



MEMORANDUM

from Joan Chaplick, Project Manager, MIG, Inc.
to Kelly Eagan and Dawn Cheser, Caltrans District 3 Planning
re Best Practices for Bicycle and Transit Performance Measures
date December 23, 2010

I. Background and Introduction

Caltrans is developing transit and bicycle performance measures for inclusion in future Corridor System Management Plans (CSMPs) and other planning documents. The first step in performance measurement development is a review of Caltrans, external agencies and organizations' practices. Caltrans staff identified numerous examples that served as a starting point during a Project Development Team (PDT) meeting held on October 1, 2010. Additionally, MIG staff undertook a review of regional, state, and national bicycle and transit performance measures and best practices. In this memorandum, MIG staff briefly describes example performance measures and related processes. The results are presented the following sections:

- Purpose of Performance Measures
- Types of Performance Measures
- Characteristics of Effective Performance Measures
- Transit Measures
- Bicycle Measures
- Conclusion

Several factors were revealed during this research that should be taken in account while developing transit and bicycle performance measures. The factors include having a clear understanding of purpose, types and characteristics of effective measures. The National Cooperative Highway Research Program (NCHRP) suggests the following:

II. Purpose of Performance Measures

Performance measures are used to provide a clear roadmap for agencies as they aim to meet established goals and objectives. The National Cooperative Highway Research Program (NCHRP) states:

[Transit and bicycle] system performance depends critically on how the parts fit and work together, not merely on how well each performs independently; it depends on interactions rather than on actions. Furthermore, a system's performance depends on how it relates to its environment—the larger system of which it is a part—and to other systems in that environment.¹

III. Types of Performance Measures

The NCHRP identifies four main types of performance measures: Multi-jurisdictional, multi-modal, multi-strategy, and multi-stage.² The following is a brief description of each type.

- Multi-jurisdictional performance measures assess the impact of the system in relation to mutual goals and transportation objectives.
 - Challenging to develop a common set of performance measures
 - Use of performance information can be increased and improved through collaboration and dialogue.
- Multi-modal performance measures can improve mobility and accessibility for all system users.
- Multi-strategy performance measures compare the benefits of smaller-scale investments, such as system operations projects, to larger roadway projects. The purpose of these is to measure added capacity through more efficient traffic operations and smoother traffic flow.
- Multi-stage performance measures provide an opportunity to evaluate a project at various stages, linking planning and implementation.

IV. Characteristics of Effective Performance Measures

According to a study conducted at the Rensselaer Polytechnic Institute, effective transit performance measurement systems share the following characteristics³:

- Stakeholder acceptance: Stakeholders include the governing body, management, staff, and customers.
- Linkage to organizational goals: Goals and objectives should be quantifiable so that accomplishments can be gauged using the performance measurement system.
- Clarity: The measures, the methods, and the reporting of results are important to how well results are understood and accepted.

¹ National Cooperative Highway Research Program. Report 664 – Measuring Transportation and Network Performance. July, 2010.

² National Cooperative Highway Research Program. Report 664 – Measuring Transportation and Network Performance. July, 2010.

³ Regional Transit Performance Indicators: A Performance Measurement Model, Nakanishi, Yuko J. and List, G.F., Rensselaer Polytechnic Institute, Troy, NY, 2000.

- Reliability and credibility: The accuracy and usefulness of measured results depends on the quality of data used in calculating measures.
- Variety of measures: Performance measures should reflect a broad range of relevant issues.
- Number of measures: The variety of measures must be balanced against the need to avoid overwhelming users and reviewers.
- Level of detail: Measures should be sufficiently detailed to accurately identify areas where improvement is needed, without being more complex than necessary.
- Flexibility: The system should permit change over time as organizational goals evolve, but should preserve enough stability to allow comparisons over time.
- Realism of goals and targets: Targets should be realistic, but optimistic.

The National Cooperative Highway Research Program Report 664 states best practices include a performance measurement system that:

- Reflects the multiple objectives addressed by public transit including mobility and efficiency.
- Maximizes the automation of data collection and electronic information management to support a performance measurement system.⁴

V. *Transit Performance Measures*

I. Sacramento Region

Sacramento Regional Transit

The Sacramento Regional Transit District's Strategic Plan (2004-2009) includes performance measures for financial sustainability, customer service, regional leadership, quality workforce, and ethical and sound business practices.

