

## **Bike, Pedestrian, and Transit, and Planning Performance Measures: Synthesis**

Prepared for  
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*Transportation Synthesis Reports (TSRs) are brief summaries of currently available information on topics of interest to WSDOT staff. Online and print sources may include newspaper and periodical articles, NCHRP and other TRB programs, AASHTO, the research and practices of other state DOTs and related academic and industry research. Internet hyperlinks in the TSRs are active at the time of publication, but host server changes can make them obsolete.*

### **Request for Synthesis**

Brian Smith, Director of Strategic Planning at WSDOT, requested a synthesis on published research on bike, pedestrian, and transit, and planning performance measures at both, federal or state levels. The research articles listed below provide information on performance measures in use and for consideration.

#### Databases Searched:

- TRID Online
- Research in Progress
- Previous Synthesis Reports
- Google
- Wisconsin DOT Transportation Synthesis Reports

#### Websites Searched:

- Federal Transit Administration (FTA)
- FHWA
- AASHTO
- American Public Transportation Association (APTA)

### ***Information Related to Bicycle and Pedestrian Performance Measures***

#### **USDOT: Policy Statement on Bicycle and Pedestrian Accommodation**

USDOT Website; March 11, 2010

Purpose: The United States Department of Transportation (DOT) is providing this Policy Statement to reflect the Department's support for the development of fully integrated active transportation networks. The establishment of well-connected walking and bicycling networks is an important component for livable communities, and their design should be a part of Federal-aid project developments. Walking and bicycling foster safer, livable, family-friendly communities; promote physical activity and health; and

reduce vehicle emissions and fuel use. Legislation and regulations exist that require inclusion of bicycle and pedestrian policies and projects into transportation plans and project development. Accordingly, transportation agencies should plan, fund, and implement improvements to their walking and bicycling networks, including linkages to transit. In addition, DOT encourages transportation agencies to go beyond the minimum requirements, and proactively provide convenient, safe, and context-sensitive facilities that foster increased use by bicyclists and pedestrians of all ages and abilities, and utilize universal design characteristics when appropriate. Transportation programs and facilities should accommodate people of all ages and abilities, including people too young to drive, people who cannot drive, and people who choose not to drive.

<http://www.dot.gov/affairs/2010/bicycle-ped.html>

### **Cumulative Logistic Regression Model for Pedestrian Level of Service Rating**

Authors: Flannery, Aimee; Ali Dr., Asma; Cristei, Cerasela; TRB; 2010

Abstract: Complete street designs are becoming increasingly popular and sought by engineers and planners to accommodate all users on urban arterials. To address analysis needs, National Cooperative Highway Research Program Project 3-70 addresses analysis needs to assist engineers and planners understand the implications of design and operational choices on the perceived level of service of travelers on urban arterials. NCHRP 3-70 was a six year project that gathered input from four modes of travel on urban arterials: auto, pedestrian, bicycle, and fixed route transit. Data gathered for the pedestrian, bicycle, and auto modes using video simulation techniques came from four locations: Oakland, CA; Chicago, IL; New Haven, CT; and College Station, TX. One hundred and forty-five participants were included in the study ranging in age and gender. The research developed models for each of the modes and an overall methodology developed to analyze multimodal level of service for urban arterials. This study seeks to utilize a new modeling approach for the pedestrian level of service data which takes advantage of each of the 1400 data points to develop a cumulative logistic model that describes the entire distribution of pedestrian level of service under a given set of conditions. Previous models in NCHRP 3-70 utilized simple linear regression with mean observations to estimate pedestrian level of service. The advantages of the newly developed model include a simplification of the required input variables and the ability to better estimate pedestrian level of service as demonstrated in the validation process.

Available through [WSDOT Library](#)

### **HPE's Walk ability Index – Quantifying the Pedestrian Experience**

Authors: Hall, Richard A; TRB, 2010

Abstract: Walking continues to enjoy a renaissance as a serious mode of urban transportation. Its latest round of design innovation blends conventional transportation planning and engineering with urban design skills. Both sides of the Right-of Way line now receive the designers focus when walk able, livable communities are established policy. This broadening of the considered pedestrian environment is vital to walking comfort, safety, and increased activity. However, describing that environment is difficult. This paper outlines a new measure, based on ten evaluation criteria to determine thoroughfare segment walk ability on a 100 point scale. HPE's Walk ability Index draws from the best transportation and urban design thinking and experience regarding walking/biking. The report considers physical elements of a given thoroughfare and block face in determining walk ability. Several criteria vary based on the context of the thoroughfare under study. The Walk ability Index not only assesses a location's current level of walk ability, but also provides suggestions for improvement. The Index serves as a richer alternate measure to the standard motor vehicle level of service, for use during project, corridor, and urban design studies. The report provides summarized experience for walk ability Index application for several cities including Towson, Maryland; Savannah, Georgia; Portsmouth, Virginia and Sarasota, Florida.

Available through [WSDOT Library](#)

## **Pedestrian and Bicycle Information Center (PBIC)**

PBIC Website, 2010

This compiled list of bicycle and pedestrian plans provides easy access to a number of useful and good examples of bicycle and pedestrian planning. It lists statewide plans, regional plans, local plans, and site plans.

<http://www.bicyclinginfo.org/develop/sample-plans.cfm>

## **Factors Associated with Federal Transportation Funding for Local Pedestrian and Bicycle Programming and Facilities**

Authors: Craddock, Angie L; Troped, Philip J; Fields, Billy; Melly, Steven J; Simms, Shannon V.; Gimmler, Franz ; Fowler, Marianne; Journal of Public Health Policy; 2009

Abstract: Providing safe, convenient places for walking and bicycling can reduce barriers to participating in regular physical activity. The study examined bicycle- and pedestrian-related investments authorized by federal transportation legislation in 3,140 counties in the United States by region, population size, and urbanization, social and economic characteristics, and indicators of travel-related walking and bicycling. From 1992 to 2004, states and counties implemented 10,012 bicycle- and pedestrian-related projects representing \$3.17 billion in federal expenditures. The report observed disparities in implementation and system-building outcomes according to population size and location and social and economic indicators. Counties characterized by persistent poverty (odds ratio=0.69, 95% confidence interval 0.53–0.91) or low educational status (odds ratio=0.66, 95% confidence interval 0.52–0.84) were less likely to implement projects. Three key policy recommendations for improving public health outcomes draw from this research and include: improved data tracking, more explicit linkages between transportation projects and public health, and improved planning assistance to underserved communities, as essential steps.

