notes that "Every transportation agency, including DOT, has the responsibility to improve conditions and opportunities for walking and bicycling into their transportation systems. Because of the numerous individual and community benefits that walking and bicycling provide — including health, safety, environmental, transportation, and quality of life — transportation agencies are encouraged to go beyond minimum standards to provide safe and convenient facilities for these modes."

5 U.S. Department of Transportation. Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations. Washington, D.C., 2010. http://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/policy_accom.cfm, accessed February 11, 2016.

TABLE 2 PERFORMANCE MANAGEMENT RESOURCES

Performance Based Planning and Programming Guidebook, September 2013

Model Long-Range Transportation Plans: A Guide for Incorporating Performance-Based Planning

Peer Exchange Report on Establishing and Integrating Performance Measures, April 2015

Cross-Modal Project Prioritization Peer Exchange, December 2014

Applying Safety Data and Analysis to Performance Based Transportation Planning

Advancing Metropolitan Planning for Operations: An Objectives-Driven, Performance-Based Approach – A Guidebook, February 2010

Listing of Performance Based Planning Resources on planning.dot.gov

NCHRP 660 Transportation Performance Management: Insight from Practitioners

NADO Transportation Project Prioritization and Performance-based Planning Efforts in Rural and Small Metropolitan Regions

FHWA Transportation Performance Management


This document is organized into four chapters. The first provides the policy context for pedestrian and bicycle performance measures. Chapter 2 establishes an organizational structure for performance measures and describes community goals as a framework for performance measurement. Chapter 3 details how performance measures are applied in practice. Chapter 4 contains a Toolbox of Performance Measures, which highlights a broad range of effective measures for pedestrian and bicycle performance and provides information on their application.


This document when viewed electronically contains various interactive elements to assist you in navigating information. Following are descriptions of the interactive options.

Items listed under the Contents on Page 3, when clicked, will lead to the corresponding section.

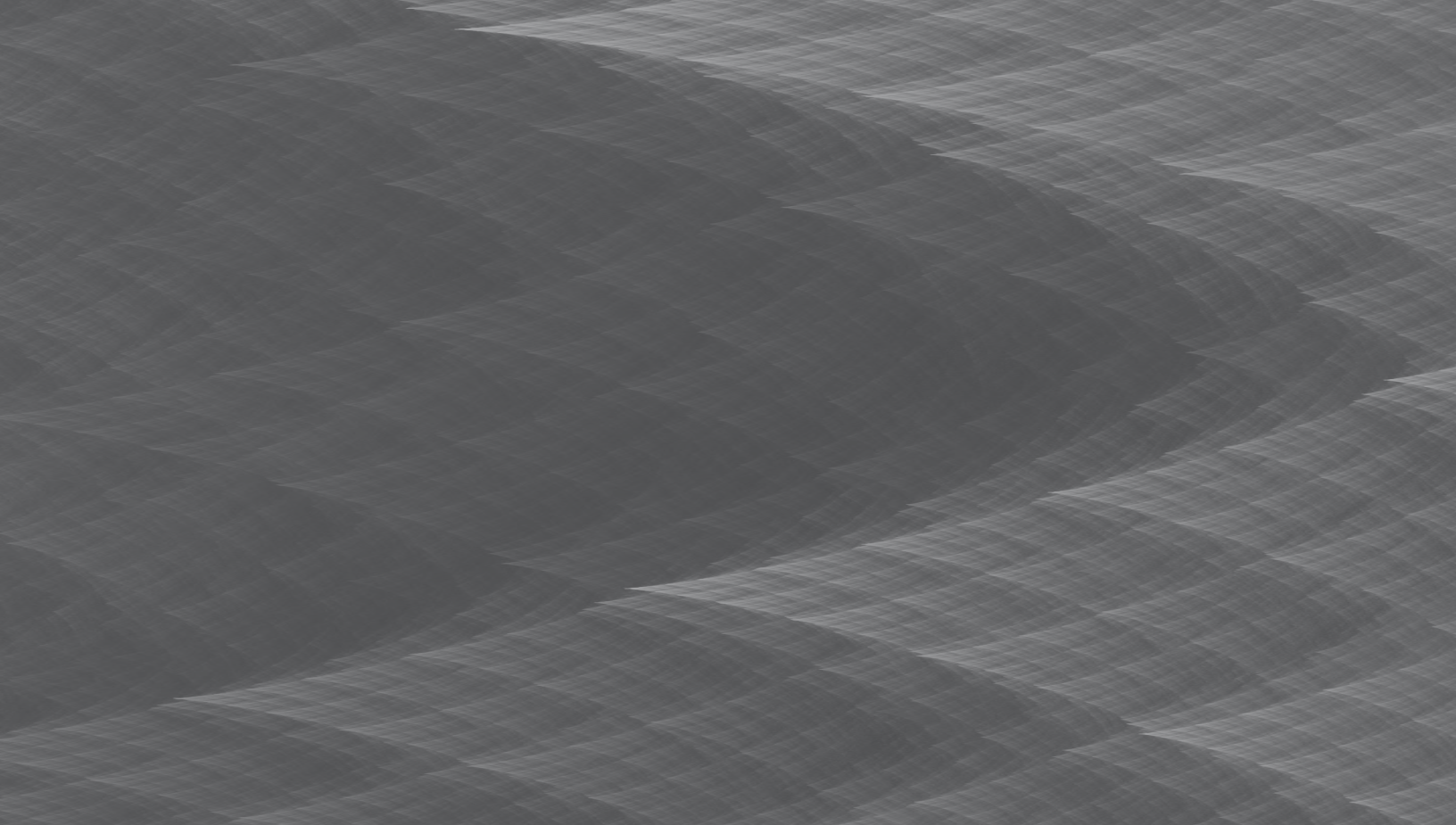
References are provided throughout the document to tables and page numbers for sections containing further information. Each of these, when clicked, will lead to the item.

Text shown in *blue italics*, when clicked, will lead to the referred documentation.

The house icon  in the upper right corner of the odd numbered pages, when clicked, will lead you back to the Contents on Page 3.

The screwtop icon  to the left of the house icon on the performance measure pages will lead you back to Table 5 Goals Applicable to Performance Measures on Page 36.

Performance Measures listed within Table 5 Goals Applicable to Performance Measures on Page 36 and Performance Measures listed under Related Measures on each Performance Measure page are hyperlinks that, when clicked, will lead you to the referenced Performance Measure.





CHAPTER 2

HOW ARE PEDESTRIAN AND
BICYCLE PERFORMANCE
MEASURES ORGANIZED?

HOW ARE PEDESTRIAN AND BICYCLE PERFORMANCE MEASURES ORGANIZED?

Agencies at all levels of government are using a wide range of performance measures to characterize pedestrian and bicycle investments, activity, and impacts. They provide the data needed to support decisionmaking and a means for measuring progress. Performance measures are also effective at communicating with the public, politicians, and professionals.

But no single performance measure can tell a complete story. To be most effective, performance measures must be selected thoughtfully and in connection with a community's goals and objectives. Engaging the public and other stakeholders in the selection of these measures ensures the community's perspectives and priorities are considered. Moreover, data availability and agency capacity impact performance measure approaches. These frame some of the key challenges related to identifying and establishing pedestrian and bicycle performance measures.

CORE CHALLENGES

How should the relationship between measure identification and data availability be handled?

How should contradictory or competing impacts of some measures be balanced?

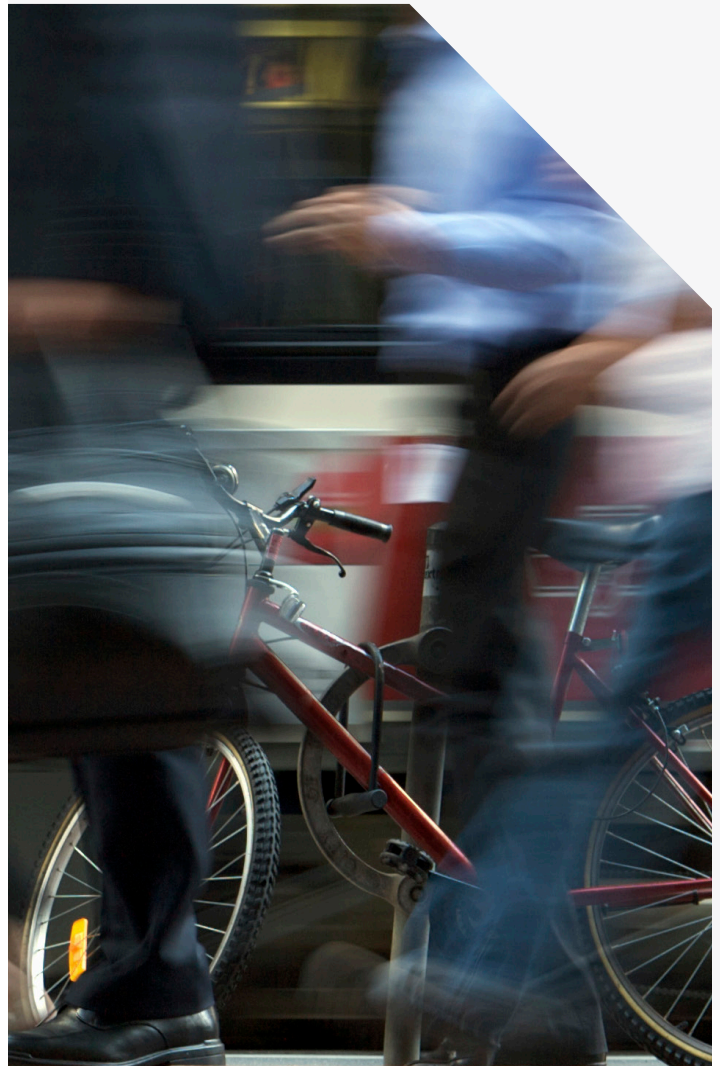
Which measures “matter” in affecting transportation outcomes?

How should “community goals” and “transportation measures” categories be differentiated?

ORGANIZING STRUCTURE

Performance measures allow transportation agencies to align decisions with established community goals. In most cases, transportation itself is not a goal, but rather a means by which other community goals are achieved. For example, “mobility” — referring to the easy movement of people and goods — does not, on its own, achieve important goals. Instead, “mobility” is an important feature of the transportation system that can foster economic activity by connecting workers to jobs.

Using community goals as a framework, performance measures can track progress and aid decisionmaking relating to these goals. Community goals supported by transportation can be organized into seven categories. These goals reflect the broad aims of government and community and are not limited in scope to transportation, though transportation does have a direct relationship to the public's ability to achieve these goals. All of the key performance measures identified in this Guidebook measure performance against one or more of these goals.





COMMUNITY GOALS

- Connectivity
- Economic
- Environment
- Equity
- Health
- Livability
- Safety

Pedestrian and bicycle transportation is critical to each of these goal categories, and many performance measures are useful in characterizing a community's transportation system's ability to further the community goals.

Separate from these community goals, many transportation agencies focus on transportation-specific goals, such as mobility and accessibility. These categories are effective in describing the transportation system and can be useful in setting policies and priorities. But transportation goals are not distinct from the community goal categories listed above. Individual transportation performance measure categories typically relate to more than one of the broader community goals. Chapter 3 provides more detail on the Community Goals and their relationship to walking and bicycling.

Many Transportation Measures relate directly and indirectly to the Community Goals. For example, accessibility is important for Economic goals as it helps connect buyers and sellers. Accessibility also supports a community's livability. Note also that Safety is a common Transportation Measure in addition to being a common Community Goal.

TRANSPORTATION MEASURES

- **Accessibility:** Refers to access for people with disabilities to programs, services, and activities.
- **Compliance:** Conforming to a requirement, e.g., a statute or regulation.
- **Demand:** The amount of existing and potential future walking and bicycling activity.
- **Reliability:** Refers to the degree of certainty and predictability in travel times on the transportation system.
- **Mobility:** The ability to travel or move from place to place.
- **Infrastructure:** All the relevant elements of the environment in which a transportation system operates, including streets, signals, bridges, transit, bike facilities, shared use paths, and sidewalks.

These Transportation Measures are a useful way of thinking about transportation questions, and serve as a cross-cutting subset of the Community

Goals. Many Transportation Measures relate directly and indirectly to the Community Goals.

The interrelationship between community goals and transportation measures is illustrated in Table 3 Community Goals and Related Transportation Measures on Page 21. Each transportation measure supports one or more community goals, as marked in the matrix.

PLANNING FACTORS IN STATEWIDE AND METROPOLITAN TRANSPORTATION PLANNING

It is also important to recognize the planning factors that are part of the Statewide (23 U.S.C. 135) and *Metropolitan Transportation Planning legislation* (23 U.S.C. 134). These factors convey the scope of the transportation planning process and connections to broader community goals. The Community Goals and Transportation Measures above can be incorporated into the planning process to provide for consideration of projects and strategies that align with these factors:

- Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency;
- Increase the safety of the transportation system for motorized and nonmotorized users;
- Increase the security of the transportation system for motorized and nonmotorized users;
- Increase the accessibility and mobility of people and for freight;
- Protect and enhance the environment, promote energy conservation, improve the quality of life, and promote consistency between transportation improvements and State and local planned growth and economic development patterns;
- Enhance the integration and connectivity of the transportation system, across and between modes, for people and freight;
- Promote efficient system management and operation;
- Emphasize the preservation of the existing transportation system;
- Improve the resiliency and reliability of the transportation system and reduce or mitigate stormwater impacts of surface transportation; and
- Enhance travel and tourism.

COMMUNITY GOALS

Performance measures allow transportation agencies to align decisions with established community goals. In most cases, transportation itself is not a goal, but rather a means by which other community goals are achieved.

The first step in establishing a performance measurement program is identifying the community's goals and priorities. Community goals may be developed through several processes and/or documents, but are most commonly developed through comprehensive plans or local, regional, and State transportation plans. These processes should emphasize public and stakeholder engagement to establish community priorities. The research identified seven primary community goals which are commonly used across the United States. Transportation plays a key role in each of the goal categories.

The pedestrian and bicycle performance measures identified in the Toolbox can be used toward one or more of the seven community goals.



CONNECTIVITY

Connectivity represents a community's ability to make connections between its people, businesses, visitors, and environment. Connectivity can be furthered through a physically well-connected transportation network with options that allow people to arrive at places they need to go (e.g., jobs, home, shopping, recreation, etc.). U.S. DOT notes that "connectivity is framed by who you are trying to provide access to, what they need to access, and what mode of transportation they seek to use."⁶ In many ways, all communities and transportation users desire similar connectivity qualities for the transportation network: getting to destinations conveniently, cost-effectively, and reliably. Connectivity of the transportation network for pedestrians and bicyclists is especially important since disconnected networks require people to walk or bike farther, which requires more time and effort. Likewise, connected routes must also be accessible to people with disabilities. Connectivity is generally framed by distance and directness, comfort and perception of safety, convenience and appropriate infrastructure. While most users desire convenience and reliability in how they move from place to place, measuring connectivity can take many shapes and forms and is reflected in the various measures transportation agencies use to assess network connectivity.

6 U.S. Department of Transportation. Ladders of Opportunity - Connect. Washington, D.C., February 8, 2015. <https://www.transportation.gov/home/connectivity>, accessed on February 11, 2016.



ECONOMIC

Improving or enhancing a community's economic productivity is a common aim of public agencies. Economic activity describes the vibrancy of an area and supports needed functions of daily life. Transportation facilitates economic activity by reducing the cost of moving people and goods which frees up resources for additional economic activity and enhances quality of life. Moreover, Federal surface transportation policy (23 U.S.C. 101) states that "transportation should play a significant role in promoting economic growth, improving the environment, and sustaining quality of life."

Transportation investment can impact a local economy in at least two fundamental ways: job impacts and population impacts, which include retail sales. Jobs can either be temporary or long-term. Temporary jobs stem from direct construction employment associated with transportation projects. Long-term (or permanent) jobs are less easily measured, but are attracted to an area based on improvements in transportation access and mobility. Retail impacts describe how a transportation system facilitates shopping, dining, and entertainment.

FHWA identifies some transportation-related measures of economic growth and quality of life,⁷ including things such as:

- Number of jobs created;
- Number of business establishments created;
- Overall increases in gross domestic product or gross regional product; and
- Increases in property values or tax bases.

While these are useful indicators of the direction of the economy or as information for decisionmakers, they can be misunderstood or misused. For instance, construction jobs appear as a cost in some economic analyses, but as a benefit in others. And economic growth can be distinct from economic development. Relocated jobs are economic development for the area that receives them, but only considered growth nationally if they represent new activity that did not previously exist.

7 U.S. Department of Transportation. Economic Development. Washington, D.C., October 20, 2015. http://www.fhwa.dot.gov/planning/economic_development/, accessed February 11, 2016.

ENVIRONMENT

Environmental measures promote the creation and maintenance of a transportation system that minimizes and/or mitigates impacts to the natural environment. Air quality impacts are the most common type of environmental measure, but others evaluate impervious surface and stormwater and noise pollution. The National Environmental Policy Act (NEPA) is the foundation for national environmental policy and goals for the protection, maintenance, and enhancement of the environment. Likewise, sustainable principles and practices are incorporated into DOT's mission and the nation's transportation system, including fostering livable communities, adapting to climate change, increasing corporate average fuel economy, and sustainable highways.

FHWA's Office of Planning, Environment & Realty identifies several environmental impacts related to transportation,⁸ including:

- Air quality;
- Water and wetlands;
- Noise;
- Habitat and wildlife; and
- Climate change.

These outcomes have a direct impact on the health and wellbeing of communities. Yet these "downstream" measures are imprecise for determining a transportation project's impacts. For example, environmental outcomes are affected by factors outside of transportation. Moreover, many of these outcomes may take years before impacts from transportation system changes are measurable.

"Upstream" measures provide a better indication of performance for environmental goals. Each of the environmental outcomes are impacted by vehicle tailpipe emissions, land use and development (including road construction), or both. The performance measures for environmental goals focus on these impacts.

Note that *FHWA Order 5520* on Transportation System Preparedness and Resilience to Climate Change and Extreme Weather Events includes a definition of resilience or resiliency as the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions.

8 U.S. Department of Transportation. Environment. FHWA Office of Planning, Environment & Realty, Washington, D.C., December 9, 2015. <http://www.fhwa.dot.gov/environment/>, accessed on February 11, 2016.

EQUITY

Recognizing the disparate costs and impacts of transportation decisions on populations of different income levels, agencies are beginning to calculate equity factors. Households without access to vehicles may not be well-served by auto-oriented transportation solutions and require walking, bicycling, and transit infrastructure. One component of equity is ensuring that pedestrian facilities along public rights-of-way are accessible so they do not discriminate against people with disabilities and serve people of all ages and abilities.

Transportation plays a critical role in connecting people and communities to economic opportunity. DOT can help more people reach opportunity by ensuring that our transportation system provides reliable, safe, and affordable ways to reach jobs, education and other essential services. U.S. DOT's recent policy initiative, Ladders of Opportunity,⁹ notes that "The choices we make regarding transportation infrastructure at the Federal, State, and local levels can revitalize communities, create pathways to work, and connect hardworking Americans to a better quality of life."



9 U.S. Department of Transportation. Ladders of Opportunity. Washington, D.C., <https://www.transportation.gov/ladders>, accessed on February 11, 2016.



LIVABILITY

Quality of life impacts of transportation systems are evaluated by many local jurisdictions. Livability measures directly acknowledge the interactions and trade-offs between the needs of travelers passing through an area and those living adjacent to the transportation infrastructure. Measures that reflect public opinion are also included within this category. U.S. DOT identifies six core principles of promoting and fostering livable communities “to show how we will pursue coordinated, place-based policies and investments that increase transportation choices and access to public transportation services for all Americans.”¹⁰

- Provide more transportation choices to decrease household transportation costs, reduce our dependence on oil, improve air quality, and promote public health.
- Expand location- and energy-efficient housing choices for people of all ages, incomes, races, and ethnicities to increase mobility and lower the combined cost of housing and transportation.
- Improve economic competitiveness of neighborhoods by giving people reliable access to employment centers, educational opportunities, services, and other basic needs.
- Target Federal funding toward existing communities — through transit-oriented development and land recycling — to revitalize communities, reduce public works costs, and safeguard rural landscapes.
- Align Federal policies and funding to remove barriers to collaboration, leverage funding and increase the effectiveness of programs to plan for future growth.
- Enhance the unique characteristics of all communities by investing in healthy, safe and walkable neighborhoods, whether rural, urban, or suburban.

Pedestrian and bicycle transportation plays a role in each of these principles. Performance measures for livability evaluate a transportation system’s ability to provide flexibility and choice to travelers. And places with higher rates of walking and bicycling have been shown to enhance a community’s livability.

U.S. DOT’s *2013 Status of the Nation’s Highways, Bridges, and Transit*:¹¹ Conditions & Performance also measures the impact of transportation investments on livability through two outcomes and accompanying measures:

OUTCOME 1 IMPROVED NETWORKS THAT ACCOMMODATE PEDESTRIANS AND BICYCLISTS.

Performance Measure: Increase the number of States that have policies that improve transportation choices for walking, wheeling, and bicycling. In FY 2011, the target was 22 States and the actual was 24; in FY 2012 the target was 26, increasing to 27 by 2013.

OUTCOME 2 IMPROVED ACCESS TO TRANSPORTATION FOR PEOPLE WITH DISABILITIES AND OLDER ADULTS.

Performance Measure: Increase the number of States that have developed an Americans with Disabilities Act (ADA) transition plan that is current and includes public rights-of-way. In FY 2011, the target was nine States and the actual was 13; in FY 2012, the target was 13, increasing to 15 by FY 2013.

¹⁰ U.S. Department of Transportation. Livability *101*. Washington, D.C., March 5, 2015. <https://www.transportation.gov/livability/101>, accessed on February 11, 2016.

¹¹ U.S. Department of Transportation. 2013 Status of the Nation’s Highways, Bridges, and Transit: Conditions & Performance. Office of Policy and Governmental Affairs, Washington, D.C., November 7, 2014. <http://www.fhwa.dot.gov/policy/2013cpr/overviews.cfm#1t>, accessed on February 11, 2016.

HEALTH

Public health impacts of transportation decisions typically include changes to levels of physical activity, safety, and air quality. U.S. DOT has identified five primary pathways through which transportation influences public health:¹²

- **ACTIVE TRANSPORTATION**
Transportation agencies and their partners can encourage physical activity by giving people options for getting to places they need to go without driving. They can also reduce the distance between destinations people travel to satisfy daily needs.
- **SAFETY**
Transportation-related crashes are one of the leading causes of death in the United States, and pedestrians and bicyclists make up a disproportionate share of the victims. By providing integrated transportation options and improving roadway facilities, transportation agencies can reduce the incidence of these crashes.
- **CLEANER AIR**
Air pollution has been linked with heart disease and respiratory illnesses, including asthma. Improving transportation system efficiency and supporting expanded transportation options as well as cleaner vehicles and fuels can improve air quality.
- **CONNECTIVITY**
Providing a well-connected, multimodal transportation network increases people's ability to access destinations that can influence their health and well-being, such as jobs, health care services, and parks.
- **EQUITY**
Negative health effects related to the transportation system often fall hardest on more vulnerable members of the community, such as traditionally underserved populations, children, and older adults. See Transportation-Disadvantaged Population Served on Page 90 for more information.