Applicable transit performance measures in the Plan include:

- Ridership average (number of passenger trips per million) including daily ridership and ADA passenger trips.
- Transit mode split, which is the proportion of people who use transit in comparison to the people who use other modes of transportation.
- Transit service availability within ¼ mile of "high transit need zones."

El Dorado County Transit Authority

The El Dorado County Transit Authority (EDCTA) prepares an administrative operations report every six months, which presents a comparison of performance

⁴ Best Practices for Public Transportation: Guidance for Local Governments and Transit Operators to Achieve the Blueprint Vision of Significantly Increased Transit Use. Sacramento Transportation and Air Quality Collaborative. December 2005.

measures between fiscal years.⁵ All transit services are evaluated using the following performance measures:

- Passenger trips
- Revenue miles
- Revenue hours – the number of hours a vehicle is in-service. Generally, revenue hours are impacted by schedule and service adjustments..
- Passenger fares
- Operating expenses
- Farebox recovery – The ratio of fare revenue to operating costs.
- Operating Cost/ Passenger Rails – The average trip cost per passenger.
- Operating Cost/ Revenue Hour
- Operating Cost/ Revenue Mile
- Passenger Trips/ Revenue Hour
- Passenger Trips/ Revenue Mile
- Vehicle Revenue hrs. per Employee
- Average Fare per Passenger

EDCTA sets an annual goal for increasing ridership by at least three-percent (3%).

Nevada County Transportation Commission

Nevada County’s Transportation Development Plan is designed to enable the Transit Services Commission (TSC) to monitor performance and guide financial stewardship of Gold County Stage and Telecare services. The Plan includes goals, standards and performance measures. The performance measures provide the mechanism for judging whether or not the standards (quantifiable observable measures that reflect achievement of the goals) have been met. Performance measures vary based on type of transit.

To measure the service efficiency goal, the following performance measures are assessed:

- Farebox recovery ratio standard
 - As a collective system, all services (both local and regional services) should meet or exceed a minimum system-wide recovery ratio of 10%. A target of 13% is recommended in order to improve efficiency and reduce public subsidy of transit operations.
 - The demand response service’s ratio of farebox income to operating costs should meet or exceed 10%.

To measure the service effectiveness goal, the following performance measures are assessed:

- Improvement in effectiveness standard.

⁵ El Dorado County Transit Authority, Administrative Operations Report Fiscal Year 2009/10.

- o All services are expected to increase ridership productivity by a minimum of 1% annually.
- Service effectiveness standard.
 - o Commuter and regional services are expected to serve a minimum of 7.0 passenger-trips per vehicle service hour and local route services are expected to serve a minimum of 8.0 passenger-trips per vehicle hour.
 - o Demand service is expected to serve a minimum of 2.0 passengers per vehicle service hour.

To measure the service quality goal, the following performance measures are assessed:

- Passenger load standard (Gold County Stage)
- Accident standard (Gold County Stage)
- Road calls (Gold County Stage)
- Preventative maintenance standard (Gold County Stage)
- Vehicle standard (Gold County Stage)
- Vehicle cleanliness standard (Gold County Stage)
- Passenger complaint standard (Gold County Stage)
- Training standard (Gold County Stage)
- On-time performance standard (Gold County Stage)
- Missed trips standard (Gold County Stage)
- Service availability standard (Demand Response Service)
- On-time performance standard (Demand Response Service)
- Missed trips standard (Demand Response Service)
- Trip denial standard (Demand Response Service)

To measure the accessibility goal, the following performance measures are assessed:

- Service area standard
- Vehicle accessibility standard

To measure the planning and management goal, the following performance measures are assessed:

- Planning standard
- Service monitoring standard
- Transportation Development Act standard
- Land use planning standard
- Coordination standard
- Marketing standard
- Administrative cost standard

Butte County Association of Governments

The Butte County Association of Governments (BCAG) prepared the Regional Transportation Improvement Program 2010/11-2014/15 in response to the 2008

State Transportation Improvement Program (STIP) Cycle. The California Transportation Commission has required that each RTIP be evaluated for performance and cost effectiveness. BCAG has been asked to use the following criteria:

- Change in vehicle occupants, freight and goods, travel time or delay.
- Change in accidents and fatalities.
- Change in vehicle and system operating costs.
- Change in access to jobs, markets and commerce.
- Change in frequency and reliability of rail/transit service.
- Change in air pollution emissions.
- Change in passenger, freight and goods miles carried.