Available through [WSDOT Library](#)

## **Integration of Real-Time Pedestrian Performance Measures into Existing Infrastructure of Traffic Signal System**

Authors: Hubbard, Sarah M. L.; Bullock, Darcy M; Day, Christopher M; TRB; 2008

Abstract: Transportation system management requires balancing the needs of many users and multiple transportation modes. The report presents motivation and means to provide real-time pedestrian performance measures using existing controller and vehicle detection technology. It also identifies applicable pedestrian service models, and recommends procedures for collecting data for pedestrian performance measures. The report compares pedestrian service at different crosswalks in the jurisdiction for prioritization purposes, or at the same crosswalk under different conditions. The proposed pedestrian performance measures used in conjunction with existing vehicle performance measures, resulting in an integrated approach to assessing the level of service for vehicles and pedestrians under different conditions and for different signal timing plans.

Available through [WSDOT Library](#)

## **Framework for Selection and Evaluation of Bicycle and Pedestrian Safety Projects in Virginia**

Authors: Natarajan, Shankar; Demetsky, Michael J; Lantz Jr., Kenneth E; VTRI; 2008

Abstract: The Virginia Department of Transportation's (VDOT) Bicycle and Pedestrian Safety (BPS) Program provides funds for implementing short-term, low-cost bicycle and pedestrian safety projects in Virginia. This study developed a four-component framework for administering the BPS Program, where i)analysis procedures were identified for each component that can be used for identifying hazardous locations ii)determining causal factors iii)establishing performance measures, and iv)determining potential counter measures. The framework applies in selecting an appropriate safety treatment and for prioritizing

a set of safety projects requested for funding. Demonstration of the applicability of the framework involved conducting five case studies at locations in and around Charlottesville, Virginia. The study findings showed that the framework synthesizes existing practice into a systematic approach for identifying bicycle and pedestrian hazardous locations and selecting appropriate countermeasures for implementation. The study also established the need for evaluation studies on safety treatments after implementation, as the effectiveness of many bicycle and pedestrian safety countermeasures are not well established.

[http://www.virginiadot.org/vtrc/main/online\\_reports/pdf/08-r8.pdf](http://www.virginiadot.org/vtrc/main/online_reports/pdf/08-r8.pdf)

### **Washington State Bike-Pedestrian Plan**

WSDOT Bike and Pedestrian Website; 2008

Washington's Statewide Goal is to increase bicycling and walking while reducing injuries and deaths. The Plan sets a goal of decreasing collisions by five percent per year for the next 20 years, while doubling the amount of biking and walking. This Plan also establishes objectives and performance measures in each of the State's five transportation policy areas (as established in state law, RCW 47.04.280), to help reach this goal.

[http://www.wsdot.wa.gov/bike/bike\\_plan.htm](http://www.wsdot.wa.gov/bike/bike_plan.htm)

### **Bicycle and Pedestrian Level-of-Service Performance Measures and Standards for Congestion Management Systems**

Authors: Linda B. Dixon, Linda B.; TRB; 2007

Abstract: The Gainesville Mobility Plan Prototype developed as the congestion management system plan for Gainesville, Florida, and incorporated level-of-service (LOS) performance measures for bicycle and pedestrian facilities. The LOS evaluations describe the degree of bicycle and pedestrian accommodation in a transportation corridor. The bicycle LOS measures are designated basic facility provided, conflicts, speed differential, motor vehicle LOS, maintenance, and provision of transportation demand management programs or intermodal links. Pedestrian LOS criteria are similar and incorporate specific pedestrian features. The Gainesville bicycle and pedestrian LOS performance measures use a point scale resulting in an LOS rating system of A through F. The research developed a scoring system sensitive to characteristics that may be mutually exclusive or inclusive to determine all possible combinations of points. The methodology hypothesizes there is a critical mass of variables that must be present to attract non motorized trips. The methodology is applicable for corridor evaluations on arterial and collector roadways in urban or suburban areas. The criteria include measures of programmatic and off-street projects such as rail-trails, bicycle parking, bikes-on-transit, employer-based programs, and so forth, in addition to traditional on-street facility improvements. The research uses LOS evaluation as a tool of the congestion management system to develop project recommendations and priorities, but it may also be useful in concurrency and long-range transportation planning.

<http://trb.metapress.com/content/36g783p825832850/>

## ***Information Related to Transit Performance Measures***

### **A Methodology for Evaluating Transit Service Quality Based on Subjective and Objective Measures from the Passenger's Point of View**

Author: Eboli, L; Mazzulla, G; Transport Policy; January 2011

Abstract: This paper proposes a methodology for measuring transit service quality. The basis of the methodology is the use of both passenger perceptions and transit agency performance measures involving the main aspects characterizing a transit service. The combination of these two types of service quality measurement fulfills the need to provide a reliable as possible measurement tool of the transit

performance. Considering passenger perceptions is fundamental because the customer's point of view is very relevant for evaluating the performance of a transit service. At the same time, the use of a more objective measurement provided by the transit agency can be a useful solution for obtaining a more comprehensive service quality measurement. The proposed procedure applies to a real case study of a suburban bus line; calculates a series of subjective and objective indicators based on users' perception about the service and measurements provided by the transit agency.

Available through [WSDOT Library](#)

### **Techniques to Visualize and Monitor Transit Fleet Operations Performance in Urban Areas**

Authors: Figliozzi, Miguel; Hostetler, Kristina; Price, Scott; TRB; 2011

Abstract: A healthy and efficient public transit system is indispensable to reduce congestion, emissions, energy consumption, and car dependency in urban areas. However, some bus routes chronically underperform. Uncertain travel times and passenger demand preclude schedule adherence and headway uniformity. In a stochastic environment, deviations from schedules are unavoidable leading to an overall decrease on level of service and capacity. This study focuses on TriMet's Route 15 which experiences difficulties in terms of schedule adherence and headway regularity. TriMet is the transit provider in the Portland metropolitan region. TriMet's Bus Dispatch System (BDS) has been collecting and archiving automated vehicle locator (AVL) and automatic passenger counter (APC) data since 1997; the availability of this rich AVL/APC archived data allows for substantial performance measurement methods, particularly data visualization techniques for route-level operations performance monitoring. Based on the analysis of a half-year's worth of TriMet BDS data for Route 15, this paper offers two frameworks for visualizing bus route operations performance measures: (1) A static visualization performance measure framework based on color-coded time-space diagrams, which allows data analysis down to an hourly level and for different segments, aggregate over time or space, or provide single stop analysis; and (2) A dynamic interactive bus monitoring visualization framework based on Google Maps API, which demonstrates bus operations performance along a route for any chosen bus. This research provides novel ways to summarize and visualize vast amounts of transit data in an insightful and intuitive manner. Visualizations proposed in this study will aid transit agency managers and operators to identify operational problems, better understand how such problems propagate spatially and temporally across routes.