Additionally, health outcomes, such as activity levels, obesity, diabetes, heart disease, and respiratory illness, provide some insight into a transportation system's impact on public health. But these "downstream" measures are imprecise and difficult to measure at a disaggregate level. Health outcomes are impacted by many factors outside of transportation, and may take years

to materialize. For example, connecting a reduction in obesity to the introduction of a multiuse path in a community may not be accurate because many other non-transportation focused policy, infrastructure, and social changes may have occurred to also lead to this reduction. Instead, these five U.S. DOT pathways focus on "upstream" factors through which transportation contributes to public health. Performance measures focusing on levels of walking and bicycling, vehicle tailpipe emissions, and safety will provide useful insight into public health outcomes. Health measures are integrated throughout the Performance Measures Toolbox. The Physical Activity and Health measure deals explicitly with active transportation, while the other categories are featured in related measures. Air quality, for example, is part of the Vehicle Miles Traveled measure, since tailpipe emissions are directly impacted by levels of driving.

Several other initiatives relate health and active transportation. The U.S. Department of Health and Human Services recognizes the role of active transportation in public health. "*Step it Up! The Surgeon General's Call to Action to Promote Walking and Walkable Communities*¹³" underscores the importance of incorporating physical activity into daily life. Specifically, Goal 5 calls for collecting data and conducting research related to walking. Likewise, *Healthy People 2020*¹⁴ identifies *physical activity*¹⁵ and environmental *health*¹⁶ objectives related to active transportation.

12 U. S. Department of Transportation. Transportation and Health Tool: Literature and Resources. Washington, D.C., October 26, 2015. <https://www.transportation.gov/mission/health/literature-and-resources>, accessed on February 11, 2016.

13 U.S. Department of Health & Human Services. Surgeon General. Step It Up! The Surgeon General's Call to Action to Promote Walking and Walkable Communities. Washington, D.C., September 9, 2015. <http://www.surgeongeneral.gov/library/calls/walking-and-walkable-communities/>, accessed March 3, 2016.

14 Office of Disease Prevention and Health Promotion. Healthy People 2020. Washington, D.C., March 4, 2016. <https://www.healthypeople.gov/>, accessed March 4, 2016.

15 Office of Disease Prevention and Health Promotion. Physical Activity, Healthy People 2020 Topics & Objectives. Washington, D.C., March 4, 2016. <https://www.healthypeople.gov/2020/topics-objectives/topic/physical-activity/objectives>, accessed March 4, 2016.

16 Office of Disease Prevention and Health Promotion. Environmental Health, Healthy People 2020 Topics & Objectives. Washington, D.C., March 4, 2016. <http://www.healthypeople.gov/2020/topics-objectives/topic/environmental-health>, accessed March 4, 2016.



SAFETY

In recent years, pedestrian fatalities comprise about 14 percent of all traffic fatalities, with between 4,000 and 5,000 pedestrians killed each year.¹⁷ Another estimated 60,000 to 80,000 pedestrians are injured in roadway crashes annually. Bicycle fatalities comprise about 2 percent of all traffic fatalities and between 500 to 1,000 bicyclists are killed each year. Another estimated 45,000 to 50,000 bicyclists are injured in roadway crashes annually.^{18, 19}

Together, pedestrian and bicycle fatalities are increasing as a share of total traffic deaths. The overwhelming majority of these fatalities and injuries occur when a motor vehicle strikes a pedestrian or bicyclist, either in the road or on the sidewalk.

These conflicts are intensified in urban areas where the numbers of vehicles and nonmotorized travelers are higher. As detailed in U.S. DOT's *Strategic Plan for Fiscal Years 2014-2018*,²⁰ the top priority is to make the U.S. transportation system the safest in the world. The FY 2015-2018 Strategic Objective to achieve this is to "Improve the safety of the transportation system for all users by addressing behavioral, vehicular, and infrastructure safety issues through prevention, minimization, mitigation, and response using innovative and effective partnerships, programs, and resources." To reduce fatalities and injuries for pedestrians and bicyclists, the following strategies are also outlined in the Strategic Objective:

- Encourage States to adopt policies and programs that improve pedestrian and bicyclist safety;
- Work with State, local, and tribal governments to provide more technical assistance;

- Develop training programs for motorists, children, pedestrians, and bicyclists;
- Provide national leadership and increase the technical capability of safety professionals;
- Work with stakeholders to increase the number of States and localities utilizing road diets, pedestrian hybrid beacons, and medians to improve pedestrian safety;
- Work with stakeholders to increase safety for people with disabilities and other road users;
- Distribute community-oriented material that offers guidance on improving pedestrian and bicycle safety;
- Consider adopting vehicle standards to reduce pedestrian deaths; and
- Work with States and stakeholders to improve data collection regarding numbers of pedestrians and bicyclists relative to crash rates, road designs, and drivers.

This goal addresses the safety of the transportation system for pedestrians and bicyclists. Safety performance measures typically track crashes, injuries, and fatalities, though some emerging analysis methods rely on estimated crash modification factors or changes in perception of safety.

17 U.S. Department of Transportation National Highway Traffic Safety Administration. Traffic Safety Facts 2013 Data. Washington, D.C., February 2015. <http://www-nrd.nhtsa.dot.gov/Pubs/812124.pdf>, accessed on March 4, 2016.

18 The Fatal Accident Reporting System (FARS) data only include crashes involving a motor vehicle. <http://www.nhtsa.gov/FARS>

19 U.S. Department of Transportation. Traffic Safety Facts 2013 Data. National Highway Traffic Safety Administration, Washington, D.C., May 2015. <http://www-nrd.nhtsa.dot.gov/Pubs/812151.pdf>, accessed on February 11, 2016.

20 U.S. Department of Transportation. Transportation for a New Generation, Strategic Plan for Fiscal Years 2014 - 2018. Washington, D.C., 2013. https://www.transportation.gov/sites/dot.gov/files/docs/2014-2018-strategic-plan_0.pdf

PEDESTRIAN AND BICYCLE PERFORMANCE MEASURES

Walking and bicycling play an important role in a transportation system's ability to support broader community goals. Together they are the most equitable, environmentally friendly, and healthy means of transportation. Where land uses support short trips, walking and bicycling are also efficient and economically productive.

Performance measures focused on pedestrians and bicycle transportation, therefore, are critical for ensuring transportation systems support the community goals. These objective measures are needed to balance the needs of people on foot and bike with those of transit, drivers, and freight. They also acknowledge the value of redundancy

in a transportation system and recognize that all individuals in the community are likely to benefit from improvements to all travel modes.

Transportation agencies in the U.S. are increasingly using pedestrian and bicycle performance measures across a variety of activities, from annual reporting to project prioritization. Many conduct annual pedestrian and bicycle counts to track changes in walking and bicycling activity over time. Additionally, many agencies document the pedestrian and bicycle features of their transportation networks, including mapping where sidewalks are located, measuring the bicycle network in terms of user comfort, and identifying infrastructure not adequate for people with disabilities. Still, many other agencies are just beginning to consider pedestrians and bicycles in their performance measurement.

ESTABLISHING A PERFORMANCE MEASUREMENT PROGRAM

Transportation agencies use performance measures for many purposes and in many different contexts. The aim of performance measurement programs is to describe how a transportation system works and its impacts on users. No single measure can fully describe the nuances of transportation experience for a variety of travel modes, so many agencies consider multiple measures.

A performance measurement program represents a selection of performance measures used in one or more activities. Analysis of the measures is conducted within a defined geography and timeframe, and using specified data inputs.

Before establishing a performance measurement program, agencies should consider several key questions to understand the scope of their program. The development of the program should engage the public and key stakeholders.

WHAT GOALS ARE THE PERFORMANCE MEASUREMENT PROGRAM SUPPORTING?

Understand the purpose of measuring performance by aligning measures with community goals. Use the goals to frame the selection of performance measures. For more information on goals and performance measures, refer to Community Goals on Page 14.

WHAT IS THE PERFORMANCE MEASURE APPLICATION?

Understand the activity for which performance measures will be used. Is it a reporting function? Or will the results be used to make decisions? Refer to Applications of Performance Measures on Page 24 for more information on common transportation performance measurement activities.

WHAT IS THE GEOGRAPHY OF ANALYSIS FOR THE PERFORMANCE MEASURES?

Identify the physical scope of the performance measurement effort. Statewide analysis requires different considerations from those done at a neighborhood level. Refer to Geography on Page 27 for more information.

WHAT IS THE PREVAILING LAND USE TYPE?

Determine the density and land use type for the analysis. Is the performance measurement activity focused on urban, suburban, or rural areas? Refer to Land Use on Page 31 for more information.



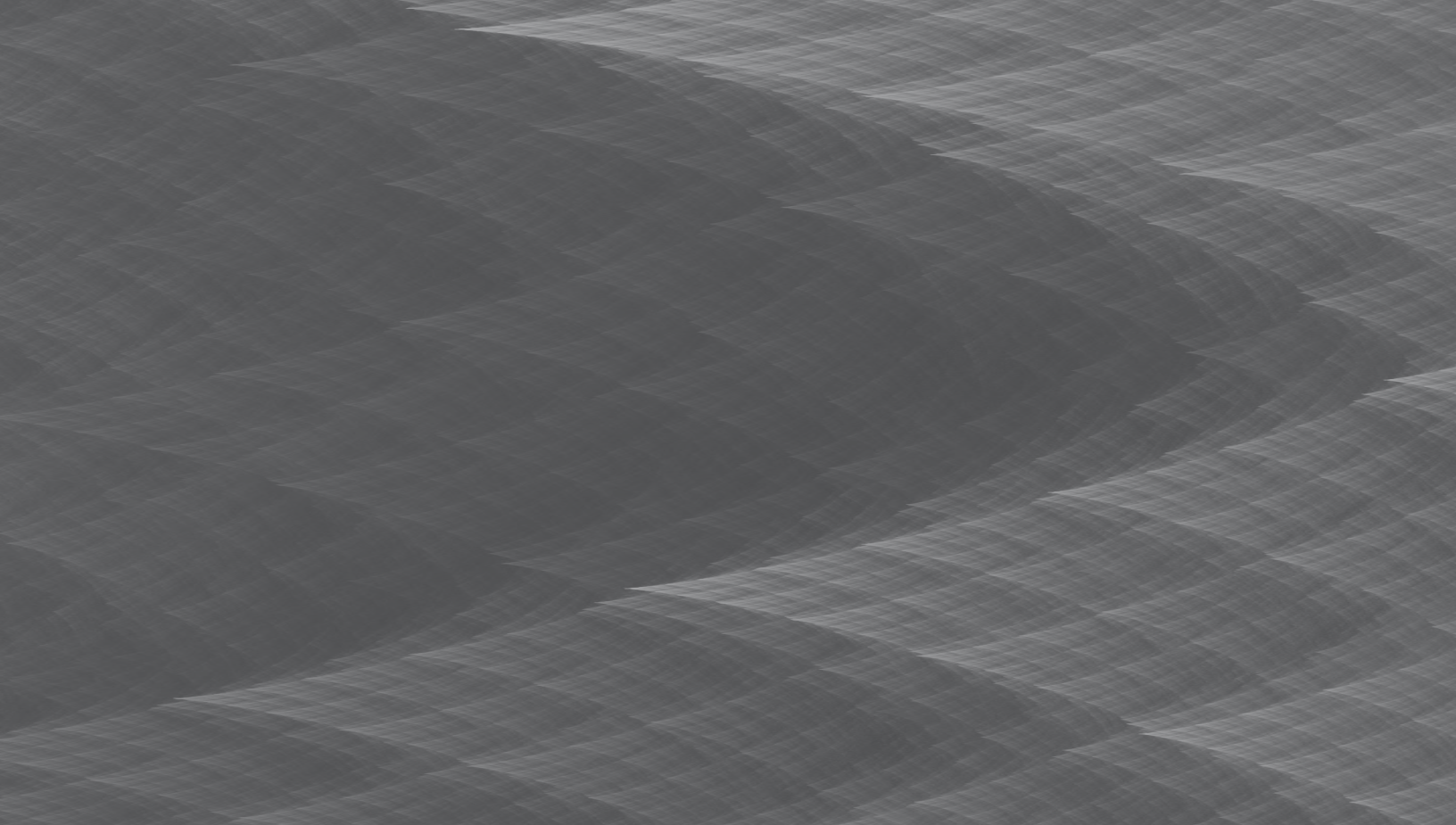
Based on the answers to these questions, certain pedestrian and bicycle performance measures will be more effective than others. The Performance Measures Toolbox on Page 34 recommends the most widely used and useful measures for any combination of goals, applications, geography, and land use type. The Toolbox is designed to help users filter through these variables to identify the measures most appropriate for the user’s circumstances. Using this information, the user can select a number of performance measures and apply them to the performance measurement program. Each entry in the Performance Measures Toolbox also includes information about how to apply the measure and what data are needed.

TABLE 3 COMMUNITY GOALS AND RELATED TRANSPORTATION MEASURES

COMMUNITY GOALS CATEGORIES	TRANSPORTATION MEASURES CATEGORIES					
	ACCESSIBILITY	COMPLIANCE	DEMAND	INFRASTRUCTURE	MOBILITY	RELIABILITY
CONNECTIVITY	High	Low		High	High	Low
ECONOMY	High			Low	High	High
ENVIRONMENT	High		High		Low	Low
EQUITY	High	Low	Low	High	High	Low
HEALTH	High	Low	High	High	Low	Low
LIVABILITY	High	Low	Low	High	Low	High
SAFETY	High	High	High	High	High	Low

DATA AVAILABILITY AND QUALITY

Performance measures are only as strong as the quality of available data. The level of detail and quality of data varies across States and MPOs, particularly as it relates to strategic goals for walking and bicycling. States with significant interest and policy direction to improve walking and bicycling often have more robust data and can in turn develop more robust performance measures. Auto-based data has been collected for years so agencies are adept at collecting this information; however, data for walking and bicycling is less prevalent. The less robust data available, the more difficult it is to make the policy and funding case for improved pedestrian and bicycle facilities at the State, MPO, and local levels.





CHAPTER 3

HOW ARE PERFORMANCE
MEASURES APPLIED IN
PRACTICE?

APPLICATIONS OF PERFORMANCE MEASURES

Communities are increasingly looking for ways to prioritize, compare, and plan for pedestrian and bicycle policies and projects. Performance measures can be used in these applications and at a variety of scales. Different agencies (State DOTs, MPOs, local agencies) have different functions, and therefore have somewhat differing applications for measures. There is not a “one size fits all” measure or metric related to bicycle and pedestrian travel. Understanding the various applications and types of measures that can be employed in each will allow agencies to select measures appropriate for their purpose and in alignment with their goals. Table 4 Example Applications of Performance Measures by Different Agencies on Page 25 illustrates common ways that different agencies apply performance measures to a variety of planning processes.



HOW ARE PERFORMANCE MEASURES APPLIED IN PRACTICE?

Transportation agencies use performance measures to evaluate how well the system serves a variety of needs. Transportation systems and the needs they serve are complex, so no single measure can fully describe their performance. A review of literature for this Guidebook revealed hundreds of different performance measures in use around the U.S., ranging from detailed pedestrian and bicycle experience to ripple effects on the economy and public health. Yet tracking this many measures is infeasible both in terms of cost and time, and would likely result in too much data to support efficient decisionmaking.

Since performance measures can be used in a variety of contexts and toward a wide range of goals, the measures provided in this Guidebook are characterized according to goals and context (type of application, geography, and land use context). The Performance Measures Toolbox in the next chapter identifies the appropriate context for each measure, and provides a brief discussion of data needs and measurement methods. The following sections outline the key elements to consider when identifying pedestrian and bicycle performance measures.

**TABLE 4** EXAMPLE APPLICATIONS OF PERFORMANCE MEASURES BY DIFFERENT AGENCIES

AGENCY/APPLICATION	COMMON PERFORMANCE MEASURE APPLICATIONS				
	PLANNING SCENARIO EVALUATION	LONG-TERM BENCHMARK	ALTERNATIVES COMPARISON	PROJECT NEED/PRIORITIZATION	NEAR-TERM STANDARD
LOCAL JURISDICTION (COUNTY, CITY)					
System/Network Planning	X	X		X	
Corridor or Project Planning			X	X	X
Development Review/ Code Compliance			X		X
Street Design					X
REGIONAL PLANNING AGENCY (MPO)					
System/Network Planning	X	X	X	X	
Regional Policy Development		X			X
Funding Allocation				X	
STATE AGENCY (DOT)					
Statewide System/ Network Planning	X		X	X	
Statewide Policy Development		X			X
Funding Allocation				X	
Code Compliance					X

PLANNING SCENARIO EVALUATION

Long range scenario planning considers multiple future scenarios that are based on potential transportation/land use decisions and investments that could occur over a designated period of time. Scenario evaluation can benefit from consideration of certain bicycle or pedestrian related measures to help inform policy choices. For example, predicted pedestrian and/or bicycle mode split can be a straightforward measure used to evaluate impacts of policies, land use futures, and/or transportation investments through a variety of sketch planning and/or modeling tools. Similarly, evaluation of measures reaching beyond transportation, such as land use density, can impact opportunities for nonmotorized travel and can be used in scenario evaluation to help assess the potential for bicycle or pedestrian travel. Typically scenario planning evaluations feed into transportation system or network planning applications, in addition to other policy documents.

LONG-TERM BENCHMARK

Benchmarking is often used to track progress towards goals over time, usually through annual or other regular reporting. Long-term benchmarking measures often reflect “high level” snapshots that are easily understood by a range of stakeholders. For example, an agency may adopt a goal of “zero traffic-related fatalities within 10 years” and choose to report a simple benchmarking measure of “annual number of traffic-related fatalities” that allows them to track annual progress towards the goal. In this example, other benchmarking measures, such as “number of intersection fatalities” can also help to show progress in agency actions.

ALTERNATIVES COMPARISON

Alternatives comparison is most frequently used at the local jurisdiction level in planning and project development, but is also used by State agencies and other agencies that own or invest in transportation facilities. Pedestrian- and bicycle-related performance measures can be used to compare alternatives in the project planning phase to help inform selection of alternatives that are supportive of walking and bicycling, if applicable to the corridor or project area. For example, “pedestrian route directness” could be used in the development of a corridor design or subarea plan to help select an alternative that provides convenient pedestrian connections along desire lines.

PROJECT NEED/ PRIORITIZATION

Understanding and prioritizing bicycle and pedestrian project needs is an application performed by agencies across all levels, particularly when budgets are constrained and expenditures are under a high degree of scrutiny. Agencies can use performance measures to ensure a data-driven, transparent prioritization process that is connected to agency goals and, if applicable, available funding sources. For example, an agency may prioritize investments based on the demand served by a particular project, either using existing demand (pedestrian and/or bicycle count data) or estimating potential demand using “density of destinations” or other similar types of measures.

NEAR-TERM STANDARD

Setting near-term standards that establish a minimum baseline for walking and bicycling performance provides consistency with agency goals and benchmarking measures, and ensures that larger policy goals are reflected in detailed evaluations, project-level decisions, and implementation. Standards are applied most frequently during development review and code compliance at the project level. Automobile level-of-service and volume-to-capacity ratio are frequently used as standards; however, relying only on these standards often results in a degradation in pedestrian or bicycle performance. Implementing standards related to pedestrian and bicycle performance, such as system completeness or pedestrian/bicycle delay can aid in the development of projects that support these travel modes.



GEOGRAPHY

While walking and bicycling performance measures have many similar qualities across the country, the geography of their application shapes the need, use, and overall impact these measures have on communities. This guide breaks down each measure by the geographic context, where the measures are most applicable, and how measures may influence actions and policies in these specific geographic locations. The measures are separated into three geographic categories: local, regional, and State. “Local” refers to cities, towns, and some county municipalities. “Regional” refers to Metropolitan Planning Organizations (MPOs), transit agencies, and other regional planning agencies. “State” refers primarily to State Departments of Transportation (DOT).

LOCAL PERFORMANCE MEASUREMENT

Pedestrian and bicycle performance measures for local jurisdictions vary widely by location, due in part to the wide range of population sizes, policies, and land use contexts governed by local agencies. In many cities across the country, emphasis on performance measures may also be a result of proactive individuals or government officials. There are also no Federal planning requirements for local agencies, which means some local jurisdictions have no measures while others maintain detailed data collection programs that allow for a broad range of measures. Because there are so many local agencies across the country, operating with various authorities, goals, and context, walking and bicycling performance measures may be used under numerous applications, and in some cases, not at all. Despite the absence of Federal planning requirements for local agencies, ADA and Section 504 regulations require local governments to develop transition plans to eliminate barriers to accessibility.

Local transportation planning deals with pedestrians and bicyclists through separate analysis and evaluation procedures. The common result is a transportation plan with elements or chapters dedicated to identifying deficiencies and recommendations for individual modes. For instance, the Master Transportation Plan for Arlington County, Virginia is divided into several modal elements, which are tied together through overarching goals and policies. Similarly, Oregon requires that all jurisdictions with more than 10,000 residents develop a 20-year Transportation System Plan (TSP) that includes modal elements. Oregon TSP Guidelines suggest that this requirement is best met by performing mode-specific analysis and organizing the TSP by mode. This type of mode-specific planning typically performed by local agencies suggests that performance measurement methodologies add value to the bicycle

and pedestrian components of comprehensive transportation planning efforts at the local level.

The New York City Department of Transportation (NYC DOT) is one of the more advanced local jurisdictions using non-auto performance measures as a method for measuring progress toward achieving citywide goals. For instance, they have been able to use a range of performance measures to conduct detailed before-after evaluations of specific projects to determine if the overall goals are being met (e.g., designing for safety, designing for all street users, designing great public spaces).²¹

Similarly, the District of Columbia Department of Transportation (DDOT) conducted a detailed bicycle facility evaluation to gain a better understanding of potential design flaws, the types of users attracted to protected bicycle facilities, operational and safety trade-offs with autos, and adherence to traffic laws. Such before-after evaluations can be valuable tools for improving future designs, and can be seen as “success” stories to the public, stakeholders, and political appointees, assuming appropriate performance measures are used to accurately inform trade-offs and impacts to users.