Placer County Transportation Planning Agency

The Placer County Transportation Planning Agency's 2035 Regional Transportation Plan (RTP). The following performance criterion helps the Agency to set priorities for implementation of RTP projects.

- Improve transportation safety throughout the region.
- Relieve congestion on roadways and continuously improve air quality.
- Enhance regional integration for all modes, and increase multi-modal travel opportunities.
- Maintain existing transportation facilities to comply with all applicable standards.
- Implement transportation projects that preserve natural and cultural resources.
- Provide opportunities for public participation in all stages and phases of transportation planning and project development and implementation.

The Agency identifies multiple tools and datasets to quantify information where available and evaluate the performance of the Plan. Datasets include: Highway Performance Monitoring System (HPMS) data, transit operator financial audits, Triennial Performance Audit to evaluate the effectiveness, efficiency, and economy of transit operations.

San Joaquin Regional Transit District and COG

The San Joaquin Regional Transit District's Short Range Transit Plan (RTD) includes performance measures for transit.⁶ When reviewing individual service efficiency and effectiveness, the RTC uses the following performance measures:

- Service efficiency and cost effectiveness: operating cost per revenue hour, operating cost per revenue mile and net subsidy per passenger trip.
- Service reliability: interruptions to revenue service and on-time performance.

⁶ San Joaquin Regional Transit District Short Range Transit Plan, Fiscal Year 2009-2013. Available online at: <http://sanjoaquinrtd.com/srtp/pdf/20090701-SRTP-Final.pdf>

- Service effectiveness: ratio of passengers per revenue hour and passengers per revenue mile.
- Fare ratio recovery: ratio of revenues received per cost to operate the service.

The San Joaquin Council of Governments (SJCOG) includes transit performance measures in its 2011 San Joaquin Council of Governments' Regional Transportation Plan.⁷ Performance measures help SJCOG achieve its goal to increase access and mobility in the region. Transit performance measures include:

- Improve current regional average of transit frequency (60 Minutes) by service (fixed route/intercity bus) by 65% by 2035.
- Increase current annual usage of public transit to population from 83:1 to 67:1 by 2035.
- Increase current number of passengers served per train miles by 30% by 2035.
- Increase current regional percentage of con-time bus routes per year by 2035.
- Reduce annual average passenger rail headway delay due to conflict with freight operations by 95% by 2035.
- Increase the number of available Park & Ride lot spaces (1,450) by one space per every 100 dwelling units through 2035.
- Increase Park & Ride lot utilization per available spaces from 70% to 85% by 2035.

City of Folsom Transit Performance Measures

The City of Folsom's Short-Range Transit Plan outline performance measures, standards, and monitoring practices meet the Folsom Stage Line's goals and objectives.⁸

⁷ 2011 San Joaquin Council of Governments' Regional Transportation Plan.

⁸ Folsom Short-Range Transit Plan Final Report, August 1999.