### **A Methodology for Performance Measurement and Peer Comparison in the Public Transportation Industry**

Authors: Ryus, Paul; Coffel, Kathryn; Parks, Jamie; Perk, Victoria; Cherrington, Linda; Arndt, Jeffrey; Gan, Albert; TRB; 2010

Abstract: Performance measurement and benchmarking tools for transit managers, decision-makers, and others interested in using to (1) identify the strengths and weaknesses of their organization, (2) set goals or performance targets, and (3) identify best practices to improve performance. The research developed and tested a methodology for performance measurement and peer comparison for (a) all fixed-route components of a public transit system, (b) the motorbus mode specifically, and (c) major rail modes specifically (i.e., light rail, heavy rail, and commuter rail). This report complements TCRP Report 88: "A Guidebook for Developing a Transit Performance-Measurement System" describing how to implement and use performance measurement on an ongoing basis at a transit agency. This report describes the eight steps for conducting a benchmarking effort.

Available through [WSDOT Library](#)

### **Best Practices for Benchmarking Public Transport**

Authors: Ryus, P; Semler, C, Kittelson and Associates; Australian Institute of Traffic Planning and Management (AITPM); July 2010

Abstract: To be useful to an organization, performance measures need comparison to either an internal performance target or one's own past performance or, ideally, the performance of comparable peers. Recent research conducted by the U.S. Transit Cooperative Research Program has developed a guidebook for applying performance measurement and peer comparison in the U.S. public transport industry as part of a comprehensive benchmarking process - a process of systematically seeking out best practices to emulate. In this process, performance measurement is not the end result, but is rather an initial tool used to generate questions that lead to identifying best practices in an area of interest. Available through [WSDOT Library](#)

### **Transit Capacity and Quality of Service Manual, 3rd Edition**

By Paul Ryus, Kittleson & Associates; TCRP A-15C [Active] Project; TRB Research in Progress Database; 2010

Abstract: The Transit Capacity and Quality of Service Manual (TCQSM), initially published in 1999, serves as a comprehensive resource document presenting information on principles and practices of transit capacity for all transit modes, and of transit quality of service from the passenger's point-of-view. The TCQSM supplements the Highway Capacity Manual (HCM), which focuses on presentation of highway capacity and quality of service principles and practices. The 2010 HCM will have a more multimodal focus than before, but given the existence of the TCQSM, the increasing page count of the HCM as a result of new research, and the difficulty of keeping the two manuals' content in sync with each other, the 2010 HCM will present a more streamlined presentation of transit. The HCM project's intent is to have a strong TCQSM continue to be the primary source for basic information on transit capacity and quality of service. Given a new HCM 2010, there is strong feeling that an update of the TCQSM, a 3rd Edition, is required to reflect refined highway and multimodal analysis procedures, and to incorporate the substantial research related to transit capacity and quality of service that has occurred since 2003. The manual's transit level-of-service (LOS) measures, the most commonly applied portion of the document, particularly in long-range transit plans and transit development plans, also apply to corridor studies, alternatives analyses, and environmental impact statements. This research's objective is to develop a 3rd Edition of the TCQSM, to reflect the latest transit capacity and quality of service applications and research, the new multimodal focus and procedures in the 2010 Highway Capacity Manual, and interest in the international community to expand the manual to reflect transit conditions outside North America.

<http://www.trb.org/TRBNet/ProjectDisplay.asp?ProjectID=2890>

### **Performance Evaluation of Bus Routes**

Author: Brochado, AO; Marrana, JRDSF; Leite, MT; Rbgn-Revista Brasileira De Gestao De Negocios; Jan-Mar 2010

Abstract: Existing approaches in the literature have mainly measured performance of transit agencies or whole transit systems. Nevertheless, the challenge for decision-makers remains on how to focus on disaggregated performance measurement: This works intends to present a methodology designed to evaluate the performance within corridors (bus routes). As the performance of a route should compare with operating routes in similar environments, we first propose a classification of 78 lines which integrate the public transport system in OPORTO city. The basis of such classification is on physical features, demand characteristics, and supply indicators as well as making the use of cluster analysis techniques. We have concluded that a rank of the obtained groups be associated with different levels of financial performance measures. It is also anticipated that this disaggregate performance evaluation could provide decision-makers with operational insights as how to improve the performance of the bus network as a whole.

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### **Performance Measurements on Mass Transit: Case Study of New York City Transit Authority**

Authors: Cramer, Anthony; Cucarese, John; Tran, Minh; Lu, Alex; Reddy, Alla; TRID; 2009

Abstract: For all organizations, public or private, it is essential to establish measurements to ensure that the services provided are done well and, when they are not, that the organization can diagnose problems. The mission of New York City Transit (NYCT) is to provide timely and reliable mass transit to more than 7 million daily riders. NYCT has established three main performance indicators (PIs) to ascertain how closely they are meeting the mission: en route schedule adherence, headway regularity, and wait assessment. Whereas en route schedule adherence (-1 to +5 min) and wait assessment explain easily, regularity ( $\pm 50\%$ ) is a useful diagnostic for operations management. NYCT selected 23 subway routes and 42 borough-representative principal bus routes for performance analysis. Researchers generated a stratified sample, designed to prevent undesirable sample bias, by using a fully automated system and achieves an accuracy of  $95 \pm 5\%$  at the route level. Implementation of computerized data processing and analysis occurred in 1995. Recently, NYCT initiated paperless data collection; this further decreases reporting lag and improving data quality. NYCT reports indicators semiannually to the public, and issues detailed internal diagnostic reports frequently to help operations management improve service performance. Senior management uses PI statistics for setting goals and by rider advocacy groups to assess agency performance. A partnership and spirit of cooperation has developed between operating areas and analytical staff in troubleshooting delay issues and continuous quality improvement. A pilot program taps the PI infrastructure to assess performance of operations improvement initiatives.

<http://dx.doi.org/10.3141/2111-15>

### **Exploring Customer Loyalty as a Transit Performance Measure**

Authors: Foote, Peter J.; Stuart, Darwin G.; Elmore-Yalch, Rebecca; TRB; 2007

Abstract: The Chicago Transit Authority (CTA) conducted its third biennial random-digit-dial telephone survey of customer satisfaction in December 1999. Between 1997 and 1999, there was a significant increase in the number of riders with positive attitudes toward CTA, measured in a number of different ways. CTA attracted additional rider's growth when customer satisfaction and loyalty increased. Investigation of the three basic dimensions of improved customer loyalty to CTA i) overall satisfaction, ii) likelihood of continued riding iii) likelihood of recommending to others are described. The report summarizes customer assessments of bus service performance, according to 44 specific aspects of service quality, and rail service performance, according to 52 specific aspects of service quality.