Local jurisdictions may also use performance measures to document progress towards fully implementing a policy or achieving a benchmark. Many cities have now passed complete streets policies and are using performance measures to document progress towards implementing these policies. For example, the City of Billings, Montana published the “Complete Streets Benchmark Report” in 2013 to track the effectiveness of its policy over time.²² Lastly, local jurisdictions also use performance measures to better understand return on investment on pedestrian and bicycle facilities.

21 New York City DOT. Measuring the Street: New Metrics for 21st Century Streets. New York City, 2012. <http://www.nyc.gov/html/dot/downloads/pdf/2012-10-measuring-the-street.pdf>

22 Friday, W. et al. Complete Street Benchmark Report. Billings, Montana, June 2013. <http://www.smartgrowthamerica.org/documents/cs/impl/mt-billings-2013report.pdf>.

REGIONAL PERFORMANCE MEASUREMENT

MPOs and other regional planning agencies employ a wide range of methods to track performance. MPOs are required to provide for the establishment and use of a performance-based approach to transportation decisionmaking, develop performance measures, targets, and performance reporting. They also must coordinate with the State DOT in developing performance targets. Some consider pedestrians and bicyclists explicitly, while others rely on traditional measures, such as congestion, travel time, and vehicle delay. Additional roles and responsibilities vary depending on the MPO's enabling legislation. Metro in Portland, Oregon has a publicly elected board of directors and is empowered to pass its own regional legislation. Other MPOs, such as the Metropolitan Council in Minneapolis-St. Paul are granted regional authority through State statutes, and can overrule some local decisions and actions. Both Portland Metro and the Metropolitan Council manage regional land use and administer urban growth boundaries, however, most MPOs have more limited land use authority. Most regional agencies primarily focus their performance measurement efforts on project prioritization, benchmarking, and project impact assessment.

PROJECT PRIORITIZATION

MPOs are responsible for distributing Federal funding through a project prioritization process as a part of their long range planning role. In general, a review of selected long range and regional transportation plans (LRTPs and RTPs) indicates that there is currently no widely used, objective system for evaluating and prioritizing individual pedestrian and bicycle transportation projects compared to projects serving other modes. More typically, project needs lists are generated separately for each mode, with the LRTP and RTP priority project list developed by selecting a certain number of projects from each mode. Also, the prioritization methods often differ for each mode. For example, highway projects may be prioritized based on sophisticated travel demand modeling, while pedestrian and bicycle projects may be prioritized based on connectivity gaps or public requests. Although quantitative analysis is used more frequently to inform prioritization of highway projects than pedestrian and bicycle projects, project prioritization for all modes is heavily influenced by policy and the desires of local jurisdictions. The ActiveTrans Priority Tool, developed as part of NCHRP 803: Pedestrian and Bicycle Transportation Along Existing Roads (link: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_803.pdf), provides guidance to help agencies prioritize improvements to pedestrian and bicycle facilities.

For example, the 2035 Regional Transportation Plan for the Capital Area Metropolitan Planning Organization (Austin, Texas metropolitan area) separately identifies deficiencies for each mode. The prioritized project list includes hundreds of millions of dollars for pedestrian and bicycle projects, but the projects identified are not based on any quantitative assessment comparing nonmotorized, highway, and transit projects to develop an optimum balance of multimodal facilities. Rather, the selected projects reflect policy direction on the part of the MPO and member agencies as to the appropriate levels of funding for each mode.

BENCHMARKING

Like States, MPOs may track performance over time through regional benchmarking efforts or public-facing dashboards. These annual tracking metrics often focus on automobile performance measures, including regional congestion and air quality, which MPOs are required to monitor. For example, the Memphis MPO ties its performance measures to nine key transportation goals, spanning many of the performance measure categories documented throughout this document. Nearly half of the performance measures identified focus on pedestrian and bicycle issues, including pedestrian and bicycle crash history, perception of safety, and the number of residential parcels within walking distance to regional attractors and generators.

PROJECT IMPACT ASSESSMENT

Some regional planning entities are involved with assessing impacts of development, often in partnership with local and State agencies. Florida's regional planning agencies play a role in growth management and are moving toward multimodal performance measurement. Agencies identify regional goals and select performance measures from an extensive list (over 200) to evaluate performance against these goals.



STATE PERFORMANCE MEASUREMENT

Federal surface transportation legislation emphasizes performance measurement of all facets of transportation in the United States. At the statewide level specifically, “the transportation planning process shall provide for the establishment and use of a performance-based approach to transportation decisionmaking to support the national goals. The performance measures and targets established shall be considered by a State when developing policies, programs, and investment priorities reflected in the statewide transportation plan and statewide transportation improvement program.”²³ States may develop their own measures to address their specific goals within their long-range transportation plan, but they are also required to use federally designated measures per 23 U.S.C. 150. Additionally, States must ensure the long-range planning process occurs in conjunction with a Statewide Transportation Improvement Program (STIP), which must be updated every four years.²⁴ The goals and performance measures identified in the State long range plan are used to assess statewide infrastructure priorities that ultimately lead to projects in the STIP. There should be a strong connection between the State’s STIP and their ADA/504 transition plan, as reflected in the requirements for State certifications when submitting their STIP to FHWA contained in 23 CFR 450.218(a)(6) and(10).

Some State DOT LRTPs are very multimodal in nature and provide goals and performance measures that relate to all modes, including details on freight, passenger rail, aviation, and pedestrians and bicyclists.²⁵ A State DOT LRTP is essentially the master copy of a State’s visions and priorities, while the detailed and nuanced elements of these goals and priorities are provided in more focused statewide plans, such as a Pedestrian and Bicycle Master Plan, Strategic Highway Safety Plan (SHSP), or Freight Plan, to name a few. For instance, Maryland DOT’s statewide plan is completed with coordination of the State’s modal agencies. Because many of the State’s goals apply to all modes, the statewide plan details

each agency’s part in furthering the broad goals for the transportation system. As a result, specific goals such as building connected networks or improving safety are applicable to all modes.

State DOTs have access to large amounts of data, specifically data related to roadway infrastructure, operations, safety, and funding. With such a large amount of available data, areas such as data management, employee accountability, and cross-disciplinary communication can be challenging for State DOTs. As a result, most statewide performance measures are broad in nature, particularly as they relate to pedestrian and bicycle issues. Historically, State DOTs have focused on automobile-centric data and performance measurement, so it is not surprising that few performance measures have been developed for pedestrian and bicycling conditions. Most State DOTs have vast quantities of data that can be used to assess walking and bicycling statewide; however, relevant measures typically remain broad in scope. Effective performance measurement must be also based on consistent data collection techniques and storage across all DOT groups. Many State DOTs now use real-time dashboards that make data available to State employees and the public, thus allowing access to consistent sets of data used for project prioritization.

The use of performance measures, including pedestrian and bicycle measures, primarily focus on project prioritization and benchmarking.

PROJECT PRIORITIZATION

State DOTs can use performance measures to assist in the prioritization of projects, or at the very least, provide important data points for making decisions. However, not all State DOTs score projects as part of the transportation plan development process. Because transportation planning is inherently driven by local conditions and policy choices, the lack of scoring does allow local and regional agencies to shape their future. At the very least, statewide performance measurement can lay the groundwork for local jurisdictions to realize elements important at all levels of government. It can also result in prioritization of projects most important to addressing statewide goals. In some cases, State DOTs require local jurisdictions to provide information on what statewide plan goals and priorities their submitted proposed projects support. So while States may not be directly prioritizing projects, their stated priorities can shape projects.

23 Title 23, U.S. Code Chapter 1 Section 135(d)(2) - Statewide transportation planning (2012). <https://www.gpo.gov/fdsys/pkg/USCODE-2011-title23/pdf/USCODE-2011-title23-chap1-sec135.pdf>, accessed February 12, 2016.

24 Zietsman, J., Ramani, T., Potter, J., Reeder, V. & DeFlorio, J. NCHRP Report 708: A Guidebook for Sustainability Performance Measurement for Transportation Agencies. Transportation Research Board of the National Academies, Washington, D.C., 2011.

25 Grant, M., McKeeman, A., Bowen, B., Bond, A., Bauer, J., LaSut, L., Barnes, B. & D’Ignazio. Model Long-Range Transportation Plans: A Guide for Incorporating Performance-Based Planning. Federal Highway Administration, August 2014.

BENCHMARKING

Statewide pedestrian and bicycle performance measures are most often used as benchmarking tools to gauge policy- and project-level achievements. Performance measures provide insight into statewide progress on specific policies and goals that frame an overall vision for a State. For instance, the *Maryland 20-Year Bicycle & Pedestrian Master Plan*²⁶ provides a statewide update on walking and bicycling every five years, which includes measuring progress on facility implementation and identifying areas where the State needs to improve in order to meet goals and priorities for walking and bicycling. The use of performance measures to assess “progress” allows responsible agencies and the public to help identify key issues, challenges, opportunities, and progress statewide.

Some States also provide detailed annual performance reports or scorecards, thus promoting government transparency and overall program improvement. For example, the Wisconsin Department of Transportation’s Performance Improvement Program uses statewide goals of Mobility, Accountability, Preservation, Safety and Service (MAPSS)²⁷ to outline a scorecard of measures presented online quarterly. The Mobility goal within MAPSS includes “Bicycle Accommodation” as one measure, and includes detailed explanations and data including the DOT division responsible for the data, why it is important, the performance measure target, how it is measured, progress, factors that affect results, and ongoing steps for improvement.



26 Maryland Department of Transportation. Maryland Twenty-Year Bicycle & Pedestrian Master Plan, January 15, 2014. <http://www.mdot.maryland.gov/bikewalkplan>

27 Wisconsin Department of Transportation. MAPSS Performance Improvement Report, January 2016. <http://wisconsin.dot.gov/Documents/about-wisdot/performance/mapss/perf-report.pdf>, accessed on February 12, 2016.



LAND USE

An additional subset of these three geographic categories that may have a substantial influence on walking and bicycling performance measures is the land use context, primarily rural, suburban, and urban. The land use context may impact the effectiveness and applicability of proposed measures. For example, a local municipality may have specific policies to improve pedestrian comfort throughout a jurisdiction, but if the jurisdiction includes various land use contexts, key measures used in a dense urban core may not be appropriate to evaluate pedestrian comfort in a suburban or rural setting.

URBAN

Urban land use contexts tend to have the highest number of applicable performance measures for walking and bicycling. Urban areas have the greatest numbers of pedestrians and bicyclists interacting with each other, with motor vehicles, and with the surrounding infrastructure, resulting in varying and measurable levels of safety, comfort, efficiency, and connectivity. Investment in walking and bicycling facilities is more impactful in areas with the greatest number of users and the return on investment is high. A pedestrian countdown signal or a median pedestrian refuge may accommodate a large number of pedestrians in a dense environment. Because walking and bicycling is highest in urban areas, data is also likely to be more robust, resulting in a greater number of possible performance measures.

SUBURBAN

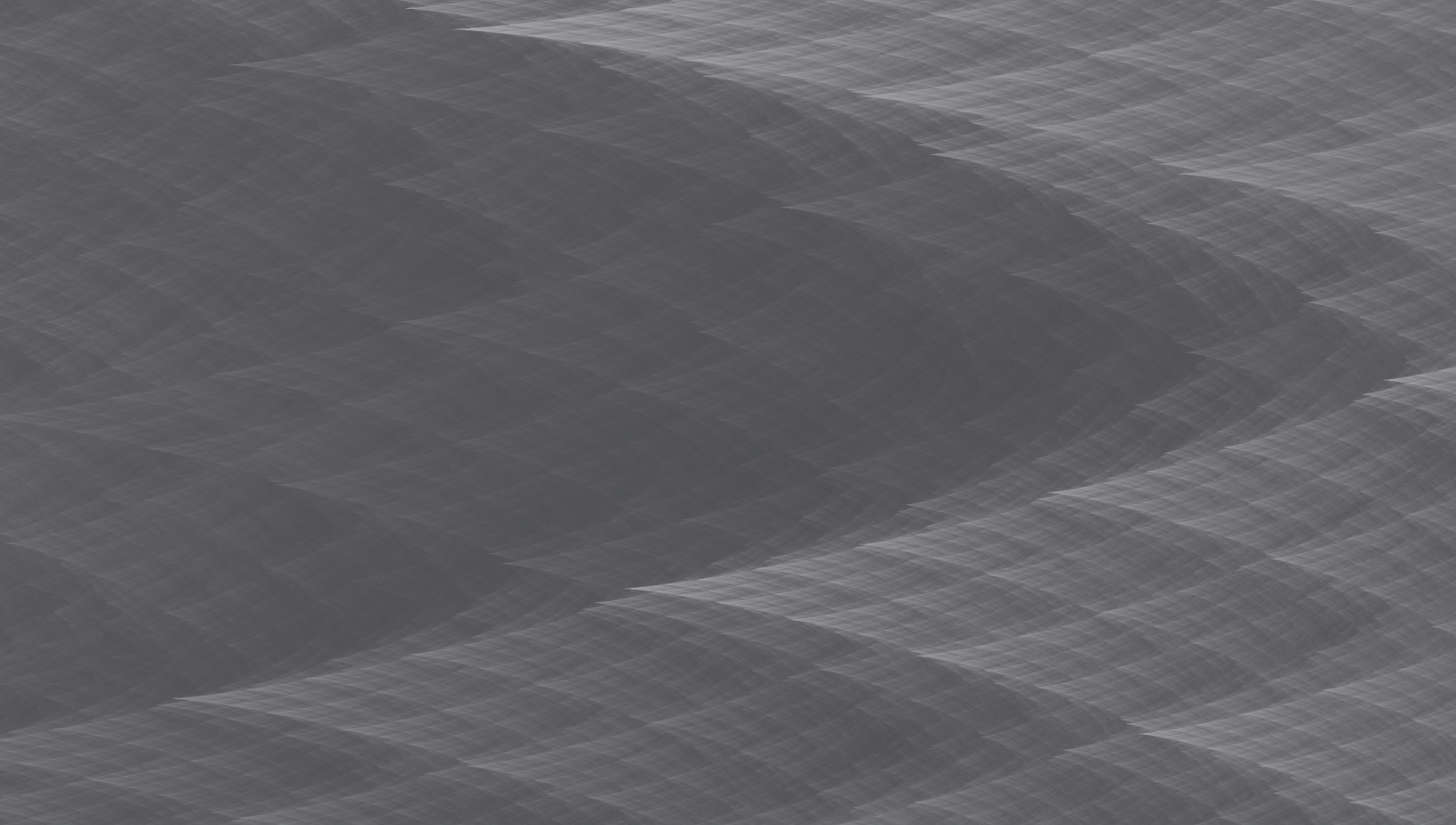
For the most part, performance measures that are appropriate and meaningful in an urban context are also useful in a suburban context, although possibly not as strong. For instance, using pedestrian and bicycle volume as a basic yet important performance measure may be more useful in an urban setting because data is more robust and likely more prevalent in an urban setting. But that does not negate the importance of pedestrian and bicycle volumes in a suburban setting, only that it may not be as strong a link to understanding the types of walkers and bicyclists on a trail, or the need for additional infrastructure on specific streets. On the other hand, using a connectivity measure may be even more important in a suburban setting than an urban setting because suburban development patterns are traditionally less connected (e.g., cul-de-sacs, poor grid of streets) and those small connections may be of greater importance in an area with limited infrastructure.

RURAL

Identifying and implementing effective walking and bicycling performance measures in a rural setting is challenging and many measures are not as meaningful when applied in rural areas. Some of these issues are data-related, because rural settings have very limited amounts of data. Likewise, issues with walking and bicycling in a rural setting are very different from those in more urban settings. For instance, retail impacts can be a strong measure for assessing before-after impacts of a new bike facility on an urban street, but such a measure may not be applicable in a rural setting without businesses. A more appropriate comparable measure could be the level of tourist activity generated or supported by rural walking and bicycling facilities. In some cases, measures that may be applicable in both urban and rural settings yield different action recommendations. For example, reviewing the number of bicycle related crashes may point to the need for a separated bike facility in an urban setting but wider shoulders in a rural setting.

TRANSITIONAL

In many communities there are areas where land use is in a period of transition. For example, a formerly rural area that is becoming more suburban as a result of greenfield development, business establishments with large surface parking lots, and wider roads to accommodate increased motor vehicle traffic. Or a suburban area that is becoming more urban as a result of increased density and more mixed use and human scale development.





CHAPTER 4

PERFORMANCE MEASURES
TOOLBOX

PERFORMANCE MEASURES TOOLBOX

This chapter presents a Toolbox of Performance Measures, which detail a broad range of performance measures for pedestrian and bicycle transportation. Since performance measurement can be done in a variety of contexts and toward a wide range of goals, the measures are characterized according to goals and context (type of application, geography, and land use context). A brief discussion of data needs and measurement methods are also described for each measure. The Toolbox highlights resources for developing measures to facilitate high quality performance based planning. This includes ways to express measures, categories of measures, and data resources for computing measures. The following definitions are used in the performance measure matrix.

GOALS

The pedestrian and bicycle performance measures identified in the matrix can be used toward one or more of seven goals.

- **CONNECTIVITY** - interconnected pedestrian and/or bicycle transportation facilities that allow people of all ages and abilities to safely and conveniently get where they want to go.
- **ECONOMIC** - describes how transportation decisions impact the economic health of a municipality or region.
- **ENVIRONMENT** - environmental measures promote the creation and maintenance of a transportation system that minimizes and/or mitigates impacts to the natural environment. Air quality impacts are the most common type of environmental measure, but others evaluate impervious surface and stormwater and noise pollution.
- **EQUITY** - recognizing the disparate costs and impacts of transportation decisions on populations of different income levels, agencies are beginning to calculate equity factors. Households without access to vehicles are not usually well-served by auto-oriented transportation solutions and require walking, bicycling, and transit infrastructure. One component of equity is ensuring that pedestrian facilities along public rights-of-way are accessible so they do not discriminate against people with disabilities and serve people of all ages and abilities.
- **HEALTH** - public health impacts of transportation decisions typically include changes to levels of physical activity, safety, and air quality. Increases in walking and bicycling are correlated with higher levels of public health.
- **LIVABILITY** - quality of life impacts of transportation systems are evaluated by many local jurisdictions. Livability measures directly acknowledge the trade-offs between the demands of auto travelers passing through an area and those living adjacent to transportation infrastructure. Measures that reflect public opinion are also included within this category.
- **SAFETY** - addresses the safety of the transportation system for all users. Safety performance measures typically track crashes, injuries, and fatalities, though some are based on estimated changes in numbers of crashes.



CONTEXT

In choosing pedestrian and bicycle performance measures, context can be a significant consideration. Some measures may be more effective at one geographic scale than another. Three contextual categories are detailed in the table: Application, Geography, and Land Use Context. The context categories for each performance measure identify the preferred application, geography, and land use context, as well as those that are possible, but may not be strongest.

APPLICATION

Performance measures are applied to a variety of planning processes.

- **PROJECT PRIORITIZATION** - scoring or ranking projects according to a set of objective criteria. For example, agencies may use an objective set of criteria to evaluate potential transportation projects for funding.
- **ALTERNATIVES COMPARISON** - comparing performance of different design options for walking and bicycling as part of the planning process. Generally used on specific projects, two or more possible configurations can be compared using a variety of measures.
- **SCENARIO EVALUATION** - evaluating planning scenarios based on performance for walking and bicycling. Agencies use models to test long range scenarios with performance measures quantifying differences in outcomes.
- **BENCHMARKING** - tracking change over time, usually through annual or other regular reporting. For example, transportation dashboards provide a high-level overview of performance across a variety of focus areas.
- **STANDARD** - establishing a minimum baseline for walking or bicycling performance through code or policy. Automobile Level of Service is the most common transportation standard, but standards for pedestrian and bicycle facilities are also used.

GEOGRAPHY

The geographic scales at which performance measurement takes place.

- **LOCAL** - city, town, and some county municipalities
- **REGIONAL** - metropolitan planning organizations, transit agencies, and other regional planning agencies
- **STATE** - State departments of transportation

LAND USE CONTEXT

Land use context impacts opportunities for walking and bicycling, which makes some performance measures more or less effective. Classifications range from **rural** to **suburban** to **urban**.

TABLE 5 GOALS APPLICABLE TO PERFORMANCE MEASURES

PERFORMANCE MEASURES	GOALS						
	CONNECTIVITY	ECONOMIC	ENVIRONMENT	EQUITY	HEALTH	LIVABILITY	SAFETY
Access to Community Destinations	X	X	X	X	X	X	X
Access to Jobs	X	X		X			
Adherence to Accessibility Laws	X	X		X	X	X	X
Adherence to Traffic Laws					X		X
Average Travel Time	X	X		X		X	X
Average Trip Length	X	X		X		X	X
Connectivity Index	X	X		X		X	X
Crashes				X	X	X	X
Crossing Opportunities	X			X	X	X	X
Delay				X		X	X
Density of Destinations	X	X		X	X	X	X
Facility Maintenance	X			X		X	X
Job Creation		X					
Land Consumption		X	X			X	
Land Value		X					



PERFORMANCE MEASURES	GOALS						
	CONNECTIVITY	ECONOMIC	ENVIRONMENT	EQUITY	HEALTH	LIVABILITY	SAFETY
Level of Service				X		X	X
Miles of Pedestrian/Bicycle Facilities	X			X	X	X	X
Mode Split			X	X	X	X	
Network Completeness	X	X	X	X	X	X	X
Pedestrian Space		X		X		X	X
Person Throughput		X		X			
Physical Activity and Health				X	X	X	
Population Served by Walk/Bike/Transit	X			X	X	X	X
Retail Impacts		X					
Route Directness	X	X	X	X		X	X
Street Trees			X		X	X	X
Transportation-Disadvantaged Population Served	X			X			
User Perceptions					X	X	X
Vehicle Miles Traveled (VMT) Impacts			X		X	X	X
Volume			X		X		X

PERFORMANCE MEASURE

ACCESS TO COMMUNITY DESTINATIONS

The proximity of pedestrian, bicycle, and transit infrastructure and services to origins and destinations (e.g., shopping, recreation, entertainment, etc.).

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

RELATED MEASURES

- Access to Jobs
- Density of Destinations
- Retail Impacts
- Transportation-Disadvantaged Population Served

CONTEXT

PERFORMANCE MEASURE APPLICATION

PROJECT PRIORITIZATION

A measure of access to destinations can also be used to prioritize investments in filling gaps in the pedestrian or bicycle network. For instance, projects that will allow for continuous access to a high number of destinations can be prioritized over projects that are not critical for access to destinations.

ALTERNATIVES COMPARISON (POSSIBLE)

Access to specific destinations can be used in comparing different investment alternatives, particularly if the alternatives represent different options for providing bicycle or pedestrian routes

SCENARIO EVALUATION (POSSIBLE)

Access to destinations can be applied in evaluating future scenarios of various potential transportation and land use plans.