Folsom Stage Line Goals, Objectives, Performance Measures, Standards and Monitoring Methods			
Goals and Objectives	Performance Measures	Standards	Monitoring
1. Provide a transit system that is effective in meeting the needs of the community.			
a. Provide convenient transit service.	% of major activity centers within 1/8 mile of routes	100%	Annually as part of SRTP update
b. Provide reliable transit service.	% scheduled departures 0-5 minutes late % DAR pick-ups within 15 minutes of quoted time Missed trips Miles between roadcalls	90% 90% Zero 10,000	Quarterly field monitoring by Lead Worker Monthly operating reports
b. Provide safe transit service.	Miles between preventable accidents	100,000	Monthly operating reports
c. Provide attractive services which respond to market demands for transportation.	Annual ridership growth	Equal to population growth	Annually as part of SRTP update
d. Provide coordinated transit services.	% timed transfers with LRT during peak periods	80% of connections within 10 minutes	Annually as part of SRTP update
e. Provide accurate and timely marketing information	Marketing materials accurate and widely distributed	Yes	Annually as part of SRTP update
2. Operate and manage the transit system efficiently.			
a. Minimize operating costs per unit of service provided.	Annual increase in cost per vehicle revenue hour	Annual increase < 90% of CPI	Annually as part of SRTP update
b. Maximize vehicle life through preventive maintenance.	% of preventive maintenance inspections completed within 500 miles of target	100%	Monthly operating reports
c. Maximize service productivity.	Passengers per vehicle revenue hour	Fixed route - 12 psgrs/hr within 2 years Dial-a-ride - 6 psgrs/hr	Monthly operating reports
d. Maximize cost recovery through farebox receipts.	% cost recovery through farebox receipts	20% systemwide 10% Dial-a-ride	Monthly operating reports
3. Provide accessible transit service.			
a. All vehicles equipped with working lifts.	% vehicles equipped with working lifts	100%	Annually as part of SRTP update
b. Concentrations of elders and persons with disabilities served by transit.	% of known concentrations of seniors and persons with disabilities served by transit	100%	Annually as part of SRTP update
c. Provide adequate capacity to meet demand.	Peak loading conditions not to exceed 150% of capacity	At all times on all services	Monthly operating reports
d. Work with community to identify areas where new services are required.	Meetings with community groups, employers in response to comments from public	Respond within 30 days to all service requests and resolve in six months.	Annually as part of SRTP update
<i>Source: Table 4-1, Folsom Short-Range Transit Plan Final Report, August 1999</i>			

Elk Grove e-tran

The City of Elk Grove’s Transit Services Department is responsible for the operation of e-tran and e-van within the City of Elk Grove. The City’s annual budget includes performance measures for transit services.⁹ Transit performance measures include:

- Total number of e-tran passengers
- Total number of e-van passengers
- Total number of revenue hours: e-tran
- Total number of revenue hours: e-van
- Passengers per revenue hour: e-tran
- Passengers per revenue hour: e-van

⁹ City of Elk Grove. Budget 2010: Chapter 10 – Enterprise Funds. Available at: <http://www.elkgrovecity.org/documents/agendas/attachments/budget/2010/10-enterprise-funds.pdf>

II. California

California's Capitol Corridor

The Capitol Corridor Joint Powers Authority prepared the Capital Corridor Intercity Passenger Rail Service Business Plan Update FY 2009-10-FY2010-11, which presents the strategic plan and funding request for the next two fiscal years. The Plan outlines the performance standards used to evaluate Amtrak and the Union Pacific Railroad (UPRR) including:

- Route ridership
 - Average daily ridership
 - Percent change in route ridership
 - Percent change in train passenger miles
 - Percent change in train miles
 - Passenger miles per train mile (PM/TM)
- System operative ratio (train and feeder bus)
 - Percent change in total revenue
 - Percent change in total expenses
 - Train revenue per train mile
 - Train revenue per passenger mile (yield)
 - Train expenses per train mile
 - Train only state cost per train mile
 - Train only state cost per passenger mile
- On-time performance
 - Percent of California Car Fleet available
- Operating results
 - Total revenue
 - Total expenses

California Department of Mass Transit

The California Department of Mass Transit's preliminary draft Statewide Transit Strategic Plan report reviewed 39 short range transit plans across the State. The report highlights common performance measures including:

- Customer service
 - Customer satisfaction
 - Customer on-time arrival to destination
 - Transit access
 - Efficient transfer-wait time
- Transit travel demand
- Physical infrastructure
- Financial health

The report also reviews common standard measures including:

- On-time performance

- Less than one minute before scheduled arrival
- Leaving no later than 5 minutes of scheduled departure
- Most agencies try to achieve between 90 to 95 percent on-time arrival
- Fare-box recovery ratio
 - TDA requires a 20% recovery ratio and is a standard, but some regions expectations are higher
- Passenger boarding
 - Measures effectiveness of routes

The following system performance indicators are variables that were commonly found across the state:

- On-time arrival
- Distance between road-call/mechanical breakdown
- Average weekday/weekend boarding
- Percent of system ridership or mode share
- Peak/off-peak load
- Percent of trips missed
- Operator absence
- Headway

The following are common performance measures for the Sacramento region:

- Annual ridership growth
- System passengers per revenue vehicle hour
- Percentage cost recovery through fare box receipts
- Annual operating cost increase per revenue vehicle hour

Performance Measures for Rural Transportation Systems

Caltrans' 2006 Performance Measures for Rural Transportation Systems Guidebook includes performance measures for the following seven main performance categories.¹⁰

- Safety
 - Accident rate per million vehicle miles traveled
- Mobility
 - Origin-destination travel times along major corridors (min)
 - Actual Average Speeds (mph)
 - Delays (sec or min)
- Accessibility
 - Accessibility different (min): time from a particular point between the fastest and second-fastest routes to State Highway System access points.
- Reliability
 - Variability of travel times between major OD pairs

¹⁰ Caltrans. Performance Measures for Rural Transportation Systems Guidebook. June, 2006.