<http://trb.metapress.com/content/ntk220h8614114q8/>

### **Variability in Comparable Performance of Urban Bus Operations**

Authors: Trompet, Mark; Anderson, Richard J; Graham, Daniel J; TRR; 2009

Abstract: This report examines whether comparing the performance of urban bus operators through a benchmarking exercise is useful and justifiable. Users deem benchmarking useful if performance comparisons exhibit sufficient significant variability in performance between operators when they learn lessons from one another. Users view the exercise as justifiable if different external conditions do not affect performance to the extent that the variability of the results judged as incomparable. The International Bus Benchmarking Group collected study data, facilitated by the Imperial College London, and related to 10 medium to large bus operators from nine countries for 2001 to 2007. After data stratification and normalization, especially for differences in vehicle size, demand profile, and commercial speed, the results suggest comparing performance of urban bus operations through benchmarking is both useful and justifiable as long as there are a sufficient number of operators in the comparison that exhibit similar operating characteristics and urban environments.

<http://trb.metapress.com/content/473v256014u3387r/fulltext.pdf>

<http://dx.doi.org/10.3141/2111-20>

### **Measuring Public Transport Connectivity Performance Applied in Auckland, New Zealand**

Authors: Ceder, Avishai; Net, Yann Le; TRB; 2009

Abstract: Bus and other public transit connectivity issues facilitate an understanding of the importance of transit planning in enhancing existing or new transit services. Improving transit connectivity is a vital task in transit operations planning. Passengers may stop using a transit service because of poor connections. Service design criteria always contain postulates to improve routing and scheduling coordination (intra- and interagency transfer centers or points and synchronized or timed transfers). Ostensibly, the lack of well-defined connectivity measures precludes weighing and quantifying the results of any coordination effort. A methodological framework and concepts provides for quantifying transit connectivity measures. In a case study of the Auckland, New Zealand, applies these new measures to the public transit network for possible revisions and changes.

<http://trb.metapress.com/content/235n463504713vr8/>

### **Beyond Generating Transit Performance Measures: Visualizations and Statistical Analysis with Historical Data**

Authors: Berkow, Mathew; El-Geneidy, Ahmed M.; Bertini, Robert L.; Crout, David; TRB; 2009

Abstract: Intelligent transportation systems provide service to transit under increasing demand and with diminishing resources encouraging automating the generation of comprehensive performance measures. In Portland, Oregon, the local transit provider, Tri-County Metropolitan Transportation District of Oregon (TriMet), has been on the leading edge of the transit industry since it implemented its bus dispatch system (BDS) in 1997. The BDS comprises automatic vehicle location on all buses, a radio communications system, automatic passenger counters on most vehicles, and a central dispatch center. Most significant, TriMet developed a system to archive all its stop-level data, which are then available for conversion to performance indicators. In the past decade, TriMet has used this system extensively to generate performance indicators through monthly, quarterly, and annual reporting. TriMet generates a wide range of performance indicators, yet an opportunity remains to explore metrics beyond general transit performance measures (TPMs). Based on an analysis of 1 year of archived BDS data for all routes and stops, this research demonstrates the power of using visualization tools to understand the abundance of BDS data. In addition, it generates several statistical models to demonstrate the power of statistical analysis in conveying valuable and new TPMs beyond those currently generated at TriMet or in the transit industry in general. TriMet envisioned that systematic use of these new methods and TPMs can help them and other transit agencies improve the quality and reliability of their service.

Available through [WSDOT Library](#)

### **Reliability Assessment of Urban Rail Transit Networks: Methodology and Case Study**

Authors: Tahmasseby, Shahram; van Nes, Rob; van Oort, Niels; TRB; 2009

Abstract: The basis of assessments of transit service networks is on a deterministic point of view by assuming that all components of the system perform as planned. A large number of regular and irregular variations influences transit services such as variations in service operation, and infrastructure availability exist. Events might block infrastructure and thus hamper transit services, and affect transit services directly. As a result, transit operators adapt their service network by introducing detours, implementing partial services or even skipping runs. For rail transit networks, this requires extra attention, as infrastructure is limitedly available. Furthermore, travelers might experience extra travel time or they might not be able to make their trip by transit at all. Researchers present an assessment model that accounts for these mechanisms. A case study for the tram network of The Hague demonstrated that the consequences of events such as bad weather, road works, and incidents are quite substantial. The report provides an analysis of different options for improving transit service reliability such as changing the service network configuration or adding infrastructure for facilitating detours or partial services. Results

show that providing additional infrastructure improves transit service reliability and even leads to a better overall transit network performance.

<http://trid.trb.org/view.aspx?id=880675>

### **Impacts of Management Practices and Advanced Technologies on Demand Responsive Transit Systems**

Author: Palmer, Kurt; Dessouky, Maged; Abdelmaguid, Tamer; 2004

Abstract: Over the past 10 years, operating expenses for demand responsive transit (DRT) have more than doubled as demand for this mandated service has expanded. The DRT systems that we studied consist of dial-a-ride programs that transit agencies use for point-to-point pick-up and delivery of the elderly and handicapped. Many advanced technologies and management practices have been proposed and implemented to improve the efficiency of the service; but, evidence for the effectiveness of these actions based upon projections or small pilot studies. We present the results of a nationwide study involving 62 transit agencies. Our analysis indicates that the use of paratransit computer aided dispatching (CAD) system and agency service delivery provide a productivity benefit while the use of financial incentives has a detrimental impact on productivity. In addition, the use of advanced communication technology has a beneficial impact on operating cost while the use of financial incentives has a detrimental impact.

Available through [WSDOT Library](#)

### **State of the Literature: Transit-Oriented Development - Assessing the Impacts of the New Jersey Transit Village Initiative**

Author: Renne, John; Wells, Jan; December 2002

Abstract: Traffic congestion, poor air quality, suburban sprawl, and urban decay have prompted a movement referred to as "smart growth." Many claim that transit-oriented development (TOD) holds the answer to solving these problems. The report describes transit villages (TVs or TODs, often used interchangeably), as hailed models for integrating land use with transportation. The report mentions selected summaries of the Brookings, TCRP, and California DOT reports. These reports summarize the existing literature on TOD in addition to suggesting future policies.

Available through [WSDOT Library](#)

## ***Information Related to Transportation Planning Performance Measures***

### **An Assessment of Urban Form And Pedestrian and Transit Improvements As An Integrated GHG Reduction Strategy**

Author(s): Lawrence D. Frank, Michael J. Greenwald, Sarah Kavage, Andrew Devlin, Urban Design 4 Health, Inc.; WSDOT; April, 2011

Abstract: This study is one of the first to test the effect of sidewalks on travel patterns and the first we know of to relate sidewalk availability with VMT (Vehicle Miles Traveled) and GHG (Greenhouse Gas) emissions. Recently, several large jurisdictions in King County have developed local sidewalk data layers, creating a new opportunity to look at pedestrian infrastructure alongside other investment and policy strategies associated with reduced VMT and CO<sub>2</sub> (carbon dioxide). The study used travel outcome data from the 2006 PSRC (Puget Sound Regional Council) Household Activity Survey. The household-level analysis was restricted to households in King County cities where sidewalk data was already available, and modeled the association of urban form, pedestrian infrastructure, transit service and travel costs on VMT and CO<sub>2</sub>, while controlling for household characteristics known to influence travel. The results provide early evidence in the potential effectiveness of sidewalks to reduce CO<sub>2</sub> and VMT, in addition to

a mixed land use pattern, shorter transit travel and wait times, lower transit fares and higher parking costs.