BENCHMARKING

Access to destinations can be used in benchmarking by assessing the portion of households that have access to destinations within a walking or biking distance along the transportation network. As transportation connectivity investments are made and land uses evolve, this metric will show increased access.

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input checked="" type="checkbox"/>	<input type="checkbox"/>
REGION	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LOCAL	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
SUBURBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
RURAL	<input type="checkbox"/>	<input checked="" type="checkbox"/>

DATA NEEDS & SOURCES

- Local parcel data.
- GIS data on schools, parks, healthcare centers, and other daily destinations.
- NAICS coded employment data, available from the U.S. Bureau of Labor Statistics.
- GIS data on transportation network for all modes.
- Optional: Demographic data from the U.S. Census Bureau.

HOW TO TRACK

First, an agency needs to define “destinations” of interest that will be included in the analysis or select specific types of destination for the analysis. Community destinations may include schools, parks, retail sites, grocery stores, medical centers, businesses with a certain number of employees, or even high-density residential locations. An “access to destinations” analysis can also be related to a specific land use, such as “access to neighborhood elementary schools.”

There are a variety of methods for evaluating the transportation network's effectiveness in providing access to community destinations. Each of the following measures can substitute travel time (e.g. 20 minutes) for distance (e.g. ½ mile) or vice versa:

- Proportion of residences within a ½-mile walking distance or 2-mile biking distance to specific key destinations, such as parks or elementary schools.
- Proportion of residences within ½-mile walking distance or 2-mile biking distance to specific key destinations along a completed pedestrian or bicycle facility.
- Proportion of residences with access to a predefined set of “community destinations” within a 20-minute walk or 20-minute bike ride.
- Percent of the network complete for pedestrians and bicyclists within ½ mile and 2 miles respectively of each designated destination.
- Number of destinations that can be accessed within a ½ mile along a walking network from a given point on the network.
- Number of destinations within 3 miles along a bicycling network from a given point on the network.

Many communities calculate these distances “as the crow flies,” but this method assumes that a destination may be accessed equally from all sides. A network analysis method allows for more reliable distance calculations. Keep in mind that network distance does not account for the safety or comfort of a route.

A baseline list of community destinations for this measure may include:

- Bikeshare stations
- Bus stops
- Community Centers
- Community colleges
- Community services
- Government offices
- High density residential
- Hospitals and other health facilities
- Major tourist destinations
- Major retail and entertainment
- Office buildings
- Parks
- Places of worship
- Public libraries
- Retirement homes
- Schools
- Transit centers
- Universities or colleges

PEERS TRACKING THE MEASURE

- ODOT Region 1 used “access to destinations” in the Active Transportation Needs Inventory project to help inform the evaluation and prioritization of bicycle and pedestrian investments.
- Portland, Oregon set a 90% target of households within 20 minutes walking or bicycling to daily needs.
- The Atlanta Regional Commission (ARC) tracks proximity to key regional destinations – including transit, home/work, and regional trails – to assess the regional distribution of walking and bicycling potential, opportunity, and equity. ARC uses active transportation travelsheds (1-3 miles) and 20-minute neighborhoods as regional planning frameworks.
- The Indianapolis MPO's Central Indiana Regional Bikeways Plan tracks educational institutions, parks, recreation and fitness locations, and other destinations. Proximity and access to these destinations can make up to 23% of a projects score for determining priorities.
- Washington State DOT uses “potential to connect pedestrians/bicyclists to businesses, community resources, and/or job opportunities” in their Pedestrian and Bicycle Program application review criteria which is used to inform evaluation and prioritization of investments.

NOTES

The quality of certain types of destinations may be relevant in more detailed analyses. For example, the quality and features of parks also relate to equity and health, so parks data may also include information about available amenities (e.g., activity fields, bike parking, bathrooms, internal trails, etc.) and the analysis can include a breakdown of access to particular activities by neighborhood, if desired.

Some destinations may generate much more activity than others, for example a major regional park versus a small neighborhood park. Destinations can be weighted in the analysis to reflect these differences.

PERFORMANCE MEASURE

ACCESS TO JOBS

The ability of pedestrian, bicycle, and transit infrastructure and services to connect people to places of employment.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

RELATED MEASURES

- Density of Destinations
- Population Served by Walk/Bike/Transit
- Retail Impacts
- Transportation-Disadvantaged Population Served

CONTEXT

PERFORMANCE MEASURE APPLICATION

PROJECT PRIORITIZATION

A measure of access to jobs can be used to prioritize investments in filling gaps in the pedestrian or bicycle network. For instance, projects that will allow for continuous access to a high number of jobs can be prioritized over projects that are not critical for access to jobs.

ALTERNATIVES COMPARISON (POSSIBLE)

Access to Jobs can be used in comparing different project alternatives, particularly if the alternatives represent different options for providing bicycle or pedestrian routes.

SCENARIO EVALUATION (POSSIBLE)

Access to Jobs can be applied in evaluating future scenarios of potential transportation investments and land use changes.

BENCHMARKING

Travel time to work, by mode, can be a useful benchmark for tracking progress on implementing a policy to improve access to jobs in a given region. As transportation connectivity investments are made and land uses evolve, this metric will show increased access.

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input checked="" type="checkbox"/>	<input type="checkbox"/>
REGION	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LOCAL	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
SUBURBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
RURAL	<input type="checkbox"/>	<input checked="" type="checkbox"/>

DATA NEEDS & SOURCES

- U.S. Census demographic and jobs data.
- U.S. Bureau of Labor and Statistics
- GIS transportation network for all modes.
- Local transportation costs (e.g., fuel prices, transit fares).

HOW TO TRACK

Residents of a neighborhood are limited in job choice by the travel time between home and potential employers. Travel in excess of 45 minutes can become burdensome and can introduce equity issues. Neighborhoods that are segregated from jobs and to which travel is slow or inconvenient have less opportunity to work and earn a living income. Transportation investment that enables people to access a greater number and variety of employment opportunities can have significant impact on communities.

Using housing, employment, and transportation data, measure the total number of jobs that may be accessed in less than 30 or 45 minutes using walking, bicycling, and transit. These measurements can be reported in terms of job type (sectors) to offer more detail. Cost is also an important consideration that may be factored in to the commute calculations.

A variation of this measure is to calculate the ratio of jobs accessed by automobile to those accessed by walk, bike, and transit.

PEERS TRACKING THE MEASURE

- New York City's Regional Plan Association maps job access by travel time and mode. <http://fragile-success.rpa.org/maps/jobs.html>
- Richmond Regional Transportation Planning Organization uses multiple jobs-related measures, including Job to Housing Ratio, Job and Housing Access to Transit, Job and Housing Access to Pedestrian Facilities.
- The Indianapolis MPO collects data on the number of jobs located within 1 mile of a proposed bikeway facility in project scoring for the Regional Bikeways Plan. This specific item is 6% of the project score.

NOTES

U.S. DOT's Ladders of Opportunity Initiative emphasizes revitalizing communities, creating pathways to work, and connecting Americans to a better way of life. Access to Jobs is a strong consideration in each of those three areas of emphasis for the U.S. DOT.

PERFORMANCE MEASURE

ADHERENCE TO ACCESSIBILITY LAWS

Section 504 of the Rehabilitation Act of 1973 prohibits discrimination against persons with disabilities by entities receiving Federal financial assistance. The U.S. DOT adopted regulations implementing this requirement at 49 Code of Federal Regulations (CFR) Part 27. Title II of the ADA prohibits public entities, such as States and local governments, from discriminating against persons with disabilities regardless of whether such entities receive Federal financial assistance.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

CONTEXT

PERFORMANCE MEASURE APPLICATION

PROJECT PRIORITIZATION

A measure of adherence to accessibility laws is whether the agency has identified physical obstacles in or on its facilities that limit accessibility by people with disabilities. Such barriers should be eliminated over time as a part of capital improvement projects and through dedicated projects to address barriers through a transition plan (for entities that employ 50 or more persons) or program access plan.

BENCHMARKING

Adherence to accessibility laws is an important annual benchmark as agencies expand accessibility across their transportation networks. Progress over time should be tracked through a transition plan (for entities that employ 50 or more persons) or program access plan.

STANDARD

Accessibility laws establish standards for transportation design and construction.

RELATED MEASURES

- Access to Community Destinations
- Access to Jobs
- Crossing Opportunities
- Facility Maintenance
- Level of Service
- Network Completeness
- Population Served by Walk/Bike/Transit
- Route Directness
- Transportation-Disadvantaged Population Served

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input checked="" type="checkbox"/>	<input type="checkbox"/>
REGION	<input type="checkbox"/>	<input checked="" type="checkbox"/>
LOCAL	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
SUBURBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
RURAL	<input checked="" type="checkbox"/>	<input type="checkbox"/>

DATA NEEDS & SOURCES

Inventory data for:

- Roadways
- Sidewalks
- Pedestrian Signals
- Curb Ramps
- Share Use Paths
- On-street parking
- Bus stops

HOW TO TRACK

The U.S. Department of Justice (USDOJ) adopted regulations (28 CFR Part 35) that require public entities to evaluate their current services, policies, and practices, and to develop a transition plan (for entities that employ 50 or more persons) or a program access plan to make any structural changes needed to achieve program accessibility. Pedestrian access to the public right of way is a service provided by public entities, and therefore, a public entity's self-evaluation and transition plan or program access plan must include how barriers to pedestrian access by persons with disabilities will be addressed. For many agencies, making such structural changes requires a multi-year effort. Public entities should track and report to the public their progress toward achieving compliance with accessibility standards for the public right-of-way. Some common measures include:

- Percent of total street crossings that meet accessibility standards (e.g. curb ramps, crosswalk grade and cross slope, and no median barriers).
- Percent of total sidewalk miles that meet accessibility standards (e.g. slopes, obstructions, protruding objects, changes in levels, etc.).
- Percent of total pedestrian signals that have Accessible Pedestrian Signal (APS) technology.
- Percent of total bus stops that are connected to streets, sidewalks or pedestrian paths by an accessible route and that have accessible boarding and alighting areas.
- Percent of total shared use paths that are accessible.
- Percent of marked or metered on-street parking spaces that are accessible.

PEERS TRACKING THE MEASURE

- In the early 2000's, the Texas Department of Transportation (TxDOT) inventoried every intersection on the state highway system and prioritized locations for curb ramp improvements. The data is stored in a non-GIS format and has proved difficult to maintain. TxDOT dedicates funding for curb ramp projects, but tracking improvements made under routine highway projects is more challenging. TxDOT is embarking on a major effort to update and expand their data collection utilizing a GIS database with a mobile data collection application, which will allow them to track many of the performance measures described here. This will provide better access to the data, thereby making collecting and updating the data more efficient.
- Maryland SHA's Transition Plan was completed in 2009 and is continually updated. It focuses on four areas: (1) prioritizing items identified in self-evaluation; (2) describing methods used to make facilities accessible; (3) developing specific schedules for improving facilities; and (4) Identifying funding.

NOTES

For additional information:

- Department of Justice Information and Technical Assistance on the ADA: www.ada.gov
- Federal Highway Administration's ADA/504 website: <https://www.fhwa.dot.gov/civilrights/programs/ada.cfm>
- NCHRP Report 20-7(232) "ADA Transition Plans: A Guide to Best Management Practices": https://www.fhwa.dot.gov/indiv/docs/ada_transition_plans_report.pdf
- U.S. Access Board: <https://www.access-board.gov>

PERFORMANCE MEASURE

ADHERENCE TO TRAFFIC LAWS

A measurement of how well pedestrians, bicyclists, and motorists obey current traffic laws.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

CONTEXT

PERFORMANCE MEASURE APPLICATION

BENCHMARKING

Reporting how transportation system users behave provides insight into the success of education and outreach campaigns and helps highlight built environment factors influencing behavior.

RELATED MEASURES

Crashes

User Perceptions

Volume

DATA NEEDS & SOURCES

- Observations of driver, pedestrian and bicyclist behaviors from field studies. For example, crosswalk yielding rates from field studies.
- Citation records from local or State police departments.
- State motor vehicle crash database.

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input checked="" type="radio"/>	<input type="radio"/>
REGION	<input checked="" type="radio"/>	<input type="radio"/>
LOCAL	<input checked="" type="radio"/>	<input type="radio"/>

LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="radio"/>	<input type="radio"/>
SUBURBAN	<input checked="" type="radio"/>	<input type="radio"/>
RURAL	<input checked="" type="radio"/>	<input type="radio"/>

HOW TO TRACK

Enforcement may be one of the most important elements in getting drivers, pedestrians and bicyclists to behave safely. Transportation agencies should work closely with law enforcement to identify dangerous behaviors and locations that may require enforcement efforts to improve safety. Evaluating the behavior of transportation system users (including pedestrians, bicyclists and motorists) as a proxy for safety can be measured by:

- Number of observed violations. Targeted behaviors can include:
 - Motorists: failure to yield to pedestrians or bicyclists, turning (left, right or right turn on red), driving under the influence, driving distracted, speeding, running a red light/sign, passing a bicyclist too closely (aggressive, negligent or reckless driving).
 - Bicyclists: failure to yield to pedestrians, running a red light/sign, wrong-way riding, failure to use front light, bicyclists failing to yield to motorists when motorists have the right-of-way, riding between two lanes of slow-moving or stopped traffic.
 - Pedestrians: darting or walking into traffic, crossing against crossing signal.
- Number and types of citations issued, including written warnings. (See examples above.) Citations and formal activity is only a small measure of actual motorists, pedestrian and bicyclist behavior at any one location.

Tracking trend data, including observations and enforcement efforts over months and years. Use consistent methodologies for observations (i.e. time of day, locations, weather, etc.). For citations, consider comparing formal operations to one another versus everyday enforcement efforts.

PEERS TRACKING THE MEASURE

In 2002, the Federal Highway Administration awarded grants to the cities of San Francisco, Las Vegas and Miami to examine and map out their pedestrian crashes and develop a plan for deploying and evaluating various pedestrian safety countermeasures in high crash "zones" and locations.²⁸

Local agencies in Washington State, such as Mount Vernon, use data from speed feedback signs to assess speeding patterns and deploy officers for speed enforcement accordingly. In Puyallup, a reduction in the numbers of traffic safety camera speed citations have been used to evaluate Safe Routes to School school zone safety efforts.

[High Visibility Enforcement on Driver Compliance with Pedestrian Right-of-Way](#) - This study out of Gainesville, Florida developed and evaluated strategies to increase driver yielding to pedestrians on a citywide basis using high-visibility pedestrian right-of-way enforcement. "

[Pedestrian Safety Enforcement Operations: A How-to Guide](#) - This law enforcement resource provides the national model for officers performing operations focused on motorists and pedestrian interaction.

NOTES

Due to the size and speed of a motorized vehicle, driver behavior around pedestrians and bicyclists is of gravest concern - pedestrians and bicyclists have no protective layer and will lose every time in a crash. However, risky pedestrian and bicyclist behavior requires the driver to react which may cause a crash. Therefore, adherence to traffic laws should be a responsibility of all road users.

PERFORMANCE MEASURE

AVERAGE TRAVEL TIME

The average time it takes road users, including pedestrians and bicyclists, to travel a specified distance.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

CONTEXT

PERFORMANCE MEASURE APPLICATION

ALTERNATIVES COMPARISON

Measuring the average travel time across a corridor for each mode provides a way to compare alternatives without overemphasizing delay at a single point.

ALTERNATIVES COMPARISON (POSSIBLE)

Changes to travel times provide an easily understood metric for the public to weigh trade-offs between project alternatives.

BENCHMARKING (POSSIBLE)

Tracking the travel time for a typical trip over time illustrates and communicates the impacts of delays and investments in an easily understood manner.

SCENARIO EVALUATION (POSSIBLE)

Travel times for representative trips can be used to communicate high-level impacts between planning scenarios.

RELATED MEASURES

Access to Community Destinations

Access to Jobs

Average Trip Length

Density of Destinations

Route Directness

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input checked="" type="checkbox"/>	<input type="checkbox"/>
REGION	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LOCAL	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
SUBURBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
RURAL	<input checked="" type="checkbox"/>	<input type="checkbox"/>

DATA NEEDS & SOURCES

- Land/use origin destination data.
- Computer simulation, sketch planning, and demand forecasting models.
- Traffic volume.
- Traffic signal timing data.
- User-based data sources (such as Strava, INRIX, or Google).
- Probe vehicle data.
- Detectors (ITS infrastructure).
- Special studies (e.g. floating car runs).

HOW TO TRACK

The traditional focus on intersection vehicle delay as a performance measure tends to exaggerate the severity of congestion. For example, an intersection with average vehicle delay greater than 80 seconds is said to have LOS "F" and is 150% more delay than a driver might expect at a LOS "C" intersection. But that intersection likely only represents one point along a trip. Using a typical vehicle trip, that same increase in delay might represent a difference of 45 seconds in a 10-minute trip. Framed in this context, decisionmakers and community members might think differently about alternatives. Reducing the delay may still be desirable, but consideration should be given to the investment required to reduce the delay relative to overall benefits. This can be a productive way to frame traffic impacts related to bicycle and pedestrian projects.

To use travel time as a performance measure, estimate the travel time for any mode to traverse a segment or typical trip. In some contexts it may be useful to identify a typical trip at a typical time period, being careful not to select the peak demand. Travel time can be calculated using average travel speeds and estimates of intersection delay. Likewise, the available data and tools for determining travel time information is growing rapidly. Various transportation-related companies such as bike share, car sharing services (e.g., ZipCar, Car2Go), ride sharing (e.g., Uber), mobile applications (e.g., Strava), and traffic data services (e.g., INRIX) provide numerous variations of origin-destination data that can be used for average travel time information for various transportation modes.

EMERGING TECHNOLOGIES AND TRENDS

Mobile smart phone applications collecting data on trips and time traveled; web-based mapping applications.

PEERS TRACKING THE MEASURE

- Oregon Department of Transportation's Alternative Mobility Measures track the number of residents who can access a region's employers based on a change in average travel time to major employment centers as a result of a given transportation project.²⁹
- PennDOT evaluates vehicle travel times as a supplement to individual intersection delay to provide context to transportation decisions and avoid widening intersections.

NOTES

A related measure, which is growing in popularity, is Reliability. Pedestrian and bicycle trips tend to have very consistent travel times from day to day and at different times of day.

A consumer surplus approach ("user benefit") can be used to measure time and cost impacts related to the introduction of new alternatives. User choice models that incorporate pedestrian and bicycle options can estimate changes in composite (multimodal) utility of travel.

PERFORMANCE MEASURE

AVERAGE TRIP LENGTH

The average distance or time traveled between an origin and a destination in a given geographical area.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

RELATED MEASURES

- Access to Community Destinations
- Access to Jobs
- Average Travel Time
- Density of Destinations
- Route Directness

CONTEXT

PERFORMANCE MEASURE APPLICATION

ALTERNATIVES COMPARISON (POSSIBLE)

Average Trip Length can be used to compare a series of project alternatives, assuming the alternatives are not necessarily on the same street. For studies focused on a series of streets, the measure can be helpful in selecting an alternative.

SCENARIO EVALUATION

Average Trip Length can be used to evaluate the location of facilities or connections and its benefit towards residents. A facility that allows for a shorter trip length to amenities may be viewed more positively than a similar facility in a location that is not as close to community amenities.

BENCHMARKING

Average Trip Length can be used by an agency to ensure progress is being made towards building pedestrian and bicycle infrastructure near where residents live and work. For example, as a region constructs more infrastructure, the number of residents and/or workers proximate to this infrastructure will also increase. Potential benchmarking criteria can be to ensure a certain percentage of the overall population is within a specific average trip length to walking and biking facilities, and thereby tracked over time.

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input checked="" type="checkbox"/>	<input type="checkbox"/>
REGION	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LOCAL	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
SUBURBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
RURAL	<input type="checkbox"/>	<input checked="" type="checkbox"/>

DATA NEEDS & SOURCES

- Local and/or regional trip surveys.
- Local and/or regional travel demand models.
- Emerging data sources collecting real-time travel data using Bluetooth, GPS, or app-based data generation.
- Long range plans.

HOW TO TRACK

Average Trip Length can be calculated and aggregated in various ways, depending on the desired application of the measure:

- Aggregate average trip distance or time for a region, including all modes – overall average trip length can be useful in comparing the relative distribution of residences and destinations across regions and can be one component of tracking the potential for walking and bicycling trips within a region.
- Average commute trip distance or time, including all modes – average commute trip length can be useful in comparing the relative distribution of residences and jobs across regions and can be one component of tracking the potential for walking and bicycling commute trips within a region.
- Portion of total trips under three (3) miles (aggregate measure) – understanding the number of trips under three (3) miles may indicate the number of trips within walking or biking distance for many people.
- Average trip distance or time by mode – understanding the average trip length by mode (walking or biking) can provide agencies with a locally specific average distance that residents of that region are likely to walk or bike.

Most regional models are not designed to represent and account for short walking trips, given that the travel analysis zones often cover relatively large geographies compared to a typical walking trip distance. The same is true for many bicycling trips. Similarly, most models do not assign walking and bicycling trips to a network, and therefore will not represent in detail the average trip length for these modes in a particular region.

A more detailed assessment of walking or bicycling trip length may come from emerging sources of data collection, such as GPS, Bluetooth, or app-based systems that allow for empirical data collection in real time.

At an overall network level (e.g., city, region, State), databases such as the National Household Travel Survey³⁰ (NHTS) provides details on the number of trips made by walking and biking at various distances. Exhibit 1-9 of FHWA's *Status of the Nation's Highways, Bridges, and Transit: Conditions & Performance*³¹ provides an example of this from 2010.

EMERGING TECHNOLOGIES AND TRENDS

Mobile smart phone applications and GPS devices collect data on trips and time traveled.

PEERS TRACKING THE MEASURE

- Most regional travel demand models estimate average trip length for the region, however, models vary in their ability to represent and forecast bicycle and pedestrian travel.
- The San Francisco County Transportation Authority developed a "Cycle Tracks" app to collect data on bicycle route choice and distance from bicyclists in San Francisco. The app has been modified and used by a number of other agencies across the US.
- Many agencies are now using Strava mobile application data to better understand types of walking and biking trips, origins and destinations, and average trip lengths. The Oregon Department of Transportation and Florida Department of Transportation recently purchased statewide datasets to monitor how pedestrians and bicyclists are moving throughout the transportation network.
- The Atlanta Regional Commission uses a new Activity Based Model to better estimate trip lengths. Georgia Tech and local partners also maintain Cycle Atlanta as a web-based app for tracking cycling trip characteristics and locations.