- Productivity
 - Number of people throughput
 - Lost lane miles
 - System wide (or) per roadway segment
- Return on investment
 - Life-cycle costs (dollars)
 - Life-cycle benefits
 - Net present value (dollars)
 - Benefit/cost ratio (benefits divided by costs)
 - Rate of return on investment
 - Project payback period
 - Calculated benefits: travel time savings, vehicle operating cost savings, accident cost savings, and emission cost savings.

Alameda County Congestion Management Agency

The Alameda County Congestion Management Agency outlined performance measures with their corresponding long-range goal, objective, required data, outcomes, and cautionary notes regarding the use of required data.¹¹ Transit performance measures include:

- Transit routing. Required data: Current CMP requirement.
- Transit frequency. Required data: Current CMP requirements. Number of lines operating at each frequency level.
- Transit ridership. Required data: Number of riders.

MTC Transportation 2035 Performance Objectives

The Metropolitan Transportation Commission developed performance objectives for each goal in the 2035 Plan, linking transportation performance measurement to the organization goals.¹²

- Economy Goal: Maintenance and safety
 - Local streets and roads: Maintain pavement condition index of 75 or better
 - State highways: Distressed land-miles no more than 10% of system.
 - Transit: Average asset age no more than 50% of useful life and average distance between service calls of 8,000 miles.
- Economy Goal: Reliability and freight
 - Reduce delays 20% per capita from today.
- Environment Goal: Clean air
 - Reduce vehicle miles traveled 10% per capita from today.
 - Reduce emissions fine particulate matter and carbon dioxide.

¹¹ Alameda County Congestion Management Agency 2008 Countywide Transportation Plan.

¹² MTC, Transportation 2035 Plan: Performance Assessment Report. Available online: www.mtc.ca.gov/planning/2035_plan/Supplementary/T2035Plan-Perf_AssessmentReport.pdf, p.3

MTC proposes quantitative performance measures to meet the goals listed above. Examples of quantitative performance measures include benefit-cost ratio (monetized) reflecting:

- Recurrent delay (vehicle hours)
- Nonrecurring delay (vehicle hours)
- Transit travel time
- Fatal and injury collisions

San Luis Obispo Regional Transit Authority

The San Luis Obispo Regional Transit Authority includes five performance measures that are calculated for each fiscal year.¹³ The five performance measures are as follows:

- Operating cost;
- Fare revenue;
- Vehicle Revenue Miles (VRM)
- Vehicle Revenue Hours (VRH)
- Unlinked passenger trips

III. Nationwide

Capital District Transportation Committee

The Capital District Transportation Committee (CDTC) in Albany, New York collected performance measures that aimed to improve overall network performance.¹⁴

- Access
 - Percentage of p.m. peak-hour trips transit accessible
 - Percentage of p.m. peak-hour trips with transit advantage
 - Percentage of p.m. peak-hour trips accessible by bicycle and walking.
- Accessibility
 - Travel time between representative locations
- Congestion
 - p.m. peak-hour trips excess person-hours delay
 - Excess person-hours of peak-hour delay per person-miles traveled
 - Excess person-hours of peak-hour delay per person
- Flexibility
 - Reserve capacity on the urban expressway and arterial system (p.m. peak-hour vehicle miles of capacity)

¹³ San Luis Obispo Regional Transit Authority. Short Range Transit Plan Update for RTC Fixed Route Service Transit Plan Update.

¹⁴ CDTC Congestion Management Process, 2007. Available online: www.cdtcmpo.org/rtp2030/amaterials/cm-doc.pdf.