<http://www.wsdot.wa.gov/Research/Reports/700/765.1.htm>

### **Incorporating Reliability Performance Measures into the Transportation Planning and Programming Processes**

Principal Investigator: Vandervalk, Anita; SHRP 2 L05 [Active], TRB – RiP: March 2010 – March 2012

Abstract: Funding limitations will exist for decades to come. Planning large-scale capacity improvements to transportation networks has also become increasingly difficult and time-consuming due to other community, social, and environmental constraints. Many transportation agencies are looking more closely at traffic-operations and related improvements as a way to get the most out of the existing transportation system. This project will develop the means--including technical procedures--for state DOTs and MPOs to fully integrate mobility and reliability performance measures and strategies into the transportation planning and programming processes. The end result will be that limited available dollars are invested in a more optimal manner and that our existing investments in capacity are used as effectively as possible. The target audiences for this research will be: planners/programmers and project managers within MPOs and state DOTs, as well as their operational and budget personnel. The project provides the key link into system and project planning, programming, and budgeting.

<http://www.trb.org/TRBNet/ProjectDisplay.asp?ProjectID=2194>

### **Workshop on Livability Performance Measures**

Contact: Tooley, Melissa S; TRIS Files: Research in Progress; Completion Date: Dec. 2011

Abstract: The U.S. Department of Transportation (U.S. DOT) and the Department of Housing and Urban Development (HUD) and the US Environmental Protection Agency (EPA) launched a "sustainable communities" initiative in 2009. The initiative, combined with other policy and research initiatives at the national, regional and state level have made livability an area of emphasis for many transportation agencies. Livability is primarily concerned with issues such as transportation choices, neighborhood character and access to destinations, affordability, and maintaining cohesive rural, urban and suburban communities. As transportation agencies work toward addressing livability goals, it is important that they monitor their progress. Performance measurement is highly relevant in this context and can help transportation agencies better understand and apply livability concepts and enhance decision-making processes. The aim of this project is to plan and conduct a workshop on transportation and livability performance measures. The workshop will involve researchers and transportation practitioners from different agencies, who will make presentations and participate in open discussions. The outcome of this workshop will advance the field of livability performance measures and help agencies such as state departments of transportation, metropolitan planning organizations, transit agencies, and other groups to develop and use livability performance measures. This workshop will also strengthen Texas Transportation Institute's (TTI's) credentials in the area of livability and performance measurement, and enhance the University Transportation Center for Mobility (UTCM's) research portfolio by covering an emerging area of national importance.

<http://trid.trb.org/view.aspx?id=1095182>

Available through [WSDOT Library](#) upon completion

### **San Francisco Municipal Transportation Agency (SFMTA): The 'Sustainable Mobility Strategy' is the New Organizational Model for Mobility Management**

American Public Transportation Association Website; 2011

Section 3 Outcomes and Measures of Success

While traditional modal performance measures remain in place, the consolidation of responsibilities for the entire surface transportation network has led to a new, ongoing effort to introduce and track the effect

of combined transportation decisions and investments on the broader set of region-wide goals, including: access within the region, green house gas emissions, utility consumption, and transportation's carbon footprint. The intent of combining of these operational and strategic measures, and related monitoring, to provide a mechanism to assess the sustainability of both the overall transportation system as well as the SFMTA itself, and to provide a mechanism to reconcile conflicting demands on the use of San Francisco's limited transportation rights-of-way.

<http://www.apta.com/resources/hottopics/mobility/profiles/Pages/SFMTA.aspx>

### **Performance-Based Planning: A State-of-the-Practice Summary**

Author: Cambridge Systematics, Inc.; September 2010

Abstract: This paper summarizes current practice related to performance-based planning in state departments of transportation (DOTs), metropolitan planning organizations (MPOs), and transit agencies and is intended to provide background information and foster discussion throughout the National Forum on Performance-Based Planning. The summary organizes around the six fundamental performance-based planning elements that are common among transportation agencies as they transition to a performance-driven and outcome-based decision process.

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### **CalTrans *Smart Mobility* Program**

CalTrans *Smart Mobility* Program Website, 2010

The Office of Community Planning is conducting this planning project, in partnership with US Environmental Protection Agency (USEPA), and in collaboration with other state project partners: the Governor's Office of Planning & Research (OPR) and the California Department of Housing & Community Development (HCD). It produced a planning guide to further integration of smart growth concepts into transportation in California. The intent is to develop a planning framework to help guide and assess how well plans, programs, and projects meet a definition of "smart mobility." The goal is to ensure applicability of the framework for Caltrans as well as for partner agencies . . . to guide development of products as well as assess how well products meet "smart mobility" principles and criteria.

<http://www.dot.ca.gov/hq/tpp/offices/ocp/smf.html>

### **Smart Mobility 2010: A Call to Action for the New Decade**

California Department of Transportation (CalTrans); January 2010

. . . This Call to Action responds to those challenges by providing new approaches to implementation and laying the groundwork for an expanded State Transportation Planning Program. In addition to continuing support for the regional Blueprint Planning programs, the Department will develop a statewide interregional, multi-modal blueprint known as the California Interregional Blueprint (Interregional Blueprint or CIB). It will enhance the scope of the existing California Transportation Plan (CTP) by analyzing the benefits of multi-modal, interregional projects on the transportation system. It will also serve to expand the understanding of the interactions between land use and transportation investments in meeting critical strategic growth and sustainability goals. The ultimate benefit of this effort will be stronger partnerships with regional and local agencies and tribal governments, as well as better data for improved decision making at the State, regional, and local level.

. . . It provides new tools and techniques to improve transportation by using performance-based measures to achieve sustainable outcomes By considering land use place types and modified performance measures, the benefits of smart mobility can be realized, both now and in the future Further, it sets the stage for the California

Interregional Blueprint and data improvement efforts that will transform transportation decisions

. . . This publication:

- Focuses attention on Smart Mobility as a response to the State's interrelated challenges of mobility and sustainability.
- Introduces the six principles that shape the Smart Mobility Framework: Location Efficiency, Reliable Mobility, Health and Safety, Environmental Stewardship, Social Equity, and Robust Economy. Chapter 2 defines and discusses each as a foundation for Smart Mobility.
- Chapter 3 introduces the concept of place types a contemporary approach to planning and design and seven place type designs use is for tools in planning and programming that implement Smart Mobility. The place types are: Urban Centers, Close-in Compact Communities, Compact Communities, Suburban areas, Rural and Agricultural Lands, Protected Lands, and Special Use Areas.