NOTES

As average trip length decreases, bicycling and walking become viable modes for a greater portion of trips within a region. In addition to average trip length, agencies may benefit from a more detailed analysis looking at the distribution of trip lengths (and trip purposes) to help understand the potential for shifting to walking or bicycling. This type of analysis may be helpful in an alternatives comparison (particularly land use alternatives) within a medium- or long-range plan or when prioritizing bicycle or pedestrian infrastructure investments.

PERFORMANCE MEASURE

CONNECTIVITY INDEX

Connectivity is a representation of the number and directness of travel routes and options available to a user, while a connectivity index represents a number of specific measures used to assess walking and biking connectivity in a specific area.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

RELATED MEASURES

- Network Completeness
- Pedestrian Space
- Street Trees

CONTEXT

PERFORMANCE MEASURE APPLICATION

PROJECT PRIORITIZATION (POSSIBLE)

A connectivity index can be used as a metric to prioritize projects – for example, completing sidewalk or bicycle facilities in an area with high street connectivity may be a higher priority than sidewalks or bicycle facilities in areas with low connectivity.

ALTERNATIVES COMPARISON

A connectivity index may be useful in comparing alternatives to maximize investment potential. For example, future transit stop locations may be evaluated based on the connectivity of the surrounding network. An alternative with high connectivity would help to maximize the catchment area of the transit stop location.

SCENARIO EVALUATION

A connectivity index can be used to evaluate benefits of future transportation investment scenarios for walkability and bikeability. For example, consider two potential investments: 1) a high-capacity arterial connection (managed access), or 2) development of a grid network of neighborhood streets. The latter would score higher on a connectivity index because it increases the availability of user-friendly streets instead of a single improvement.

BENCHMARKING

A connectivity index can be used as a benchmark in a region actively seeking to create more connections for walking and bicycling. For example, if a region adopted a policy to create nonmotorized connections between cul-de-sacs in previously developed neighborhoods, a connectivity measure (link-to-node ratio) can help to track progress.

STANDARD

Local jurisdictions can set standards for street network connectivity in their land development code. A standard can take on several forms, such as a link-to-node ratio, intersection density standard, maximum block-face or block perimeter size, or requirements to create connections to the local street network.

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input type="checkbox"/>	<input checked="" type="checkbox"/>
REGION	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LOCAL	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
SUBURBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
RURAL	<input type="checkbox"/>	<input checked="" type="checkbox"/>

DATA NEEDS & SOURCES

- GIS transportation networks for each mode to be evaluated are needed to apply a connectivity index measure to an area larger than a few blocks.
- Aerial imagery or static maps can be used to manually calculate connectivity for small areas.
- Long range plans.
- STIP/TIPs.

HOW TO TRACK

A variety of metrics can be used as connectivity indices, as shown and described in the table below.^{32 33 34}

MEASURE	DEFINITION AND CALCULATION	NOTES	TYPICAL RANGE FOR "GOOD" CONNECTIVITY
Intersection Density	Number of intersections in a given land area, such as square mile or acre.	Can be limited to "4-leg intersections" or "intersections with pedestrian and bicycle accommodations" Easy to medium difficulty to calculate with GIS, depending on structure of available data.	100-160
Intersections per Linear Mile	Number of intersections in a given land area divided by the linear network miles in the same given area.	Can be limited to "4-leg intersections" or "intersections with pedestrian and bicycle accommodations" Easy to medium difficulty to calculate with GIS, depending on structure of available data.	
Network Density	Number of linear miles of street or other facility per given area (square mile).	Easy to calculate in GIS	18-26 miles
Connected Node Ratio (Portion of Nodes*that are Intersections)	Number of 3- or 4-way intersections divided by the number of 3- or 4-way intersections plus cul-de-sacs or dead ends	Easy to medium difficulty to calculate in GIS, depending on the structure of the existing data.	0.7 to 1
Link-to-Node* Ratio	Number of roadway links divided by the number of nodes in the network in a given area.	Easy to medium difficulty to calculate in GIS, depending on the structure of the existing data.	1.2 to 1.4; 2.4 is perfectly connected
Polygon Density ³⁵	Number of blocks or polygons created by the network within a given area		100-160 for block grids

*Nodes include intersections, cul-de-sacs, and dead ends.

PEERS TRACKING THE MEASURE

The Indianapolis MPO has incorporated "Connectivity Theme" into the scoring criteria for the Regional Bikeways Plan. The theme is divided into four criteria that track the following:

- **New Coverage:** providing a bikeway in a location that will provide access to new households that previously did not have access to a dedicated bikeway within one mile.
- **Bikeways Connections:** Measures how many existing bikeway facilities a new project would connect to as well as the length of those facilities.
- **Transit Connections:** Measures the number of transit stops located within ¼ mile of a proposed bikeway a measured along the street network.
- **Barriers:** Tracks if a proposed bikeway is crossing a barrier of some kind such as an interstate, primary arterial or water. Points are awarded based on the assumption that the new facility will address the ability to cross that barrier and enhance connectivity.

NOTES

- GIS analysis techniques are used to estimate connectivity. Mobile crowdsourcing applications enable residents to document barriers to connectivity.
- Various measures of connectivity are often used as standards for new development.
- Pedestrian and bicycle connectivity may be more difficult to calculate accurately within GIS, since nonmotorized connections may not be part of the roadway layer.
- Built-out land use patterns may limit the amount of change to connectivity that can occur, depending on the opportunities for property easements and the development of new connections.
- Connectivity index measures can be used as indicators of the potential for pedestrian and bicycle activity.

PERFORMANCE MEASURE

CRASHES

The measured number of crashes or rate of crashes (i.e., crashes per volume of users) over a designated period of time, typically separated into modes (i.e., autos, pedestrians, bicyclists) and severity (i.e., fatalities, injuries, property damage only).

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

RELATED MEASURES

- Adherence to Traffic Laws
- Crossing Opportunities
- User Perceptions
- Volume

CONTEXT

PERFORMANCE MEASURE APPLICATION

PROJECT PRIORITIZATION

The frequency and rate of crashes can be used to prioritize safety improvements along various corridors and/or intersections. For examples, locations with higher rates of specific crashes may receive funding priority to address the safety issues before a location that may have less of a demonstrated or objective safety issue.

ALTERNATIVES COMPARISON

The frequency and rate of crashes can be used with safety countermeasures to assess various design alternatives on corridors and intersections.

BENCHMARKING

The frequency and rate of crashes involving pedestrians and bicyclists can be used as a benchmark in an area actively seeking to improve walking and biking conditions. For example, States typically set a specific goal to annually gauge progress towards improving safety. Likewise, another example is "Vision Zero," an initiative originating in Europe and now being used in various US cities, it sets a benchmark of zero fatalities or severe injuries through roadway crashes.

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input checked="" type="radio"/>	<input type="radio"/>
REGION	<input checked="" type="radio"/>	<input type="radio"/>
LOCAL	<input checked="" type="radio"/>	<input type="radio"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="radio"/>	<input type="radio"/>
SUBURBAN	<input checked="" type="radio"/>	<input type="radio"/>
RURAL	<input checked="" type="radio"/>	<input type="radio"/>

DATA NEEDS & SOURCES

- Local or State crash report database.
- State reported data.
- Fatality Analysis Reporting System (FARS).
- Potentially; emergency room visit data.
- Pedestrian and bicycle counts (volumes).
- Demographic information.
- Facility inventories.
- [Highway Safety Improvement Program Online Reporting Tool](#).
- Highway Performance Monitoring System (HPMS).
- State Highway Safety Plan (HSP) and the State Strategic Highway Safety Plan (SHSP).

HOW TO TRACK

Crash data is useful for identifying the number and severity of crashes, where crashes occur, the circumstances surrounding each crash, who is involved in crashes, and the conditions and time of day that crashes occur. By understanding common crash types and locations, agencies can determine the appropriate countermeasures and prioritize projects to improve safety. Additionally, the number of crashes can be tracked over time to track progress towards meeting safety goals. Crash data is often used along with volume data and facility type data to determine crash rates and identify crash hotspots. Some of the common measures used to evaluate the safety of the transportation system based on crash history are:

- Number of bicycle-involved and/or pedestrian-involved crashes over 5 years.
- Number of fatal or serious injuries of bicyclists and/or pedestrians over 5 years.
- Crashes per volume of bicyclists and/or pedestrians over 5 years (crash rates).

State DOTs, MPOs, and other agencies may use data for non-motorized fatalities and serious injuries that is being collected by State DOTs to satisfy the requirements of 23 CFR 490. This data includes the number of non-motorized fatalities computed from FARS and FARS Annual Report File (ARF), and the number of non-motorized serious injuries from the reported values in the HSIP Report.

EMERGING TECHNOLOGIES AND TRENDS

Mobile smartphone applications collecting data on crashes, near misses, location, circumstances, etc.

PEERS TRACKING THE MEASURE

- Measuring the Street: New Metrics for 21st Century Streets <http://www.nyc.gov/html/dot/downloads/pdf/2012-10-measuring-the-street.pdf>
- New York City DOT measures crash rates for each transportation mode, both on the corridor level and city wide.
- North Carolina Department of Transportation geocodes each crash and uses the PBCAT (Pedestrian and Bicycle Crash Analysis Tool) software to perform the crash typing to identify a specific crash type for each crash in the State. This data is used to inform programs, identify goals, and track progress in many plans including the Statewide Pedestrian & Bicycle Plan and the Strategic Highway Safety Plan.
- The Richmond Regional Transportation Planning Organization tracks Number of Bicycle and Pedestrian Crashes and Number of Bicycle and Pedestrian Fatalities.
- Various local agencies across the country are tracking bicycle and pedestrian-involved crashes to identify areas where these users are disproportionately represented.

NOTES

Pedestrian and bicycle crashes are often underreported and can be inconsistent from source to source. Comprehensive safety studies have sought to compile records from police and ambulance/hospital sources to supplement those that are officially reported.

Each *State Highway Safety Office* must annually establish a performance measure for the statewide totals for pedestrian fatalities and the statewide totals for bicyclist fatalities, involving a crash with a motor vehicle on a public roadway (23 U.S. Code 402(k)4).

PERFORMANCE MEASURE

CROSSING OPPORTUNITIES

The average or actual distance between designated pedestrian and bicycle crossing locations.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

RELATED MEASURES

- Connectivity Index
- Network Completeness
- Pedestrian Space
- Route Directness

CONTEXT

PERFORMANCE MEASURE APPLICATION

PROJECT PRIORITIZATION

Crossing opportunities can be used to identify and prioritize crossing needs. Limited crossing opportunities or long distances between crossings along a corridor for instance, would likely give a particular corridor priority over one with more frequent crossing opportunities.

ALTERNATIVES COMPARISON

Crossing opportunities can be applied in an alternatives comparison of particular design options for a corridor, for example. Rather than an evaluation of performance, crosswalk spacing can also be used as a guideline or goal in development of alternative for consideration.

BENCHMARKING (POSSIBLE)

Crossing opportunities can be used as a benchmark across a region or jurisdiction to track progress over time if the region is actively adding crossings. In addition, agencies can use crosswalk spacing as a benchmark measure to compare different subareas. For instance, a grid network with small blocks may have crosswalks every 200 to 250 feet, while a more suburban network will have higher spacing.

STANDARD

A minimum crosswalk spacing standard can be applied along particular corridors or roadways, such as arterials and collectors. A standard can vary depending on the surrounding land use characteristics and function of the roadway.

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input checked="" type="checkbox"/>	<input type="checkbox"/>
REGION	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LOCAL	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
SUBURBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
RURAL	<input type="checkbox"/>	<input checked="" type="checkbox"/>

DATA NEEDS & SOURCES

- GIS transportation network.
- GIS layer with crossing opportunities.
- Aerial photography.

HOW TO TRACK

Crossing opportunities can be evaluated in a number of ways — along a specific roadway, as an average measure for a particular area, or related to intersections. In tracking this measure, crossing opportunities may be defined and measured in a variety of ways:

- Calculate linear distance along a corridor between legal crossing opportunities.
- Calculate linear distance along a corridor between marked crosswalks.
- Calculate linear distance along a corridor between signalized crossings.
- Evaluate the portion of intersections with crossings of all intersection legs.
- Evaluate the number of crossing opportunities within a specific subarea.
- Calculate average walk time between points on opposite sides of a corridor.

The quality of unsignalized crossing opportunities can also be evaluated based on roadway characteristics and crossing volumes as described in NCHRP Report 562 Improving Pedestrian Safety at Unsignalized Crossings.

PEERS TRACKING THE MEASURE

Washington DC's moveDC Plan included increasing crossing opportunities as a feature of its Pedestrian Element.

NOTES

Crossing opportunities is a useful and easily understandable measure in many applications. In applying the measure, it is important to consider the locations of origins and destinations, and ensure that crossings are serving to provide access to those locations, rather than simply meeting an ideal spacing distance.

PERFORMANCE MEASURE

DELAY

The average delay (typically measured in seconds) associated with biking and walking at specific locations (e.g., a signalized intersection) or across longer distances (e.g., a corridor or larger study area where a beginning and end point are identified). Pedestrian and bicycle delays result from numerous occurrences, but the most common include signal delay, congestion-based delay, indirectness of routes, and traffic gap acceptance.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

CONTEXT

PERFORMANCE MEASURE APPLICATION

PROJECT PRIORITIZATION

Pedestrian or bicycle delay can be used to prioritize a set of projects aimed at reducing vehicle miles traveled within a corridor or region or expanding the area for viability of active transportation modes for a downtown area.

ALTERNATIVES COMPARISON

Pedestrian or bicycle delay can be used to compare alternative designs, such as intersection design and signal timing plans at signalized intersections.

SCENARIO EVALUATION (POSSIBLE)

While applications of pedestrian and bicycle delay may be limited for scenario evaluations, a high-level assessment of this metric can be useful in determining the potential time savings from creating a network of separated multiuse paths compared to providing pedestrian and bicycle travel along signalized vehicular corridors.

BENCHMARKING (POSSIBLE)

While applications of pedestrian and bicycle delay may be limited for benchmarking, it can be used to track the impacts over time of investments in signal retiming, construction of grade separated crossings, or construction of separate multiuse paths.

STANDARD

Pedestrian or bicycle delay can be used as a standard in some contexts, potentially by setting a maximum signal cycle length to minimize delay for pedestrians or bicyclists.

RELATED MEASURES

Level of Service

Person Throughput

Volume

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input checked="" type="radio"/>	<input type="radio"/>
REGION	<input checked="" type="radio"/>	<input type="radio"/>
LOCAL	<input checked="" type="radio"/>	<input type="radio"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="radio"/>	<input type="radio"/>
SUBURBAN	<input checked="" type="radio"/>	<input type="radio"/>
RURAL	<input type="radio"/>	<input type="radio"/>

DATA NEEDS & SOURCES

- Data on transportation networks for pedestrians and bicycles.
- Roadway data, such as number of lanes and speeds.
- Traffic signal timing data.
- Multimodal traffic volumes (pedestrian, bicycle, and vehicles).
- *FHWA's Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance Reports.*

HOW TO TRACK

Pedestrian or bicycle delay is a measure of the amount of delay experienced by someone traveling through an intersection or along a particular crossing. This measure has parallels to auto level of service, which accounts for delay that vehicles experience at intersections. Average delay can be calculated as follows:

- Agencies can measure delay for pedestrians and/or bicyclists at an intersection, assuming average walk/bike speeds, random arrivals, existing signal timing (cycle length), and desired movements. For instance, a jurisdiction may choose to measure average delay of left-turning bicyclists or pedestrians arriving at an intersection assuming they need to make two crossings. In addition, a signalized intersection without crossings of all legs may create more delay for pedestrians, if they need to cross three legs (instead of the one without a striped crossing).
- At unsignalized intersections, agencies can assess delay for pedestrians and bicyclists by estimating the number of available gaps in traffic providing sufficient space for crossings.
- Delay along a segment can be estimated as a sum of the delay at intersections or crossings along the segment.
- In some high volume circumstances, pedestrians or bicyclists may be delayed by other users traveling on the same facility. The Transportation Research Board's Highway Capacity Manual 2010⁵¹ and FHWA's Traffic Signal Timing Manual⁵⁷ provides methodologies for estimating delay resulting from high volumes of pedestrians or bicyclists, both for on-street facilities as well as multiuse paths.

EMERGING TECHNOLOGIES AND TRENDS

Mobile smartphone applications collecting data on trips and time traveled.

PEERS TRACKING THE MEASURE

Pedestrian and bicycle delay is used by many cities as a measure of intersection performance, including Washington, DC, Boston, and New York City.

NOTES

Pedestrian or bicycle delay can provide a useful measure for comparison with delay for motor vehicles, and can help jurisdictions select designs and signal timing plans that reflect the context and modal priority in an area.

Minimizing delay for pedestrians and bicycles at signalized intersections can minimize occurrences of noncompliance by these modes, reducing potential conflicts and increasing safety.

At the intersection level, the 2010 Highway Capacity Manual Multi-Modal Level of Service measures average pedestrian delay.

PERFORMANCE MEASURE

DENSITY OF DESTINATIONS

The number of desirable destinations (e.g., jobs, homes, recreation, shopping, etc.) within a specific area.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

RELATED MEASURES

- Access to Jobs
- Access to Community Destinations
- Population Served by Walk/Bike/Transit
- Transportation-Disadvantaged Population Served

CONTEXT

PERFORMANCE MEASURE APPLICATION

PROJECT PRIORITIZATION

Density of Destinations can be used to prioritize enhancements to the bicycle or pedestrian transportation networks in locations with high densities of destinations, since these areas are more likely to attract and be served by shorter distance trips that can be completed on foot or by bike.

SCENARIO EVALUATION (POSSIBLE)

Density of destinations can be used in scenario evaluations particularly at the regional level in the context of integrated land use and transportation scenario modeling. Scenarios resulting in higher densities of destinations likely lead to shorter trip lengths and more potential to access destinations via walking and bicycling.

BENCHMARKING (POSSIBLE)

Density of Destinations can be used as a benchmarking measure to track the densities of destinations over time.

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input type="checkbox"/>	<input checked="" type="checkbox"/>
REGION	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LOCAL	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
SUBURBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
RURAL	<input checked="" type="checkbox"/>	<input type="checkbox"/>

DATA NEEDS & SOURCES

- Local parcel data.
- GIS data on employment centers, schools, parks, healthcare centers, and other daily destinations.
- NAICS coded employment data, available from the U.S. Bureau of Labor Statistics.
- Population data from the U.S. Census Bureau.

HOW TO TRACK

First, an agency needs to define “destinations” of interest that will be included in the analysis. Destinations may include schools, parks, retail sites, grocery stores, medical centers, businesses with a certain number of employees, or even high-density residential locations. Once destinations are defined, the agency can determine the density of destinations in a given land area, showing areas where pedestrian and bicycle travel demand may be occurring or may occur if infrastructure is available. In jurisdictions where bicycle and pedestrian count data is not available or is not comprehensive, density of destinations can be a helpful proxy for potential pedestrian and bicycle demand.

A baseline list of community destinations for this measure may include:

- Bikeshare stations
- Bus stops
- Community Centers
- Community colleges
- Community services
- Government offices
- High density residential
- Hospitals and other health facilities
- Major tourist destinations
- Major retail and entertainment
- Office buildings
- Parks
- Places of worship
- Public libraries
- Retirement homes
- Schools
- Transit centers
- Universities or colleges

Density of destinations focuses on land use patterns and rewards developments with greater intensity. Access to destinations, on the other hand, considers the transportation network’s ability to connect travelers between origins and destinations.

PEERS TRACKING THE MEASURE

- The Draft 2035 Regional Transportation Plan for Washington County, OR, established a target density of destinations.
- WalkScore™ is a popular tool used to estimate a locations walk-friendliness which is based heavily on density of destinations.
- Density of destinations is being used by Washington State DOT to inform evaluation and prioritization of investments for the Pedestrian and Bicycle Program.
- Evansville, Indiana’s Bicycle and Pedestrian Master Plan used a computer-generated demand model to identify concentrated areas where people live, work, and go to school to determine recommended bicycle facility locations.

NOTES

While this performance measure can be part of a bicycle or pedestrian master plan, it also needs to be included in a land use plan or comprehensive plan that informs development practices and priorities. Density of Destinations is particularly relevant in the context of integrated transportation land use and modeling applications and can be a good proxy measure of potential pedestrian and bicycle demand.

PERFORMANCE MEASURE

FACILITY MAINTENANCE

A measurement of the physical condition and state of repair for pedestrian and bicycle facilities.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

CONTEXT

PERFORMANCE MEASURE APPLICATION

PROJECT PRIORITIZATION

The existing condition of a pedestrian or bicycle facility can increase a project's ranking in a prioritization process.

BENCHMARKING

Tracking the maintenance of pedestrian and bicycle facilities is a good way to evaluate an agency's performance over time.

STANDARD (POSSIBLE)

A minimally acceptable condition for streets and sidewalks can ensure ongoing maintenance and safety.

RELATED MEASURES

Network
Completeness

DATA NEEDS & SOURCES

- Sidewalk facility presence and condition.
- Pavement condition.
- Lane marking condition.
- Curb ramp condition.

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input checked="" type="radio"/>	<input type="radio"/>
REGION	<input checked="" type="radio"/>	<input type="radio"/>
LOCAL	<input checked="" type="radio"/>	<input type="radio"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="radio"/>	<input type="radio"/>
SUBURBAN	<input checked="" type="radio"/>	<input type="radio"/>
RURAL	<input checked="" type="radio"/>	<input type="radio"/>

HOW TO TRACK

To develop and maintain a complete pedestrian and bicycle network, an up-to-date facility inventory with the presence and condition of sidewalks and bicycle facilities is necessary. Typically, this inventory will be stored in a geospatial database which can be updated and tracked over time. Agencies that have a detailed database will be able to prioritize facility improvements based on need.

“Maintenance” of facilities can be subjective depending on local, regional, and State codes and requirements; however, FHWA does maintain several guidebooks that provide additional information including *A Guide for Maintaining Pedestrian Facilities for Enhanced Safety*³⁶ and *Designing Sidewalks and Trails for Access*.³⁷

EMERGING TECHNOLOGIES AND TRENDS

Mobile crowdsourcing applications documenting maintenance issues; remote surveying technology such as Lidar.

PEERS TRACKING THE MEASURE

- Many State DOTs and local jurisdictions measure and track pavement condition, which is graded according to the Pavement Condition Index on a scale from 0 to 100.
- The Evansville (IN) MPO uses a Regional Pavement Management System which analyzes pavement condition on all streets. The data are used to prioritize future roadway needs.

NOTES

Disabled pedestrians and bicyclists are especially sensitive to the maintenance of walking and bicycling facilities. Poorly maintained surfaces and inaccessible features can cause both user groups to travel outside of the intended travelway, potentially creating unsafe conditions.