#### 4.1 Performance Measures: Definition and Purpose (pg 50)

Performance measures provide quantified evidence of the consequences of a decision or action. Performance measures are an efficient means through which to present key information for system users, managers and decision makers in an objective, concise and consistent format.

Transportation performance measures forecast, evaluate, and monitor the degree to which the transportation system accomplishes adopted public goals and mobility objectives. Smart Mobility Performance Measures (SMPMs) demonstrate the relationship between integrated transportation and land use decisions and the consequent effects on the full range of economic, social, and environmental conditions. The intent of SMPMs is for use in decision-making at both the planning and the project level to evaluate progress toward implementing the principles of Smart Mobility and attaining Smart Mobility benefits.

[http://www.dot.ca.gov/hq/tpp/offices/ocp/smf\\_files/SMF\\_handbook\\_062210.pdf](http://www.dot.ca.gov/hq/tpp/offices/ocp/smf_files/SMF_handbook_062210.pdf)

#### **Transportation Performance Management: Insight from Practitioners**

Corporate Authors: Cambridge Systematics, Inc.; NCHRP Report 660; TRB; 2010

Abstract: This guidebook provides insights from selected transportation agencies who have successfully integrated transportation performance management programs into a range of key decision-making processes in order to improve their effectiveness and transparency. This guidebook will assist transportation agency staff challenged with turning performance data into meaningful information that will influence agency decisions and actions.

[http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp\\_rpt\\_660.pdf](http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_660.pdf)

#### **Performance Measurement Frameworks and Development of Effective Sustainable Transport Strategies and Indicators**

Authors: Pei, Yi Lin; Amekudzi, Adjo A; Meyer, Michael D; Barrella, Elise M; Ross, Catherine L; TRR; 2010

Abstract: Seven attributes of robust performance measurement systems attained by analyzing five performance measurement frameworks and their use of transportation system performance indicators is discussed. The attributes are then used to examine three case studies from Europe and the United States to demonstrate the value of performance measurement frameworks for developing and improving sustainable transportation strategies and indicators. The case studies point to important considerations in formulating a robust sustainable transportation strategy at different levels of governance and also indicate the importance of ensuring alignment in an agency's vision, objectives, and monitoring systems. In addition, a framework should capture the interactions among variables, reflect stakeholder perspectives, and consider the capabilities and constraints of the agency and should be flexible to foster self-learning.

<http://dx.doi.org/10.3141/2163-08>

#### **A Primer on Safety Performance Measures for the Transportation Planning Process**

Author(s): Herbel, Susan; Meyer, Michael D.; Kleiner, Bernardo; Gaines, Danena; FHWA; September 2009

Abstract: This Primer is a tool to help State and local practitioners, transportation planners, and decision-makers identify, select, and use safety performance measures as a part of the transportation planning process. The Primer draws from current literature, professional experience, and State DOT and MPO practice. Key elements of the Primer include: a definition of performance measures; a step-by-step description and flowchart showing how safety performance measures can be identified and integrated into the transportation planning process; characteristics of effective performance measures; a checklist to assess an organization's current status with respect to the use of safety performance measures in the transportation planning and decision-making process; a list of references; and case studies of noteworthy practice.

<http://safety.fhwa.dot.gov/hsip/tsp/fhwahep09043/>

### **Applying System-Level Performance Measures and Targets in the Detroit, Michigan, Metropolitan Planning Process**

Authors: Guerre, Joseph A; Evans, Jennifer; TRR; 2009

Abstract: The Southeast Michigan Council of Governments (SEMCOG) is the metropolitan planning organization for the Detroit, Michigan, region. SEMCOG is in the early stages of developing its 2035 regional transportation plan (RTP). As part of its planning process, SEMCOG is implementing a new approach for prioritizing transportation investments. The objectives of this effort are to (a) build consensus on the region's transportation priorities and help ensure that the projects included in the RTP support these priorities, (b) provide decision makers with the quantitative information needed to understand fully the consequences of their investment choices, and (c) enable SEMCOG to develop an RTP that is realistic in terms of how much it will cost and how much it can achieve. SEMCOG's investment prioritization process consists of defining measures of effectiveness, analyzing the relationship between funding and performance in each of its goal areas, and presenting the results to decision makers in a manner that helps them reach a consensus on long-range funding and performance targets for the region. This paper describes each step in SEMCOG's prioritization process and presents the results of the analysis used to facilitate an initial round of target-setting discussions. It presents a comprehensive example of how an agency has incorporated performance measures and targets into their regional planning process.

<http://trb.metapress.com/content/r40920l6h1608802/fulltext.pdf>

<http://dx.doi.org/10.3141/2119-04>

### **Performance Measurement and Outcomes**

Corporate Authors: Harrington-Hughes and Associates, Incorporated; TCRP Digest; April 2010

Abstract: This Transit Cooperative Research Program (TCRP) digest summarizes the mission performed March 20 to April 3, 2009, under TCRP Project J-03, "International Transit Studies Program." This digest explores how performance measurements are used to achieve organizational goals and enhance quality of service at public transport planning, funding, and operating agencies in Hong Kong, Special Administrative Region of the People's Republic of China; in the city-state of Singapore; in Kuala Lumpur, Malaysia; and in Taipei, Taiwan. It is based on individual reports provided by the mission team members, and it reflects the observations of the team members.

[http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp\\_rrd\\_95.pdf](http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rrd_95.pdf)

### **Performance Measures for Iowa Transportation Systems**

Authors: Plazak, David J; CTRE; 2006

Abstract: The purpose of performance measures in planning operations is to identify and track meaningful, quantifiable measures that reflect progress toward the goals of the plan. This report is an

initial effort to utilize performance measures for transportation system planning. The selected measures provide a cross-section of system performance indicators across three selected transportation planning goals (safety, efficiency, and quality of life) and five transportation modes (highways/bridges, public transit, railroads, aviation, and pedestrian/bicycle). These performance measures are exploratory in nature, and constitute a first attempt to apply performance measures in the context of a statewide, multimodal transportation plan from the Iowa DOT. As such, the set of performance measures that the Iowa DOT uses for planning will change over time as users learn more about the application of such measures. Researchers developed the performance measures explained in this document through consultation with Iowa DOT modal staff (aviation, railroads, highways, public transportation, and pedestrian/bicycle) and the Office of Traffic and Safety.