28 CFR 35.133(a) - Maintenance of accessible features states a public entity shall maintain in operable working condition those features of facilities and equipment that are required to be readily accessible to and usable by persons with disabilities by the Act or this part.

Maintenance responsibilities also include aspects outside of existing pavement conditions, including snow removal policies, 311 requests for street sweeping, vegetation trimming, and restriping crosswalks.

PERFORMANCE MEASURE

JOB CREATION

The change in the number of jobs in a neighborhood or region related to modifications in pedestrian and bicycle infrastructure and policies.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

CONTEXT

PERFORMANCE MEASURE APPLICATION

PROJECT PRIORITIZATION

Job creating potential, both temporary and long-term, can be estimated for projects and used as a criterion for prioritization.

SCENARIO EVALUATION

The potential for creating and attracting jobs is an important measure for evaluating planning scenarios.

BENCHMARKING (POSSIBLE)

Job creation can be used to track progress over time toward an agency goal to improve economic vitality in a region, neighborhood, or along a corridor.

RELATED MEASURES

Land Consumption

Land Value

Retail Impacts

DATA NEEDS & SOURCES

- Local municipality employment data.
- U.S. Census jobs data.
- Employment data from the U.S. Bureau of Labor and Statistics (BLS).

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input type="radio"/>	<input checked="" type="radio"/>
REGION	<input checked="" type="radio"/>	<input type="radio"/>
LOCAL	<input type="radio"/>	<input checked="" type="radio"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="radio"/>	<input type="radio"/>
SUBURBAN	<input checked="" type="radio"/>	<input type="radio"/>
RURAL	<input type="radio"/>	<input checked="" type="radio"/>

HOW TO TRACK

Transportation investment can impact local employment in two ways: temporary construction jobs and permanent jobs. Permanent jobs exist after the construction is complete, and usually result from employers locating to the project area in response to the investment. According to recent research, pedestrian and bicycle infrastructure projects create 11–14 jobs per \$1 million of spending, compared with highway infrastructure projects which create 7 jobs per \$1 million of expenditures.³⁸

Job creation can be measured in a few different ways:

- Number of jobs created by construction project – measure the direct number of temporary construction jobs created.
- Retail sales tax findings – track new employers and associated number of permanent jobs attracted to the project area.
- Employment data – review Census and BLS data to track change in employment over time.

PEERS TRACKING THE MEASURE

- The City of Chicago considers expansion of its bicycle network as a means for attracting jobs and talent to the City. The City's Streets for Cycling Plan 2020 explicitly acknowledges the role of bicycling in Chicago's economic future and its ability to attract employers.
- ODOT Mosaic measures the jobs directly created during construction of projects.³⁹
- The Atlanta Regional Commission uses several tools on employer attraction, quality of life, and regional equity to assess and prioritize regional economic competitiveness from active transportation investments.

NOTES

Distinguish between temporary and permanent jobs in reporting job impacts. Job creation is affected by many factors, so caution is needed when attributing impacts to transportation investment.

PERFORMANCE MEASURE

LAND CONSUMPTION

The amount of land dedicated to development of various uses, including buildings, transportation infrastructure, pervious materials, etc.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

CONTEXT

PERFORMANCE MEASURE APPLICATION

PROJECT PRIORITIZATION (POSSIBLE)

Estimates of a project's land consumption can be reported and evaluated in a project prioritization matrix.

ALTERNATIVES COMPARISON (POSSIBLE)

A project's estimated land consumption impacts can be considered as part of an alternatives analysis.

SCENARIO EVALUATION

Determine how transportation investments will impact land consumption under different planning scenarios.

BENCHMARKING

Land development impacts can be reported annually.

RELATED MEASURES

Land Value

Retail Impacts

DATA NEEDS & SOURCES

- GIS data on land use, zoning, and density.
- Development site plans.
- Population data (U.S. Census Bureau, regional or State estimates).

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input checked="" type="radio"/>	<input type="radio"/>
REGION	<input checked="" type="radio"/>	<input type="radio"/>
LOCAL	<input checked="" type="radio"/>	<input type="radio"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="radio"/>	<input type="radio"/>
SUBURBAN	<input checked="" type="radio"/>	<input type="radio"/>
RURAL	<input checked="" type="radio"/>	<input type="radio"/>

HOW TO TRACK

Transportation decisions have a direct impact on land development in a region. But traditional performance measures (such as vehicle capacity and delay) reward projects that widen intersections and encourage sprawling growth. Explicitly considering land consumption as a transportation performance measure allows the opportunity to think about a project's impact in a broader sense.

At the local level, an agency can calculate the percentage of land consumed by a development scenario (compared to the amount of land conserved). At any geographic level, an agency can compare land consumption to population growth (subtracting base year population from current year population) as a way to track whether growth is occurring through infill of previously developed areas. Infill development minimizes natural resource impacts, reduces distances between destinations, and reduces the need for expensive infrastructure. Dense development encourages walking and biking.

EMERGING TECHNOLOGIES AND TRENDS

Analysis of aerial photography and satellite imagery.

PEERS TRACKING THE MEASURE

- FHWA identified changing land use patterns as a key element in its Resource Sourcebook for Reducing Greenhouse Gas Emissions from Transportation Sources.⁴⁰ The Office of Planning, Environment, and Realty (HEP) identifies a variety of Land Use Tools, and identifies agencies using land use goals as a means of project prioritization.
- King County, Washington, (Seattle area) tracks the ratio of land consumption to population growth during a given period to benchmark the use of urban land. As a proxy for newly developed land, the county uses the net acreage of land that is formally platted. Since this acreage could include open space and protected areas, this method is more likely to overestimate rather than under estimate the amount of newly developed land.
- The Puget Sound Regional Council's 2009 Regional TIP Policy Framework includes project selection criteria that overlap with the regional transportation and land use vision, Vision 2040. Projects receive points for supporting land uses sensitive to land consumption.
- The Evansville (IN) MPO used a Land Use Model to analyze environmental and fiscal impacts of various land consumption scenarios to educate developers and change land consumption patterns in the region.

NOTES

Different regions will have varying levels of data availability and may have different considerations with respect to land consumption.

Land consumption can also be considered with respect to land dedicated to transportation. Streets with wider rights-of-way dedicate land to transportation that might be used for public space or private development.

PERFORMANCE MEASURE

LAND VALUE

The assessment and valuation of property, land development, and revenue of a particular location. Changes in land value resulting from investments in walking and bicycling can be used to quantitatively evaluate transportation projects.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

CONTEXT

PERFORMANCE MEASURE APPLICATION

PROJECT PRIORITIZATION

Estimates of a project's impacts on land value can be a criterion in prioritization.

SCENARIO EVALUATION

Land value impacts of various planning scenarios can illustrate how a variety of transportation investment futures affect property values.

BENCHMARKING (POSSIBLE)

Tracking changes in land value over time offers perspective into the impact of public investment decisions, including transportation, on property values.

RELATED MEASURES

Job Creation

Retail Impacts

DATA NEEDS & SOURCES

- Local municipality parcel data.
- Historical property value data.
- Local development proposals.
- Transit data.
- STIPs and TIPs.

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input type="radio"/>	<input checked="" type="radio"/>
REGION	<input type="radio"/>	<input checked="" type="radio"/>
LOCAL	<input checked="" type="radio"/>	<input type="radio"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="radio"/>	<input type="radio"/>
SUBURBAN	<input checked="" type="radio"/>	<input type="radio"/>
RURAL	<input type="radio"/>	<input checked="" type="radio"/>

HOW TO TRACK

Transportation infrastructure has been shown to impact property values of abutting or nearby properties. In urban areas, investments in premium transit, sidewalks, and bicycle facilities often correlate to increased property values. But the degree of change is dependent on a variety of factors, including land use and demand for walking, bicycling, and transit.^{41 42}

Since many factors influence the value of property, measuring impacts associated with transportation investment can be challenging. Moreover, property values tend to be a lagging indicator, with information available only as properties are sold or assessed. Still, enough is understood about the relationship between property value and transportation to reasonably estimate how a project may impact property. Specific methods include:

- Evaluate the change (or expected change) in unimproved property value – looking only at the land value portion of a property assessment, determine the impacts before and after a project is constructed. Using historic data this can also be done through estimates during a project's alternatives evaluation phase.
- Evaluate development impacts through changes in improved property value and investments – transportation investment may spur economic development. Tracking development proposals before and after a project is constructed (or proposed) can lend insight into the development community's response to investment. Over a longer term, changes in the improved value of a property may also reveal the impacts of a project.

PEERS TRACKING THE MEASURE

Oregon DOT has a transportation planning decisionmaking tool called Mosaic. Under the category "Land Use and Growth Management," there is a specific indicator that examines the change in land values associated with a plan or bundle of actions, as compared to the base case. To estimate future land value, Oregon uses its Statewide Integrated Model, which incorporates land values in an integrated manner between the land use and transportation network components. <http://www.oregonmosaic.org/188/19/land-value.html>

NOTES

- Investments in walking and bicycling in urban areas consistently correlate to increased property value. But the same may not be true in suburban or rural areas where demand for walking and bicycling is less.
- This performance measure may be duplicative of other performance measures, such as travel time, since changes in land value may be due to anticipated, future travel benefits.
- A number of past studies detail the impacts Complete Streets projects have on land value, including Smart Growth America's Safer Streets, Stronger Economies and Benefits of Complete Streets: Complete Streets Stimulate the Local Economy; Rails-to-Trail Conservancy's Investing in Trails: Cost-Effective Improvements – for Everyone and Trail User Surveys and Economic Impact; and New York City Department of Transportation's The Economic Benefits of Sustainable Streets.

PERFORMANCE MEASURE

LEVEL OF SERVICE

A quality of service measurement that reflects how users may perceive a service condition (e.g., delay, travel time, speed, comfort). Pedestrian and bicycle level of service can be assessed through various methodologies depending on context and desired outcomes, but generally focus on assessing comfort levels under specific situations. “Level of service” is also commonly used to describe the Highway Capacity Manual methodology for measuring vehicular level of service primarily based on vehicular delay; however, this guidebook focuses on level of service for pedestrians and bicyclists.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

CONTEXT

PERFORMANCE MEASURE APPLICATION

- PROJECT PRIORITIZATION**
Rank projects based on existing level of service (lower scores rank highest) or potential future quality of service.
- ALTERNATIVES COMPARISON**
Evaluate the impact of project alternatives for each mode.
- SCENARIO EVALUATION (POSSIBLE)**
Use level of service as a measure across a network under various planning scenarios.
- BENCHMARKING (POSSIBLE)**
Report network level of service changes over time.

RELATED MEASURES

- Delay
- Person Throughput
- Volume

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input checked="" type="radio"/>	<input type="radio"/>
REGION	<input checked="" type="radio"/>	<input type="radio"/>
LOCAL	<input checked="" type="radio"/>	<input type="radio"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="radio"/>	<input type="radio"/>
SUBURBAN	<input checked="" type="radio"/>	<input type="radio"/>
RURAL	<input checked="" type="radio"/>	<input type="radio"/>

DATA NEEDS & SOURCES

- Traffic volume/speed data, including automobiles, buses, trucks, pedestrians, cyclists.
- Roadway characteristic data (e.g., travel lane width, number of travel lanes, turn lanes, driveway inventory).
- Bicycle/pedestrian facility characteristic data (e.g., sidewalk and buffer width, bicycle facility width, street trees).
- Traffic signal timing information.
- Land use and building data.

HOW TO TRACK

Level of service analysis methods for pedestrians and cyclists that assess the speed, convenience, comfort, and security of transportation facilities and services as experienced by users, include:

- Highway Capacity Manual 2010 Multimodal Level of Service (MMLOS)⁵¹ – a method for assessing how well urban streets serve the needs of all users. MMLOS includes methods for evaluating auto, bus, bicycle, and pedestrian level of service on urban streets using a combination of readily available data normally gathered by an agency to assess auto and transit level of service. MMLOS is included in the 2010 Highway Capacity Manual.
- Danish Bicycle/Pedestrian Level of Service⁵² – methods for objectively quantifying pedestrian and cyclist stated satisfaction with roundabouts, signalized and unsignalized intersections, midblock crossings, and pedestrian bridges and tunnels.
- Bicycle Environmental Quality Index (BEQI)⁵³ – a quantitative observational survey developed by the San Francisco Department of Public Health to assess the bicycle environment on roadways and evaluate what streetscape improvements could be made to promote bicycling.
- Pedestrian Environmental Quality Index (PEQI)⁵⁴ – a quantitative observational tool developed by the San Francisco Department of Public Health to assess the quality and safety of the physical pedestrian environment and inform pedestrian planning needs.
- Level of Traffic Stress (LTS)⁴⁸ – a bicycle comfort classification system based on different bicycle skill levels.
- Shared-Use Path Level of Service Calculator⁵⁵ – a spreadsheet-based calculator to analyze the quality of service provided by shared-use paths of various widths that accommodate various travel mode splits.
- Capacity Analysis of Pedestrian and Bicycle Facilities⁵⁶ – analysis procedures for calculating the operations of pedestrian and bicycle facilities based on speed, flow, and user density.

EMERGING TECHNOLOGIES AND TRENDS

Mobile crowdsourcing applications collecting data on trips, route choice, and level of comfort experiences.

PEERS TRACKING THE MEASURE

Most municipalities use some type of multimodal level of service, including:

- Washington, DC's District Department of Transportation (DDOT) evaluates bicycle projects after construction using a variety of methods, including Danish Bicycle/Pedestrian Level of Service and HCM 2010 Multimodal Level of Service.
- The Bicycle Environmental Quality Index (BEQI) and the Pedestrian Environmental Quality Index (PEQI) were developed by the San Francisco Department of Public Health's (SFDPH) Health and Place team.
- Montgomery County, Maryland reports its countywide bicycle network in terms of Level of Traffic Stress.
- The Nashua (New Hampshire) Regional Planning Commission (NRPC) has been testing its city streets for bicycle friendliness using the Level of Traffic Stress method as part of the Plan4Health Nashua complete streets project.
- Evansville, Indiana's Bicycle and Pedestrian Plan recommends measuring bicycle and pedestrian levels of service

NOTES

Quality of service for pedestrians and bicyclists can be calculated using a number of methodologies, some of which are more appropriate under various contexts. For instance, the HCM's Multimodal Level of Service methodology or Danish Bicycle/Pedestrian Level of Service are most appropriate at the corridor level, particularly for before-after evaluations to identify potential trade-offs with roadway changes. But a tool like San Francisco's BEQI/PEQI or Level of Traffic Stress are more appropriate at a network level to better assess the quality of streets at a broader scale.

The various methodologies also require varying levels of data. For instance, MMLOS requires more data than others, but often these data are available if it is part of a project with access to multimodal traffic counts, signal timing data, and basic street typologies. On the other hand, LTS requires only a handful of data inputs that can typically be gathered from aerial mapping.

The field of pedestrian and bicycle level of service continues to evolve as practitioners implement these methods and learn about limitations. As with any performance measure, the results of these tools should not be used in isolation, rather as one perspective among many.

PERFORMANCE MEASURE

MILES OF PEDESTRIAN/BICYCLE FACILITIES

The total distance, expressed in miles, of all pedestrian and bicycle facilities in a specified geographic area. The measure is often separated into specific pedestrian and bicycle facilities, such as miles of bike lanes, miles of separated bike facilities, miles of ADA-compliant sidewalks, and of miles of shared-use paths.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

CONTEXT

PERFORMANCE MEASURE APPLICATION

BENCHMARKING

Miles of bicycle or pedestrian facilities can be used as a benchmark in a State, region, or locality to monitor progress in developing pedestrian and bicycle infrastructure. For example, if an agency adopted a policy to increase walking and biking infrastructure then it can be tracked over time to monitor progress, with the ultimate goal of continually increasing the total mileage, potentially working towards a stated goal.

RELATED MEASURES

Network Completeness

Pedestrian Space

Street Trees

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input checked="" type="checkbox"/>	<input type="checkbox"/>
REGION	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LOCAL	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
SUBURBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
RURAL	<input checked="" type="checkbox"/>	<input type="checkbox"/>

DATA NEEDS & SOURCES

Inventory data for:

- Sidewalks.
- Bike facilities.
- Multiuse paths.
- Roadway shoulders (if these are considered bicycle or pedestrian facilities in rural areas).

HOW TO TRACK

“Miles of bicycle or pedestrian facilities” is a simple measure describing the total mileage of the network within a specified geography. Calculating this measure generally requires an inventory of the facilities. However, if a full inventory is not feasible, jurisdictions can track miles of bicycle or pedestrian facilities added annually within their boundaries or on their transportation facilities. Reporting miles added annually allows for tracking progress over time.

Pedestrian facilities are defined by AASHTO as “sidewalks, trails, curb ramps, grade separated crossings, wide shoulders and other technology, design features, and strategies intended to encourage pedestrian travel. Bicycle facilities are defined as improvements and provisions to accommodate or encourage bicycling, including parking and storage facilities, and shared roadways not specifically designed for bicycle use. Miles of bicycle or pedestrian facilities can be reported as:

- Total miles of bicycle facilities.
- Miles of bicycle facilities added.
- Total miles of sidewalks.
- Miles of sidewalks added.
- Total miles of multiuse paths.
- Miles of multiuse paths added.

A baseline list of facility types to track may include:

- Sidewalk
- Bike Lane
- Buffered Bike Lane
- Climbing Lane (i.e., bike lane on uphill side only)
- Separated Bike Lane or Protected Bike Lane or Cycle Track
- Bike Boulevard
- Shared Use Path
- Other (such as shared lane marking and paved shoulder)

PEERS TRACKING THE MEASURE

- The District Department of Transportation (DDOT) tracks bicycle facility mileage and posts it online annually.⁴³ The tracking includes trails, bike lanes, separated bike lanes, signed bike routes, and others. The San Francisco Municipal Transportation Agency (SFMTA) also tracks bicycle facility mileage through their annual report, *Moving Forward*.⁴⁴ The City of Memphis documents the miles of bike facilities (i.e., shared-use paths, cycle tracks, bike lanes, shared lanes) annually in their *State of Bicycling* report.⁴⁵
- Maryland DOT reports total miles of bicycle facilities in its Annual Attainment Report. Likewise, Florida DOT reports total miles of bicycle lanes (as well as shared path width and separation, sidewalk barriers, and sidewalk width and separation) in GIS and has made it publicly available.⁴⁶
- The Atlanta Regional Commission (ARC) tracks and reports bicycle mileage regularly. ARC regularly funds local pedestrian infrastructure inventories. For regional planning ARC categorizes walking and bicycling infrastructure as “regionally significant” or “local” for investment of Federal funds.

NOTES

One method for monitoring mileage, depending on the size of the agency, is implementing a reporting system that records new mileage each time a project is constructed.

With ever improving photographic inventories such as third party aerial photography and street-level photo inventories, agencies may be able to collect bulk information much more easily.

Miles of bicycle or pedestrian facilities is a simple, easily understandable measure and can be useful for publicizing and communicating progress to a broad audience; however, its usefulness in assisting with decisionmaking is limited without the additional context provided by other more complex measures. Many agencies typically see large increases in the early years of network development and monitoring as the “low hanging fruit” are addressed; however, as networks become more complete the large gains in mileage tend to level out. Once this occurs the emphasis is then generally placed on key barriers and linkages that unlock the potential of the larger network.

PERFORMANCE MEASURE

MODE SPLIT

The proportion of total commute trips by transportation mode.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

RELATED MEASURES

Person Throughput

Population Served by Walk/Bike/Transit

Transportation-Disadvantaged Population Served

CONTEXT

PERFORMANCE MEASURE APPLICATION

PROJECT PRIORITIZATION (POSSIBLE)

Prioritize projects in neighborhoods with underperforming walk/bike mode share.

ALTERNATIVES COMPARISON

Determine how a project alternative might impact mode choice.

SCENARIO EVALUATION

Assess macrolevel impacts on mode split under various planning scenarios.

BENCHMARKING

Track changes in mode split over time.

STANDARD

Identify a minimum threshold or target for walk and/or bike mode share to be considered in transportation decisionmaking.

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input checked="" type="checkbox"/>	<input type="checkbox"/>
REGION	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LOCAL	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
SUBURBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
RURAL	<input type="checkbox"/>	<input checked="" type="checkbox"/>

DATA NEEDS & SOURCES

- Multimodal traffic counts.
- Transit ridership.
- U.S. Census (American Community Survey).
- National Household Travel Survey.
- Transit station access mode share from transit agencies.
- GIS data.

HOW TO TRACK

Mode split data are typically collected in several different ways:

- **Commute Mode Split:** travel mode choice for commute trips is collected through the American Community Survey (ACS) and is available across the US in geographies as small as Census Tracts. It is regularly updated, readily available for download, and available historically. A key limitation of this data is its lack of data during non-commuting periods, which excludes most recreational trips and trips taken for non-work related reasons, including travel for shopping, dining, education, and worship, to name a few.
- **Travel Surveys:** to supplement ACS data, some agencies conduct household travel surveys to understand trip-making behavior for a greater variety of trip types.
- **Project-Specific:** data collection along a corridor or subarea can be used to estimate the mode split by counting the number of people traveling by each mode.

Mode split is generally calculated as the total number of modal trips along a corridor or within a region and expressed as a percentage.

EMERGING TECHNOLOGIES AND TRENDS

Mobile smartphone applications collecting data on trips and mode choice.

PEERS TRACKING THE MEASURE

Many cities, regions, and States measure mode split for commuters, which is readily available from the American Community Survey. Some conduct additional surveys to understand travel mode choice for other trip types. A few specific examples:

- As documented in the EPA's Guide to Sustainable Transportation Performance Measures, the Puget Sound Regional Council forecasted daily trips in 2040 by three nonmotorized modes (walk, bike, and walk to transit) in their 2040 LRTP process. For each of the five plan alternatives, the Council calculated the percentage change in trips by mode as compared to a baseline scenario.
- The Metropolitan Washington Area Council of Governments (MWCOG) conducts a household travel survey for the Washington, DC region to measure trip making behavior for all types of trips. Many regional agencies complete a similar travel survey to calibrate regional travel demand models.
- Trip-based regional travel demand models generally rely on various trip types and purposes to represent how people move throughout a region. For example, a majority of the Delaware Valley Regional Planning Commission's model components rely on various person trip types.
- Many employers and transportation management associations collect travel behavior data through annual surveys as part of regular reporting requirements. One example, the NoMa Business Improvement District in Washington, DC, reports mode share annually by neighborhood and trip type.⁴⁷

NOTES

When reporting mode split, it is important to always acknowledge the denominator; that is: what trips are counted? Commute travel data are the most widely available and typically serve as a proxy for overall travel patterns. But according to the National Travel Household Survey, commute trips represent only about 10 to 15 percent of person trips.

PERFORMANCE MEASURE

NETWORK COMPLETENESS

The portion of the transportation network that is usable for people walking or bicycling, and represents the minimum accommodations needed for a facility to be considered part of the walking or bicycling network.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

CONTEXT

PERFORMANCE MEASURE APPLICATION

PROJECT PRIORITIZATION

A measure of network completeness can be used to prioritize projects that fill crucial gaps or meet unaddressed needs for walkers and bicyclists.

ALTERNATIVES COMPARISON

When comparing design options, an agency may consider how two or more possible configurations contribute to a more complete transportation network for those walking or biking.

SCENARIO EVALUATION (POSSIBLE)

Network Completeness can be applied in evaluating future scenarios of potential transportation investments and land use changes.

BENCHMARKING

An agency can report change over time through regular updates to inventories of intersection treatments, bicycle facilities, and sidewalks.

STANDARD

A performance baseline related to network completeness may call for a given percentage of the network to be completed each year or for a given percentage of sidewalks to meet ADA standards by a given year.

RELATED MEASURES

Connectivity Index

Miles of Pedestrian/
Bicycle Facilities

Pedestrian Space

Route Directness

DATA NEEDS & SOURCES

Inventory data for:

- Roadways.
- Sidewalks.
- Bike facilities.
- Pavement markings.
- Signs.
- Signals.

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input checked="" type="checkbox"/>	<input type="checkbox"/>
REGION	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LOCAL	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
SUBURBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
RURAL	<input type="checkbox"/>	<input checked="" type="checkbox"/>

HOW TO TRACK

In some cases, agencies set a threshold for what qualifies as complete based on the context of the street (e.g., wider sidewalks in commercial areas or separated bike lanes in higher traffic conditions).

System completeness can be defined and measured in a variety of ways:

- Percent of roadway miles with complete sidewalks or bicycle facilities on both sides.
- Percent of planned pedestrian or bicycle network that is constructed.
- Percent of pedestrian or bicycle or roadway system that serves pedestrian and bicycle users ages 8 to 80.
- Percent of signalized intersections that have complete pedestrian and bicycle facilities, such as detection, push buttons or pedestrian-recall, striped crossings.
- Percent of sidewalk facilities accessible to users of all abilities.
- Percent of arterial and collector roadways with crossing opportunities every XX miles.
- Percent of signals with accessible pedestrian signals (APS).
- Percent of bus stops with accessible boarding and alighting areas.

System completeness and inventory information can be reported as an aggregate measure (e.g., total miles of bike lanes) or stored in a GIS database.

PEERS TRACKING THE MEASURE

- Most agencies maintain an inventory of sidewalk, crosswalk, and/or bicycle lane infrastructure.
- A number of agencies, including the City of Oakland (California), the City of Boulder (Colorado), Montgomery County (Maryland), and Delaware DOT measure network connectivity using the Level of Traffic Stress method.⁴⁸ LTS is an effective measure for assessing the completeness of a network, particularly because it highlights all streets that are appropriate for the “interested but concerned” bicycling demographic. LTS also highlights areas of concern where the network is not complete and uncomfortable for less experienced bicyclists.
- Oregon DOT has developed Level of Traffic Stress analysis procedures that are included in its Analysis Procedures Manual and used by jurisdictions across the State.
- The Central Indiana Regional Bikeways Plan displays network completeness as measure for the region as well as every county, city, and town in the planning area. For example, Central Indiana has made 28% progress toward construction of all the proposed bikeways facilities in the region.

NOTES

Completeness can be a subjective term and should be explicitly defined. For example, a minimum width of a sidewalk should be identified to qualify as part of a complete system.

Collecting inventory data can be time consuming and expensive, and some agencies lack documentation on pedestrian and bicycle infrastructure. With ever improving photographic inventories such as third party aerial photography and street-level photo inventories, agencies may be able to collect bulk information much more easily.

Network Completeness can be tied in with agencies' ADA Transition Plans, which require DOTs and other agencies to identify barriers to access for persons with disabilities and schedule removal of such barriers.

PERFORMANCE MEASURE

PEDESTRIAN SPACE

The measurement or proportion of public right-of-way dedicated to pedestrian activities, including sidewalks, plazas, median refuges, and crosswalks, to name a few.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

CONTEXT

PERFORMANCE MEASURE APPLICATION

ALTERNATIVES COMPARISON

Pedestrian Space is a measure that can be used to evaluate various alternatives, including roadway designs, in terms of their potential benefits to pedestrians.

BENCHMARKING

Pedestrian Space can be a useful measure for benchmarking progress over time, particularly in subareas that are actively working to increase pedestrian access and street-level retail activity.

STANDARD

A measure of pedestrian space can be used as a standard, either simply as a required minimum sidewalk width (very common), or as a required portion of the overall street cross section or particular area.

RELATED MEASURES

Crossing Opportunities

Miles of Pedestrian/
Bicycle Facilities

Network Completeness

Street Trees

Volume

DATA NEEDS & SOURCES

Inventory data for roadway characteristics, including:

- Sidewalks (width and length).
- Median refuges and crosswalks.
- Other non-auto space within right-of-way (e.g., parks, plazas).
- GIS network of sidewalk, bicycle, park, and plaza facility data.

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input type="radio"/>	<input checked="" type="checkbox"/>
REGION	<input type="radio"/>	<input checked="" type="checkbox"/>
LOCAL	<input checked="" type="checkbox"/>	<input type="radio"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="checkbox"/>	<input type="radio"/>
SUBURBAN	<input checked="" type="checkbox"/>	<input type="radio"/>
RURAL	<input type="radio"/>	<input type="radio"/>

HOW TO TRACK

Pedestrian Space is a measure that quantifies the amount or proportion of the right-of-way that is allocated to pedestrian activity. It may also include parks or privately owned plazas immediately adjacent to the street. Most simply, it can be measured as the amount of sidewalk space in a given area. Jurisdictions can choose to measure sidewalk space in a number of ways:

- Portion of public right-of-way dedicated to pedestrians (area dedicated to pedestrian use divided by the total area of public right-of-way).
- Square feet of pedestrian space in a corridor or given area.
- Width of sidewalks in a corridor or given area.
- Effective sidewalk width (or clear width) measures the amount of space available for walking after accounting for street furniture and other obstacles, adjacent curbs, or adjacent buildings, and is a calculation in the Highway Capacity Manual.
- Jurisdictions may choose to track annual changes to the portion of space dedicated to pedestrians through the addition of sidewalk, widening of roadway, expansion of parks and/or pedestrian plazas.

PEERS TRACKING THE MEASURE

- FHWA's Course on Bicycle and Pedestrian Transportation, Walkways, Sidewalks, and Public Spaces,⁵⁸ provides design guidance on features that make up "pedestrian space" and effective ways for measuring the pedestrian space elements.
- Measuring the Street: New Metrics for 21st Century Streets⁵⁹
- New York City DOT keeps an inventory of number of pedestrian refuges. While this does not present the data as a ratio, it does measure an increase or change of pedestrian space within the right of way.
- FDOT's Expanded Transportation Performance Measures⁶⁰
- FDOT measures the square feet of auto space, bicycle space, and pedestrian space in square feet per mile as a "rough measure of the bicycle and pedestrian amenities provided within an urban environment."

NOTES

Assuming appropriate GIS data is available for basic pedestrian facilities, monitoring pedestrian space is a relatively simple calculation to determine the proportion of overall right-of-way space that is dedicated to non-auto modes. It can also be done at a more localized corridor level by using specific roadway measurements that may be available through project-based collection and analysis.

A higher amount of pedestrian space may be correlated with a variety of economically beneficial uses, such as sidewalk sales, farmers' markets, or outdoor seating for cafes and restaurants.

PERFORMANCE MEASURE

PERSON THROUGHPUT

A mode neutral estimate of the person through-capacity of a given corridor. The fundamental unit of measure is a person. Capacity has traditionally been estimated as a function of vehicle units, but limited occupancy and the presence of transit users, bicyclists, pedestrians, and carpools render these analyses insufficient in the estimation of total demand. In other words, it measures the number of people using a corridor, regardless of the mode of transportation.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

CONTEXT

PERFORMANCE MEASURE APPLICATION

PROJECT PRIORITIZATION

Projects can be compared against their ability to move people (rather than vehicles) as part of a prioritization process.

ALTERNATIVES COMPARISON

Comparing total person throughput across alternatives helps illustrate the level of mobility a project provides.

SCENARIO EVALUATION

Comparing planning scenarios, evaluate how well various alternatives move people through the network.

STANDARD

A threshold for a corridor or intersection performance defined by total person capacity rather than vehicle capacity.

RELATED MEASURES

Delay

Level of Service

Mode Split

Population Served by Walk/Bike/Transit

Transportation-Disadvantaged Population Served

Volume

DATA NEEDS & SOURCES

- Traffic volume data, including automobiles, buses, trucks, pedestrians, cyclists.
- Transit ridership, if available.
- Transit schedules from local/regional/State transit agencies.
- Regional commuter data from the FHWA's National Household Travel Survey can be used to estimate the average number of passengers in private automobiles and buses. Similar data is often available through regional planning agencies for use in travel demand modeling.
- Performance Based Planning and Programming Guidebook.
- Performance Based Planning and Programming through Scenario Planning.

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input checked="" type="radio"/>	<input type="radio"/>
REGION	<input checked="" type="radio"/>	<input type="radio"/>
LOCAL	<input checked="" type="radio"/>	<input type="radio"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="radio"/>	<input type="radio"/>
SUBURBAN	<input checked="" type="radio"/>	<input type="radio"/>
RURAL	<input type="radio"/>	<input checked="" type="radio"/>

HOW TO TRACK

Person Throughput can be measured or estimated in a number of ways depending on the availability of data and the complexity of a corridor, but ultimately includes the combination of the following modal elements:

- Persons in private vehicles: A common method is to estimate average vehicle occupancy and then apply that to the number of counted vehicles over a period of time. Average vehicle occupancy data can come from a few sources, but the easiest data to access is from a regional household travel survey or FHWA's National Household Travel Survey (NHTS).
- Persons in transit vehicles: transit ridership can generally be obtained by local, regional, and/or State transit agencies. If the actual ridership data is not available then an estimate of transit vehicle capacity based on time of day can be applied to the frequency of transit vehicles over a period of time.
- Pedestrians: pedestrians are typically counted at intersection crosswalks, but can also be counted midblock.
- Cyclists: cyclists are typically counted at intersections, similar to motor vehicles but can also be counted midblock or on trails.

The aforementioned approach to measuring person throughput is demand based (i.e., used to measure existing conditions), but with enough detail it can potentially be used to determine projected person throughput tied to population growth, increase in density, and modifications to existing infrastructure.

PEERS TRACKING THE MEASURE

Washington, DC's District Department of Transportation (DDOT) has used person throughput as an evaluation metric on several of its busiest multimodal corridors. A key goal of the District's Multimodal Long Range Transportation Plan, moveDC, is to "increase the person-carrying capacity of the transportation system." To better assess the current person carrying capacity of 16th Street NW, a busy north-south commuter route, the person throughput assessment revealed nearly 50% of morning commuters were actually in buses.

NOTES

Collecting existing conditions person throughput is not overly complex, assuming traffic count and bus ridership data are available. Developing projected person throughput volumes is significantly more difficult however, and includes a more detailed understanding of projected land use changes, resulting multimodal trip generation, and expected changes to all modes. Projecting future motor vehicle volumes is relatively commonplace through travel demand models and trip generation; however, accounting for future pedestrian, bicycle, and transit volumes are significantly more nuanced and challenging.

PERFORMANCE MEASURE

PHYSICAL ACTIVITY AND HEALTH

Measure of the level of physical activity per capita or the portion of the population that is physically active. Walking and bicycling for transportation are important ways to incorporate physical activity into people's daily lives. Increased physical activity from walking and bicycling has been linked to improved health outcomes, among other important public health factors of safety, access to health, supportive destinations, and air quality.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

RELATED MEASURES

Access to Community Destinations

Crashes

Vehicle Miles Traveled (VMT) Impacts

CONTEXT

PERFORMANCE MEASURE APPLICATION

PROJECT PRIORITIZATION

Current levels of physical activity or activity-related health indicators could be used as a measure to help prioritize active transportation investments in areas where residents currently are not physically active.

SCENARIO EVALUATION

Physical activity from transportation can be used to evaluate future scenarios, based on the forecast numbers of trips made by walking and bicycling. Scenarios that facilitate more walking and bicycling can result in the health benefits that result from increased physical activity.

BENCHMARKING

Physical activity levels can also track progress towards a goal over time in response to infrastructure investments or policy changes.

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input checked="" type="radio"/>	<input type="radio"/>
REGION	<input checked="" type="radio"/>	<input type="radio"/>
LOCAL	<input checked="" type="radio"/>	<input type="radio"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="radio"/>	<input type="radio"/>
SUBURBAN	<input checked="" type="radio"/>	<input type="radio"/>
RURAL	<input checked="" type="radio"/>	<input type="radio"/>

DATA NEEDS & SOURCES

- Surveys tracking physical activity or other health indicators.
- Estimates of physical activity from transportation based on travel demand model outputs.
- Emerging sources of physical activity data like Strava, Inc. or other fitness-tracking applications.
- Estimates of impacts on health outcomes from integrated models, such as the Integrated Transport and Health Impact Model.
- County-level health indicators measures are available at County Health Rankings & Roadmaps.⁶¹

HOW TO TRACK

Physical activity can lower the risk of various diseases and health conditions, including premature mortality, coronary heart disease, stroke, high blood pressure, Type 2 diabetes, osteoporosis, breast and colon cancer, falls, and depression. These health conditions can be tracked at State and national levels, as well as in some regions, but the data and outcomes will lag behind behavior changes. Measuring physical activity levels, however, provides a way to set targets and measure progress, closely linking transportation and health.

Physical activity levels can be measured in a variety of ways:

- Average minutes of physical activity per day per capita.
- Average minutes of physical activity attributable to active transportation per day.
- Portion of people regularly using active transportation modes.
- Number of walking or biking trips.
- Portion of population that is “inactive” or “active”.

While travel models can be helpful in estimating levels of walking and bicycling, most regional models are not designed to represent and account for short walking or bicycling trips, given that the travel analysis zones often cover relatively large geographies compared to a typical walking trip distance.

More detailed assessments of minutes spent walking or bicycling may come from emerging sources of data collection, such as GPS or app-based fitness-tracking systems that allow for empirical data collection in real time.

EMERGING TECHNOLOGIES AND TRENDS

Mobile smartphone applications collecting data on users' physical activity and attributes such as heart rate.

PEERS TRACKING THE MEASURE

- The Nashville Area MPO surveyed households on physical activity and also employed GPS and activity monitors to help understand and assess the effects of transportation planning decisions on physical activity and health of Nashville area residents in the Middle Tennessee Transportation and Health Study.
- Blue Zones⁶² communities, such as Hermosa Beach, are incorporating physical activity for transportation into daily lives of residents to improve health outcomes.

NOTES

Walking and bicycling is closely related to health in several ways beyond physical activity, which are also measures in this guide: crash-related injuries and fatalities; access to destinations (health care, groceries, and recreational opportunities); and air quality (vehicle miles traveled impacts).

Measures of health outcomes can also be tracked to augment physical activity measures in collaboration with public health agencies, including emergency room visits due to asthma, levels of childhood obesity, adult obesity, cardiovascular disease, diabetes, hypertension, and depression.

The Transportation and Health Tool⁶³ has data on physical activity from transportation by State.

Upcoming national household travel surveys (NHTS) will have additional questions on physical activity.

Surveys on health status from the Centers for Disease Control (CDC) include the Behavioral Risk Factor Surveillance System (BRFSS)⁶⁴ (reports on physical activity, but not transportation-related specifically), the National Health and Nutrition Examination Survey⁶⁵ and the National Health Interview Survey.⁶⁶

PERFORMANCE MEASURE

POPULATION SERVED BY WALK/BIKE/TRANSIT

The proximity of pedestrian, bicycle, and transit infrastructure and services (e.g., travel time, distance) to residential populations.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

RELATED MEASURES

- Access to Community Destinations
- Access to Jobs
- Density of Destinations
- Transportation-Disadvantaged Population Served

CONTEXT

PERFORMANCE MEASURE APPLICATION

PROJECT PRIORITIZATION

Measuring the percent of population served by pedestrian, bicycle, and transit facilities can be used to prioritize investments. For instance, projects that will provide access in currently underserved areas would be prioritized over projects that do not provide crucial connections. Likewise, projects that have a strong cost-benefit ratio may be prioritized over a project with a weaker cost-benefit.

ALTERNATIVES COMPARISON (POSSIBLE)

Measuring the percent of population served by pedestrian, bicycle, and transit facilities can be used to compare alternatives for expanding or enhancing the network.

SCENARIO EVALUATION

Agencies should consider the population served when evaluating investment scenarios.

BENCHMARKING

An agency can regularly measure the percent of population served by pedestrian, bicycle, and transit facilities to determine its progress improving access.

STANDARD

An agency can establish a baseline for the percent of the population that is within a certain distance of a facility. For example, the standard can be to improve access by a certain percentage each year or to achieve access for a certain percentage of the population by a given year (i.e., 75% of residents are within a ½-mile of a bicycle facility by 2025).

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input checked="" type="checkbox"/>	<input type="checkbox"/>
REGION	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LOCAL	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
SUBURBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
RURAL	<input type="checkbox"/>	<input checked="" type="checkbox"/>

DATA NEEDS & SOURCES

- U.S. Census demographic data.
- GIS transportation network for all modes.

HOW TO TRACK

The network of walking, biking, and transit infrastructure is essential for completing everyday activities. These facilities allow residents to access work, school, and other community destinations. Access to these facilities also allows residents to walk and bike safely and contributes to a healthy lifestyle. There are numerous ways to evaluate the transportation network effectiveness in providing access to sidewalks, bicycle facilities, and transit stops:

- Percent of population within a ½-mile walking distance or 2-mile biking distance to a transit stop.
- Percent of population within a ¼-mile network distance to sidewalk, trail, or bike facility.
- Percent of transit stops that are accessible.

To understand equity implications, break out population or household data by income-level and/or race. Low-income and minority neighborhoods are less likely to have access to a car so access to walking and biking facilities is crucial. Access to these facilities also improves access to transit. Tracking the population that has direct access to non-auto infrastructure and services, particularly disadvantaged populations, is a key element of U.S. DOT's current Ladders of Opportunity Initiative. In particular, the Initiative supports creating a connected multimodal transportation system for all users.

PEERS TRACKING THE MEASURE

- Oregon DOT's value and cost informed transportation planning tool, Mosaic, features a performance measure on access to transit stops: AC.4 Population and employment within ¼ mile of a transit stop served by at least 30 vehicles per day.
- The cities of Seattle, Washington; Minneapolis, Minnesota; and Portland, Oregon each use "demographic equity" as a key project evaluation criterion. Focus is typically on populations identified as low-income, minority, seniors, and children, as well as populations with lower than average rates of bicycling or do not have access to a car.
- Several agencies have used population served by walking, bicycling, and transit in transit-oriented development (TOD) analysis:
 - Maryland DOT's TOD Last Mile Connection <http://mdpgis.mdp.state.md.us/tod/index.html>
 - Denver TOD Last Mile Connection https://www.denvergov.org/Portals/193/documents/DLP/TOD_Plan/TOD%20Executive%20Summary_051214.pdf
 - Chicago Metropolitan Agency for Planning TOD <http://www.cmap.illinois.gov/about/2040/supporting-materials/process-archive/strategy-papers/urban-design/tod>
 - Hawaii TOD <http://www.honolulu.gov/tod.html>

NOTES

Whenever possible, calculate distances along an existing or planned network. Buffer calculations can provide a rough idea of access, but this method does not account for barriers that do not have a crossing for people on foot or bike (e.g., canyons, rivers, freeways, etc).

PERFORMANCE MEASURE

RETAIL IMPACTS

The commercial impacts (e.g., change in revenue, spending habits) and the ability to access retail establishments (e.g., the mode used to access the establishment) by pedestrians and bicyclists as a result of transportation investment.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

CONTEXT

PERFORMANCE MEASURE APPLICATION

ALTERNATIVES COMPARISON

Results from intercept surveys that ask about transportation mode and spending habits can be used to compare project design options.

SCENARIO EVALUATION

Estimates of retail impacts can be used to evaluate planning scenarios.

BENCHMARKING (POSSIBLE)

An intercept survey or survey of business owners can be used to track progress in an area actively seeking to increase the proportion of people who access businesses by foot or by bike. A survey can also be used to benchmark business owner-reported revenue or spending habits, by transportation mode.

RELATED MEASURES

Job Creation

Land Value

DATA NEEDS & SOURCES

- Sales tax data.
- Survey data.

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input type="radio"/>	<input checked="" type="radio"/>
REGION	<input type="radio"/>	<input checked="" type="radio"/>
LOCAL	<input checked="" type="radio"/>	<input type="radio"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="radio"/>	<input type="radio"/>
SUBURBAN	<input checked="" type="radio"/>	<input type="radio"/>
RURAL	<input type="radio"/>	<input type="radio"/>

HOW TO TRACK

Street-level retail depends on its customers' ability to access and patronize their shops. Investments in walking and bicycling have been shown to increase retail activity, especially in areas with latent pedestrian and bicycle demand.^{67 68} Parking supply, both for bicycles and autos, and transit also impacts access to storefronts. Two common methods are used to evaluate retail impacts:

- Sales tax receipts – sales tax data provide an objective and consistent method for tracking how much spending takes place within a given study area. Measuring sales before and after a project is constructed may indicate how transportation investment impacted retail sales.
- Shopper surveys – surveys of customers can reveal access mode choice and stated preferences for walking and bicycling infrastructure. Surveys can be done before or after a project is built to understand how it may impact shopping.

PEERS TRACKING THE MEASURE

- New York City DOT analyzed quarterly sale tax reports from ground floor businesses in the year before and three years after a Complete Streets infrastructure project. The city's study included comparison corridors to control for broader economic trends in the city. The 2012 report includes lessons learned: <http://www.nyc.gov/html/dot/downloads/pdf/dot-economic-benefits-of-sustainable-streets.pdf>
- The San Francisco Municipal Transportation Agency conducted an intercept survey along Polk Street to better understand transportation and spending habits. This information informed transportation planning decisions. 2013 survey summary:
- Salt Lake City tracked retail sales on Broadway following the installation of separated bike lanes, which removed parking on the street, and saw more than 8 percent increase in sales in the first six months.

NOTES

Some transportation agencies have difficulty obtaining sales tax records. And retail sales are impacted by a variety of factors, so caution should be used in relating impacts to transportation investment.

A survey of businesses by Portland State University (Bike Corrals – Local Business Impacts, Benefits, and Attitudes) found that because of the bike corral program "40 percent of all businesses estimate that they have seen an increase in customers."