[http://www.ctre.iastate.edu/reports/perf\\_measures.pdf](http://www.ctre.iastate.edu/reports/perf_measures.pdf)

### **Transportation Investment Decision-Making Transportation-Efficient Land Use Mapping (TELUMI): Phase 3 of Integrating Land Use and Transportation Investment Decision-Making**

Authors: Anne Vernez Moudon, D.W. Sohn, UW; WSDOT; June 2005

Description: The objective of this project was to devise a conceptually simple tool that operationalized the complex relationship between land use and travel behavior. The TELUMI is a set of maps that depicts how the region's urban form affects overall transportation system efficiency. Nine map layers represent the effects of individual land-use variables on transportation efficiency. They include density (residential and employment), mix of uses (shopping and school traffic, the presence of neighborhood centers (NC)), network connectivity (block size), parking supply (amount of parking at grade), pedestrian environment (slopes), and affordable housing. The tenth layer is a composite index, which takes into account the relative effects of each of the nine variables on transportation efficiency, based on a statistical analysis that modeled the relationship between the land-use variables and King County bus ridership . . . TELUMI shows how to rate areas . . . for their existing transportation efficiency . . . which is useful in goal setting for future transportation efficiency and to monitor progress over time . . .

<http://www.wsdot.wa.gov/Research/Reports/600/620.1.htm>

### **Arterial Performance Measurement Using Transit Buses as Probe Vehicles**

Authors: Tantiyanugulchai, S.; Bertini, R.L.; Intelligent Transportation Systems, 2003

Abstract: Developing clear, relevant performance measures for arterials is challenging due to complicated traffic control parameters and users with numerous origins and destinations. With increasing data availability from intelligent transportation systems (ITS) deployments, it is increasingly possible to develop and test new arterial performance measures. Users can obtain important parameters including average speed, travel time, and delay both directly and indirectly from sources such as automatic vehicle location (AVL) system. This paper demonstrates how to use AVL data to characterize the performance of an arterial. Researchers used two sources of ITS data to assess arterial performance on one corridor in Portland, Oregon. First, we extracted data from the bus dispatch system (BDS) of the transit provider for Portland, Oregon. Performance characteristics as described by bus travel on the arterial compared with ground truth data collected by probe vehicles equipped with global positioning systems (GPS) sensors traveling with normal traffic on the same arterial on the same days. Comparisons made between the two methods and conclusions draw regarding the utility of the transit AVL data for real-time advanced traffic management and traveler information systems.

Available through [WSDOT Library](#)

### **Multimodal Investment Choice Analysis: Volume I, Phase 1**

Authors: Rhonda Young, Jennifer Barnes, G. Scott Rutherford, UW; WSDOT; 2002

Description: The Multimodal Investment Choice Analysis (MICA) project is developing a computer-based tool to assist the Washington State Department of Transportation (WSDOT), the Washington State

Transportation Commission, and the Washington State Legislature in making state transportation funding decisions. The function of MICA is to summarize the multimodal budgetary tradeoffs that will result from varying funding allocation and priority scenarios. MICA's methodology basis is a benefit-cost and goal achievement analysis. The project completed the first phase of research. The purpose of this two-volume report is to document the analysis methodology contained within the MICA program, as well as general findings from the first phase of this research effort. The document's design serves as a User's Manual for operating the MICA program. While challenges still exist, the results of the Phase I research effort indicate that development of a multimodal analysis tool is feasible. Report includes discussion of benefit measures and outcomes.

<http://www.wsdot.wa.gov/Research/Reports/500/547.1.htm>

### **Use of Performance Measures in Transportation Decision Making**

Authors: Pickrell, S; Neumann, L; HRIS; 2001

Abstract: The report introduces explicit transportation system performance measures into transportation agency policy, planning, and programming activities. Many transportation agencies apply performance measurement widely and their use often extends well beyond the performance of the transportation system itself. The first section of this conference resource paper is a definition of the elements of the process necessary to use performance measures to influence decisions and a summary of why agencies are increasingly interested in the use of system performance measures as a decision-making tool. Subsequent sections define several decision-making contexts with which performance measures may be applied and present some general lessons learned in working with a broad range of agencies that have begun to implement some aspect of performance-based planning and decision-making processes.

<http://pubsindex.trb.org/view.aspx?id=717442>

### **A Guidebook for Performance-Based Transportation Planning**

Cambridge Systematics; NCHRP 446; TRB; 2000

Abstract: This is intended to provide transportation organizations, planning practitioners, and transportation decision makers a guidebook; it brings together lessons learned from different regions of the country and establishes a rationale for performance-based transportation planning and provides guidance for a wide range of applications having different scopes and levels of complexity. This guidebook provides a structured approach to monitoring, evaluating, and considering transportation system performance in various components of the planning process. It also includes a summary of case studies (Appendix A) and a "Performance Measures Library" (Appendix B) that catalogs measures currently being applied throughout the country. It should also be a useful educational resource on the concepts, tools, and procedures currently employed for establishing system performance as a basis for transportation planning and decision making.

[http://onlinepubs.trb.org...bs/nchrp/nchrp\\_rpt\\_446.pdf](http://onlinepubs.trb.org...bs/nchrp/nchrp_rpt_446.pdf)

### **Multimodal Transportation: Development of a Performance-Based Planning Process**

Cambridge Systematics, Inc.; TRB; December 1999

Abstract: This project involved several years of active research into the application of performance measurement to the multimodal transportation planning process. In two distinct phases, the project team conducted some 20 case studies and eight formal workshops to identify the extent to which public agencies and private transportation organizations have incorporated performance measurement into their planning decision making. The team reviewed an extensive amount of written material, extending beyond the transportation sector and beyond the normal perspective of governmental agencies as well. The team also took part in many discussions with practitioners across the United States and Canada to identify their interests, needs, and implementation experiences with application of performance measurement to their planning missions. This report includes a discussion of the project objectives and work plan, a summary

of 10 case studies, a summary of four workshops conducted around the country, and identification of further research or product development suggested by the results. Appendix A contains detailed documentation of the case studies conducted during Phase II of the project. Appendix B provides a copy of the Phase I Draft Final Report which was originally delivered in August 1996.

[http://onlinepubs.trb.org...pubs/nchrp/nchrp\\_w26-a.pdf](http://onlinepubs.trb.org...pubs/nchrp/nchrp_w26-a.pdf)

## ***Information on Performance Measures Related to Complete Streets***

### **National Complete Streets Coalition**

National Complete Streets Coalition Website; 2011

The National Complete Streets Coalition, a diverse coalition of prominent national organizations works for the adoption of Complete Streets policies across the country. The design and operation of Complete Streets design enables safe access for all users. Instead of fighting for better streets block by block, the National Complete Streets Coalition seeks to fundamentally transform the look, feel, and function of the roads and streets in our community, by changing the planning, construction and design of most roads.