PERFORMANCE MEASURE

ROUTE DIRECTNESS

A measurement of the most direct routes for walking and biking between two designated locations. Ideally, walking and biking routes should be as short and direct as possible without sacrificing user comfort.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

RELATED MEASURES

- Average Travel Time
- Average Trip Length
- Connectivity Index
- Network Completeness

CONTEXT

PERFORMANCE MEASURE APPLICATION

PROJECT PRIORITIZATION (POSSIBLE)

Route Directness can potentially be used as a prioritization measure. Jurisdictions can choose to prioritize projects that have the highest impact on improving route directness.

ALTERNATIVES COMPARISON

Route Directness can be useful in comparing alternatives, particularly in looking at site development, corridor, or subarea planning. Route Directness can be easily evaluated with a relatively limited number of origins and destinations. An automated GIS process can help to determine the route directness of multiple origins and destinations within an area.

SCENARIO EVALUATION (POSSIBLE)

Average route directness can be used to evaluate benefits of future transportation investment scenarios for walkability and bikeability. Consider two potential investments: 1) a high-capacity arterial connection (managed access); or 2) development of a grid network of neighborhood streets. The latter would score higher on a route directness measure for bicyclists and pedestrians.

BENCHMARKING (POSSIBLE)

Average route directness can be used as a benchmark in a region actively seeking to improve routes and connectivity for walking and bicycling. For example, if a region adopted a policy to create nonmotorized connections between cul-de-sacs in previously developed neighborhoods, average route directness can help to track progress.

STANDARD

Route Directness can also be applied as a standard, which can be used to designate and develop a pedestrian or bicycle network. For instance, a jurisdiction can specify a route directness of 1.25, expressed as travel distance-to-actual distance ("as the crow flies") for trips longer than one mile. The standard can also be applied within planned developments.

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input type="checkbox"/>	<input checked="" type="checkbox"/>
REGION	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LOCAL	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
SUBURBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
RURAL	<input type="checkbox"/>	<input type="checkbox"/>

DATA NEEDS & SOURCES

For a simple application measuring route directness between a specific origin and destination:

- Maps of travel networks by mode.
- Location of origin and destination.

For a broader application with a variety of origins and destinations:

- GIS transportation networks for each mode.
- GIS information on land use (origins and destinations).

HOW TO TRACK

The directness of a trip determines the walking or bicycling distance between an origin and destination. Since active transportation relies on physical exertion, out-of-direction travel negatively impacts the walking and bicycling experience. Calculate the ratio of the shortest path route distance to straight-line distance for two selected points. The lowest number achievable would be 1.0, although unlikely, and lower results indicate strong, connected networks with little out-of-direction travel.

EMERGING TECHNOLOGIES AND TRENDS

Mobile smartphone applications collecting data on trips and time traveled; GIS analysis techniques.

PEERS TRACKING THE MEASURE

- The Skagit Island Regional Transportation Planning Organization in Washington used route directness as a measure to rank and prioritize projects as part of its Regional Nonmotorized Plan.
- Bellingham, Washington used parcel point-to-point GIS metrics, including route directness, as a benchmarking and prioritization measure.

NOTES

Pedestrian or bicycle route directness is one of the best measures of connectivity and most representative of the user's actual experience, but it requires the selection of an origin or destination, and so is more complex to apply on an area-wide basis. In most cases, a GIS software with the Network Analyst extension is needed to perform the route directness analysis.

PERFORMANCE MEASURE

STREET TREES

The number of trees on a street or other area. Typically measured as number of trees, percent of street tree canopy coverage, number of trees per mile, and tree spacing.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

CONTEXT

PERFORMANCE MEASURE APPLICATION

ALTERNATIVES COMPARISON (POSSIBLE)

Using the presence of street trees as an evaluation criterion for project alternatives would recognize projects that include trees.

BENCHMARKING

Annual tracking of the percent of streets with tree cover can be used to track an agency's progress.

STANDARD

Agencies can set a minimum threshold for street tree cover.

RELATED MEASURES

Crashes

Level of Service

Pedestrian Space

User Perceptions

DATA NEEDS & SOURCES

- GIS-based inventory of trees.
- Aerial imagery.
- On-site inventory.

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input type="radio"/>	<input checked="" type="radio"/>
REGION	<input type="radio"/>	<input checked="" type="radio"/>
LOCAL	<input checked="" type="radio"/>	<input type="radio"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="radio"/>	<input type="radio"/>
SUBURBAN	<input checked="" type="radio"/>	<input type="radio"/>
RURAL	<input type="radio"/>	<input checked="" type="radio"/>

HOW TO TRACK

Street trees provide a comfortable walking space and numerous environmental benefits, including wastewater diversion, CO₂ sequestration, improved air quality, and habitat for wildlife. They also visually narrow the roadway, which has a traffic calming effect that improves livability and safety outcomes for all roadway users. Agencies can measure the presence of street trees in a variety of ways, depending on the application of the information:

- Tree canopy coverage for the jurisdiction or a given area using aerial imagery or LIDAR data.
- Total number of street trees in a site plan, small area, or jurisdiction.
- Spacing of street trees (can be applied as a standard).
- Number of street trees per roadway mile.

Maintain database of jurisdiction's street trees through manual inventory, including data on age, size, condition, and species of street trees.

EMERGING TECHNOLOGIES AND TRENDS

Analysis of aerial photography and satellite imagery.

PEERS TRACKING THE MEASURE

The City of San Francisco's Urban Forest Plan measures the tree canopy and recommends tracking of this measure every five years. http://www.sf-planning.org/ftp/files/plans-and-programs/planning-for-the-city/urban-forest-plan/Urban_Forest_Plan_Final-092314WEB.pdf

NOTES

Policies on street trees also include language about maintenance responsibilities to ensure that trees are properly managed through their lifecycles, are replaced when needed, and do not become overgrown, create sight distance problems, or cause tripping hazards.

If an agency is more concerned with the livability aspect rather than the environmental aspect of this performance measure, it might consider a performance measure about spatial enclosure (e.g., ratio of building height to street width).

In some contexts, roadside trees are considered a hazard to drivers who may inadvertently veer off the road. Both the AASHTO Policy on Geometric Design of Highways and Streets and the ITE Designing Walkable Urban Thoroughfares specify that such "clear zone" requirements are only appropriate along highways and rural roads where pedestrian activity is not expected.

PERFORMANCE MEASURE

TRANSPORTATION-DISADVANTAGED POPULATION SERVED

The proportion of low income, minority, senior, and disabled populations with access to pedestrian, bicycle, and transit infrastructure and services.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

RELATED MEASURES

- Access to Community Destinations
- Access to Jobs
- Density of Destinations
- Population Served by Walk/Bike/Transit

CONTEXT

PERFORMANCE MEASURE APPLICATION

PROJECT PRIORITIZATION

Projects serving neighborhoods with transportation-disadvantaged populations can be prioritized for funding.

ALTERNATIVES COMPARISON (POSSIBLE)

Project alternatives can be evaluated on their ability to serve transportation-disadvantaged populations. For example, alternatives that promote auto mobility at the expense of pedestrian accessibility would be harmful to households who do not have access to a vehicle.

SCENARIO EVALUATION

Comparing planning scenarios on their impacts to transportation-disadvantaged populations can identify important tradeoffs.

BENCHMARKING

Annually tracking a transportation system's ability to serve people, especially those who are transportation-disadvantaged, is an important metric for an agency's performance.

STANDARD

Agencies can set a minimum level of access for transportation-disadvantaged populations.

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input checked="" type="checkbox"/>	<input type="checkbox"/>
REGION	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LOCAL	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
SUBURBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
RURAL	<input checked="" type="checkbox"/>	<input type="checkbox"/>

DATA NEEDS & SOURCES

- U.S. Census demographic data, including income, levels of poverty, zero-car households, seniors, children.
- GIS transportation network for all modes, including existing and proposed pedestrian and bicycle infrastructure. This data is usually found in local GIS Clearinghouses and/or from relevant local, regional, and State agencies.

HOW TO TRACK

Evaluate the transportation system effectiveness in providing access to sidewalks, bicycle facilities, and transit stops for transportation disadvantaged populations. Transportation-disadvantaged population is frequently represented as an index of certain population characteristics, and could include one or more of the following: low-income households, persons with disabilities, under 18, 65 and over, minority populations, households without access to a vehicle, or single parent households.

- Percent of transportation-disadvantaged population within a ½-mile walking distance or 2-mile biking distance to a transit stop.
- Percent of transportation-disadvantaged population within a ¼-mile walking distance to sidewalk, trail or shared use path.
- Percent of transportation-disadvantaged population within 1/2-mile bicycling distance to on-street bicycle facility.
- Percent of transit stops that are accessible (boarding/alighting connected to sidewalk).
- Percent of transportation-disadvantaged population within a 2-mile biking distance to an off-street bicycle facility.

TERM	DESCRIPTION
Disadvantaged	Per Federal law, socially disadvantaged includes persons who have been subject to racial or ethnic prejudice or cultural bias within American society because of their identification as a member of groups without regard to their individual qualities. Economically disadvantaged persons refers to socially disadvantaged individuals whose ability to compete in the free enterprise system has been impaired due to diminished capital and credit opportunities.
Low Resource Communities	Communities that have limited resources, both economic and social, compared to other communities. These communities are a focus for Safe Routes to School projects.
Traditionally Underserved	Can include populations identified in the Executive Order 12898 on Environmental Justice. E.O. 12898 (low-income populations and minority populations such as Hispanics/Latinos, African Americans/Blacks, Asian Americans, Native Americans/Alaskan Natives, and Native Hawaiians and Pacific Islanders) as well as populations recognized by Title VI of the Civil Rights Act of 1964 and other civil rights legislation, executive orders, and transportation legislation such as people with limited English proficiency, older adults, and persons with disabilities.
Underserved	Populations that are not served as well as they could be by transportation systems. Primarily minority and low-income populations. This can also include other demographic categories that face challenges engaging with transportation processes and reaping equitable benefits, such as LEP, children, seniors, persons with disabilities, and others.

PEERS TRACKING THE MEASURE

- Washington County, OR is planning to track access to daily needs for low-income, minority, senior, and disabled populations, but the metrics are still under development. <http://www.co.washington.or.us/lut/divisions/longrangeplanning/planningprograms/transportationplanning/transportation2035/upload/potential-performance-measures-9-25-color.pdf>
- The cities of Seattle, Washington; Minneapolis, Minnesota; and Portland, Oregon each use "demographic equity" as a key project evaluation criterion. Focus is typically on populations identified as low-income, minority, seniors, and children, as well as populations with lower than average rates of bicycling or do not have access to a car.
- The Metropolitan Transportation Commission used "Communities of Concern" - an index of various population characteristics - to evaluate equity impacts of different scenarios in Plan Bay Area 2040.
- Evansville's Bicycle and Pedestrian Connectivity Plan recommends measuring the equity of the bike and pedestrian network. Equity is defined as the percent of low income or minority populations with 1/4 mile and 1/2 mile of pedestrian and bicycle facilities.

NOTES

A focus on transportation-disadvantaged populations provides an important equity perspective. Agencies should explicitly understand the impact of investments on those with the least means, and who rely most on public infrastructure.

Communities should define what its transportation-disadvantaged populations are.

PERFORMANCE MEASURE

USER PERCEPTIONS

A measurement of how safe a user feels under various network scenarios. For example, a pedestrian will likely perceive a street to be “unsafe” if it lacks sidewalks and permits high auto speeds. The measure predominantly applies to infrastructure and roadway network conditions, not safety as an element of security.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

RELATED MEASURES

- Adherence to Traffic Laws
- Crashes
- Network Completeness
- Pedestrian Space
- Street Trees
- Volume

CONTEXT

PERFORMANCE MEASURE APPLICATION

PROJECT PRIORITIZATION (POSSIBLE)

Estimating existing safety perception or potential improvements to safety perception for a given project can be used for ranking and prioritizing projects.

ALTERNATIVES COMPARISON

Measures of safety perception are easily calculated for various project alternatives.

SCENARIO EVALUATION (POSSIBLE)

Perception of safety can be used to evaluate the transportation network’s ability to encourage walking and bicycling under different planning scenarios.

BENCHMARKING

Annual reporting of the transportation network’s perceived safety for bicyclists and pedestrians, either estimated or reported through user surveys, can be used to track progress over time.

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input checked="" type="radio"/>	<input type="radio"/>
REGION	<input checked="" type="radio"/>	<input type="radio"/>
LOCAL	<input checked="" type="radio"/>	<input type="radio"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="radio"/>	<input type="radio"/>
SUBURBAN	<input checked="" type="radio"/>	<input type="radio"/>
RURAL	<input checked="" type="radio"/>	<input type="radio"/>

DATA NEEDS & SOURCES

- 85th percentile motor vehicle speeds (preferred) or posted speeds from local jurisdiction.
- Motor vehicle volumes from local jurisdiction.
- Other roadway attributes such as bicycle and pedestrian facility presence, condition, and width; shoulder presence and width; on-street parking presence and width; and street light coverage.

HOW TO TRACK

Understanding the perceived safety of the transportation system from a user or potential user perspective is important in identifying critical network gaps and identifying locations for improvement. There are several models that evaluate the network and specific locations based on attributes that may affect the level of comfort and consequently whether people walk and bike there and the behaviors that they may exhibit such as riding on the sidewalk (for bicyclists) or crossing against the signal (for pedestrians). Examples of these models include:

- “Level of traffic stress” metric for bicyclists.
- A multimodal level of service metric for bicyclists and pedestrians.
- On-site user surveys that assess user comfort and perception of safety under various scenarios. When facility data is not widely available, a network screening of perception of safety could simply include measures of vehicle volumes and speeds.

EMERGING TECHNOLOGIES AND TRENDS

Mobile crowdsourcing applications collecting data on trips and level of comfort experiences.

PEERS TRACKING THE MEASURE

- At a national level, the National Highway Traffic Safety Administration (NHTSA) conducts surveys of pedestrian and bicyclist attitudes and behaviors. The surveys gauge comfort and perception of safety for nonmotorized travelers.
- The Atlanta Regional Commission conducts a regional bicycle user survey to assess perceptions of safety and user satisfaction.
- The Central Indiana Regional Bikeways Plan measured perception of safety (see Figure 3.10 on page 23)

NOTES

This is a growing field of applied research with several new and improved models being developed to identify the best way of highlighting pedestrian and bicyclist needs. Ideally, determining the perception of safety should focus on the largest user group, those interested in walking and biking but concerned about the safety and comfort of doing so. Planning and designing for this concerned user group, specifically by ensuring they perceive an acceptable level of safety, will likely lead to the greatest overall increase in walking and biking.

PERFORMANCE MEASURE

VEHICLE MILES TRAVELED (VMT) IMPACTS

The measurement of miles traveled by vehicles in a specific location for a specific period of time. Total VMT has impacts on emissions levels and air quality, which impact public health.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

CONTEXT

PERFORMANCE MEASURE APPLICATION

PROJECT PRIORITIZATION

Anticipated VMT changes can be calculated for projects and used to rank transportation investments.

ALTERNATIVES COMPARISON (POSSIBLE)

A project's impact on VMT may depend on resulting mode split and changes to the transportation network.

SCENARIO EVALUATION

Measuring VMT at a macro level under various planning scenarios helps describe impacts and benefits.

BENCHMARKING

Annual reporting of VMT will help a transportation agency understand changes in net new or net reduction of vehicle trips.

STANDARD

Using VMT impact to measure a project's impacts focuses on net new vehicle trips rather than delay or capacity.

RELATED MEASURES

- Average Travel Time
- Average Trip Length
- Density of Destinations
- Mode Split
- Person Throughput
- Volume

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input checked="" type="radio"/>	<input type="radio"/>
REGION	<input checked="" type="radio"/>	<input type="radio"/>
LOCAL	<input checked="" type="radio"/>	<input type="radio"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="radio"/>	<input type="radio"/>
SUBURBAN	<input checked="" type="radio"/>	<input type="radio"/>
RURAL	<input type="radio"/>	<input checked="" type="radio"/>

DATA NEEDS & SOURCES

- Roadway characteristics (e.g., segment length).
- Daily traffic volumes (through counts or from local jurisdiction).
- To estimate VMT for projects and land use scenarios, access sketch models or regional or State travel demand models.
- State DOT, MPO, and the FHWA Office of Highway Policy Information may have relevant data.

HOW TO TRACK

VMT is emerging as a strong metric for evaluating transportation impacts. Unlike intersection level of service analysis, VMT impacts focus on additional vehicle trips on the network, irrespective of existing congestion. Whereas traditional methods may discourage infill development, a focus on VMT actually encourages investment in areas that can take advantage of existing walk, bike, and transit infrastructure. "Trips, another obvious and useful measure of the quantity of travel, differs from VMT in length, making VMT a more convenient measure by which to combine the travel consisting of multiple trips made by many people."⁶⁹ A reduction in VMT also means fewer greenhouse gases and pollutants that are harmful to the environment and public health. FHWA's Congestion Mitigation and Air Quality Improvement (CMAQ) Program supports multimodal projects and other efforts that contribute air quality improvements and provide congestion relief.⁷⁰

VMT can be calculated per capita, an average daily basis, in total, and/or on an annual basis. There are two approaches for calculating VMT:

1. Geographic boundary: use traffic counts to estimate the amount of vehicle travel that occurs within a given geographic boundary. This is the method used to develop the FHWA VMT data.
2. Trip generation: use a travel demand model to estimate the vehicle travel of residents living within a given geographic area. An alternative data source is household surveys. Travel model data can include trips produced by and/or attracted to an area, for all trip purposes (e.g., work, school, shopping, etc.).

A rural community may need to rely on a statewide travel model to estimate VMT.

PEERS TRACKING THE MEASURE

- Memphis MPO – The Long Range Transportation Plan goal related to congestion has performance measures that track whether the number of vehicle miles traveled annually is decreasing per capita and whether the number of work commute trips made by bicycling, walking, or transit is increasing.
- State of California – New draft CEQA guidelines from the Governor's Office of Planning and Research require that environmental review of transportation impacts is measured by changes to VMT, not automobile level of service.
- Denver Regional Council of Governments – DRCOG's Metro Vision 2035 Plan identifies a 10 percent reduction in VMT per capita by 2035.
- Puget Sound Regional Council (Seattle, WA) – the Council's Transportation 2040 refers to the VMT goal and target reduction established in State legislation: RCW 47.01.440 establishes statewide annual per capita reduction benchmarks for vehicle miles traveled. The legislation established the forecast baseline of statewide vehicle miles traveled of 75 billion by the year 2020, exempting trucks over 10,000 pounds, with a targeted reduction of 18 percent by 2020, 30 percent by 2035, and 50 percent by 2050.

NOTES

The Environmental Protection Agency's Mixed-Use Trip Generation Model may be used to help estimate the trip-generation impacts of mixed-use developments.

PERFORMANCE MEASURE

VOLUME

The measured (i.e., counted) number of pedestrians and bicyclists in a specified area for a designated period of time.

GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

CONTEXT

PERFORMANCE MEASURE APPLICATION

PROJECT PRIORITIZATION

Pedestrian and bicycle volume data can be used to estimate demand for walking and bicycling, which would indicate a higher priority for a project.

SCENARIO EVALUATION (POSSIBLE)

Pedestrian and bicycle volume trends can be used to estimate future volumes.

BENCHMARKING

Since walking and bicycling are sensitive to the built environment, counting volumes of nonmotorized transportation users offers useful information on an agency's performance.

RELATED MEASURES

Delay

Level of Service

Person Throughput

DATA NEEDS & SOURCES

- Bicycle and pedestrian volume counts.
- Classification data (e.g., gender, race, helmet use).

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input type="radio"/>	<input checked="" type="checkbox"/>
REGION	<input checked="" type="checkbox"/>	<input type="radio"/>
LOCAL	<input checked="" type="checkbox"/>	<input type="radio"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="checkbox"/>	<input type="radio"/>
SUBURBAN	<input checked="" type="checkbox"/>	<input type="radio"/>
RURAL	<input type="radio"/>	<input checked="" type="checkbox"/>

HOW TO TRACK

Pedestrian and bicyclist volumes can be used in a number of ways including establishing baselines and measuring use, evaluating before-and-after data on projects, multimodal modeling, and project prioritization and safety analyses. Depending on data goals, pedestrian and bicyclist volumes can be collected in a number of ways, from short duration counts that are collected by a person over a few hours or the course of a day, to longer duration counts collect-ed by automated equipment.

NCHRP Report 797: Guidebook on Pedestrian and Bicycle Volume Data Collection⁴⁹ provides guidance on collecting volume data using manual count methods and automated counters.

FHWA's Traffic Monitoring Guide (TMG)⁵⁰ is a key data collection reference guide for State highway agencies regarding policies, standards, procedures, and equipment used in a traffic monitoring program.

Bicycle and pedestrian counts generally have greater variability due to generally lower volumes and these modes' susceptibility to the effects of weather; therefore, a combination of long and short duration counts can provide geographic coverage and seasonal insights to more accurately understand demand and travel patterns.

The "means of transportation to work" data provided by the American Community Survey can provide additional insight on how people are traveling to work within specified geographic areas. The major drawback of this data is that it does not consider the trips that occur during non-commuting periods of the typical weekday.

EMERGING TECHNOLOGIES AND TRENDS

Mobile crowdsourcing applications collecting data on pedestrian and bicycle volume.

PEERS TRACKING THE MEASURE

- Arlington, Virginia uses 32 permanent and six portable count stations to collect volume data at locations throughout the county.
- Delaware Valley Regional Planning Commission collects counts throughout the region using automated equipment and makes this available to the public via an interactive website.
- North Carolina DOT has a nonmotorized count pilot program that utilizes automated equipment to collect short and long duration counts and representative locations throughout the pilot region.
- Since 2009, Colorado DOT has been installing bicycle and pedestrian counters at various locations throughout the State.
- Washington State DOT collects manual counts throughout the State each fall by providing a network of city staff, bicycle club members, and other volunteers to collect counts using a consistent process. Washington State has also funded the installation of 50 additional automated bicycle/pedestrian counters to obtain count data from a representative sample for the State.
- Appendix A of NCHRP Report 797 also contains 10 case studies in different North American cities.

NOTES

Updated guidance on counting and formatting volume data is forthcoming and should make collecting nonmotorized counts more streamlined and commonplace in the industry. Advances in both counting technology and guidance will help move towards more consistency in pedestrian and bicycle volume counts.

NCHRP Report 797: Guidebook on Pedestrian and Bicycle Volume Data Collection provides a wealth of information designed to assist agencies with developing and implementing pedestrian and bicycle count programs. The report contains chapters on applications for count data; planning and implementing a count program; applying adjustment factors and expanding count data; and guidance for choosing a particular automated count technology for various contexts.

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