<http://www.completestreets.org/>

### **Performance Measures for Complete, Green Streets: A Proposal for Urban Arterials in California**

Authors: Sanders, Rebecca; Macdonald, Elizabeth; Anderson, Alia; TRB Annual Meeting Papers; 2010

Abstract: The California Department of Transportation (Caltrans) or manages more than 15,000 miles of state highways, ranging in scale and function from local streets to interstate highways. Historically, Caltrans governance is by the principles of highway engineering, which focus on providing mobility to motorized vehicles. Over the past decade, however, the Department has joined in a national movement to better incorporate non-motorized transportation and community-level outcomes into its transportation decision-making framework, embodied by the approach known as "Complete Streets." Recognizing that Caltrans' current performance measurement system does not reflect this shift toward Complete Streets principles, researchers at the University of California, Berkeley created new measures to more accurately gauge Departmental progress toward these objectives. This paper elaborates on a proposed framework of performance measures for encouraging non-motorized transportation and increasing the environmental sustainability of the transportation system. The framework focuses on urban arterials, which carry high amounts of multimodal traffic and constitute 26% of California's urban roadway network. Based on Complete Streets principles and the findings from an extensive literature review, the proposed framework compliments Caltrans' current performance measurement system and presents an opportunity for the Department to become a national leader in encouraging non-motorized transportation and preserving the environment.

Available through [WSDOT Library](#)

### **Level of Service Analysis for Complete Streets**

Authors: Dowling, Richard G; Flannery, Aimee; Landis, Bruce; Petritsch, Theodore Anton; Roupail, Nagui M; Ryus, Paul; ITE 2010 Technical Conference and Exhibit. Meeting Transportation's 21st Century Challenges. Compendium of Technical Papers; 2010

Abstract: This paper presents the results of recent agency testing of a proposed national method for the multimodal assessment of the quality of service provided by an urban street. The multimodal level of service method (MMLOS) considers the level of service from the point of the view of four different types of travelers typically using the urban street: the auto driver, the transit passenger, the bicycle rider, and the pedestrian. The MMLOS method is currently under consideration for inclusion in the Year 2010 update of the Highway Capacity Manual. Researchers used video laboratories and transit on-board surveys to

develop data sets of the quality of service perceived by the general public for each of the modes of travel on the urban street. The researchers conducted laboratories in several different metropolitan areas of the United States and developed four level-of-service (LOS) models, one for each mode. All four LOS models share a common measure, “user satisfaction.” The models assign a letter-grade level-of-service (A-F) based on the street cross-section, the intersection controls, and traffic characteristics (the auto, transit, bicycle, and pedestrian volumes on the street). Researchers use the models in combination to compare the tradeoffs of different street cross-sections from the unique perspectives of each mode. The models are particularly useful for testing the impacts of converting auto through lanes to bicycle lanes, wider sidewalks, and wider planter strips. Testing of the proposed MMLOS method occurred on 35 urban streets in 10 metropolitan areas around the United States: Tallahassee, Orlando, Tampa, Philadelphia, San Diego, Arlington County, Atlanta, San Antonio, Portland Oregon, and Boise Idaho. Researchers trained local agency staff on the method and gathered the necessary data.

<http://trid.trb.org/view.aspx?id=926146>

### **Performance Measures for Complete, Green Streets: A Proposal for Urban Arterials in California**

Authors: MacDonald, Elizabeth; Sanders, Rebecca; Anderson, Alia; TRIS; 2010

Abstract: In California, a directive mandates that the California Department of Transportation (Caltrans) provide for bicycling and walking facilities along Caltrans’ roadways, thus creating Complete Streets. Performance measurement systems used by state DOTs to identify best practices were compiled and reviewed for roadside design elements. The performance measurement framework focused on arterial roadways where the greatest conflicts between motorized and nonmotorized traffic occur. The framework provides Caltrans with the supplementary measures needed to monitor pedestrian and bicyclist safety and the environmental health of urban arterials.

<http://www.uctc.net/research/papers/UCTC-FR-2010-12.pdf>

### **Complete Streets: We Can Get There from Here**

Author: Laplante, John; Mccann; Barbara; ITE Journal; May 2008

Abstract: This feature explains the complete streets Movement and explores ways to make urban thoroughfares more Pedestrian and bicycle friendly and respectful of the surrounding community while not unduly compromising motor vehicle travel. The article describes techniques for designing an arterial street that can control traffic speeds and permit more comfortable and safe pedestrian and bicycle access.

Available through [WSDOT Library](#)

### **Creating More People-Friendly Urban Streets through 'Link and Place' Street Planning and Design**

Authors: Jones, Peter; Marshall, Stephen; Boujenko, Natalya; TRID; 2008

Abstract: This article details one method of creating more people friendly streets called “Link and Place” street planning and design in the United Kingdom. Most planners are traffic engineers who are mainly concerned with the needs of vehicles and follow the Buchanan principles, which distinguish between roads meant for traffic distribution and those meant for local access. The article notes several problems with this approach that have all led to difficulties in traveling by foot, bicycle, and public transit. It offers an alternative in “Link and Place” design. This method defines a “Link” as a street for movement by private vehicle, bus, bicycle, or pedestrians. A “Place” is a street destination where people spend time primarily on foot. The article then describes a method of classification using a grid, which serves as a means of assessing street performance and a method of street design. Researchers emphasized including residents in the design, and a case study describes the method of design.

<http://trid.trb.org/view.aspx?id=864807>

### **Multimodal Level of Service Analysis for Urban Streets: Users Guide**

Authors: Dowling, Richard G; NCHRP 128, TRB; February 2008

Abstract: This document explores a set of procedures for predicting traveler perceptions of quality of service and performance measures for urban streets. Report considers quality of service and performance in terms of the needs of auto drivers, bus passengers, bicyclists, and pedestrians.

[http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp\\_w128.pdf](http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w128.pdf)

### **Building a New Paradigm: Improving Public Health through Transportation**

Author: Killingsworth, Richard E.; Nazelle, Audrey De; Bell, Richard H.; ITE Journal; June 2003

Abstract: This feature describes the emerging active living movement, explains the potential health benefits that can result from a transportation system that supports walking and bicycling, articulates the role transportation professionals can play in improving public health and recommends ways to create and support an active transportation system. It identifies significant relationships between the built environment and travel choices, progress in building healthier communities and a need for better methods, data and improved multidisciplinary collaboration and decision-making.

Available through [WSDOT Library](#)

### **Linking Land Use and Transportation through Street Design**

Author: Kloster, Tom; James Daisa, James; Ledbetter, Rich; TRB; 2002

Abstract: Metro's regional street design policies will guide the eventual design of major streets in the 24 jurisdictions that make up the Portland metropolitan area. The street design classifications represent the most direct link between land use and transportation planning in the region, and also serve as a tool for coordinating various, often competing modal needs. Researchers mapped the design classifications at a detailed level to provide specific direction for local implementation. The "Creating Livable Streets" handbook is a resource for local implementation of the regional street design policies. The handbook provides a primer on general design issues, as well as specific design solutions that address each of the regional street design classifications.

Available through [WSDOT Library](#)