- Safety
 - Estimated annual societal cost of transportation accidents (SM)

Transit Cooperative Research Program

A survey of 22 transit operators and 10 related planning agencies conducted by the Transit Cooperative Research Program identified the following performance measures as being the most widely used.¹⁵

Measures Used by at Least 50% of Agencies

- Cost effectiveness
- Ridership
- On-time performance
- Cost-efficiency
- Accident rates

Additional Measures Used by 25-50%

- Road (service) calls
- Employee productivity
- Missed trips
- Complaint/compliment ratio
- Passenger load

Other Performance Measure Examples:

- Weighted average ratio of auto-to-transit travel times
- Coverage/turn-down rate for demand-responsive services.
- Customer satisfaction and customer loyalty.
- Incident reports and other measures of passenger safety, including vandalism, other crime, and safety personnel/passenger ratios.
- Energy consumption per passenger.

Florida Department of Transportation

The Florida Department of Transportation reports on the performance of Florida's transportation system and the performance of our agency for many years in various reports on a policy-level, a system level, a program-level, and a project level. Mobility is defined as "the ease with which people and goods move throughout their community, state, and world." The Department uses the following transit mobility performance indicators:

- Transit mobility¹⁶
 - Ridership – total passenger trips
 - Auto/transit travel time ratio – door-to-door trip time

¹⁵ A Guidebook for Developing a Transit Performance Measurement System (Report 88), Transit Cooperative Research Program, Transportation Research Board, 2003.

¹⁶ Florida Department of Transportation. Long Range PP FY 2010/11-2014/15. September 2009.

- o Reliability – on-time performance
- o Coverage - % person minutes served
- o Frequency – Buses per hour
- o Span – hours of service per day
- o Load factor 0 % seats occupied

The principles of the mobility performance measure program include:

- Builds on national research
- Policy-driven and supported by data
- Reflect the users’ experience in the system
- Address multimodal considerations
- Results are understandable to the General Public
- Results can be forecast into the future

New York City Transit Authority

The New York City Transit (NYCT) Authority’s mission is to provide timely and reliable mass transit to more than 7 million daily riders.¹⁷ NYCT established three main performance indicators (PIs) to ascertain how closely this mission is being met including:

- En route schedule adherence (-1 to +5 minutes)
- Headway regularity (+/- 50%)
- Wait assessment

Data is collected electronically and indicators are reported semi-annually to the public. Detailed internal diagnostic reports are issued frequently to help operations management improve service performance.

VI. Bicycle Performance Measures

There are several statewide guides and manuals that set standards for bicycle facilities. While these documents do not include performance measures, they identify how to determine the completeness and quality of bicycle facilities. Performance measures related to system completeness can be developed using these documents.

Caltrans Highway Design Manual

Chapter 1000 Bikeway Planning and Design of the Highway Design Manual (HDM) includes miles of conventional highway miles with standard shoulder widths in Chapter 1000 as follows:

“Many rural highways are used by touring bicyclists for intercity and recreational travel. It might be inappropriate to designate the highways as

¹⁷ Transportation Research Board Business Office. “Performance Measurements on Mass Transit: Case Study of New York City Transit Authority.” Transit 2009, volume 2.

bikeways because of the limited use and the lack of continuity with other bike routes. However, development and maintenance of 1.2 m (3.9 ft) paved roadway shoulders with a standard 100 mm (3.9 in) edge line can significantly improve the safety and convenience for bicyclists and motorists along such routes.”¹⁸

The HDM includes general criteria for bicycles and design guidelines for bicycle facilities.

Guide for Development of Bicycle Facilities

The American Association of State Highway and Transportation Officials developed the Guide for Development of Bicycle Facilities that comprehensively guides the planning, design, and operation and maintenance of bike lanes, shared use paths, bicycle crossings, bicycles on freeways, and parking facilities.

Caltrans Manual - Pedestrian and Bicycle Facilities in California

The Pedestrian and Bicycle Facilities in California Report prepared for Caltrans Planners and Engineers provides standard and innovative practices for bicycle facilities, Class I bike paths, Class II bike lanes, Class III bike routes, signals, roadway design and resurfacing.¹⁹ Class III bike routes are shared facilities which service either to: provide continuity to other bicycle facilities; or designate preferred routes through high demand corridors.

Standards and recommendations for Class II Bike Lanes and Class III Bike Routes in the Report include:

- Bike lanes should be 1.5 m (or 5 feet) wide (Class II).
- Delineation lines must be dropped at the approach of the right-turn lane (Class II).
- Bike Xing signs to warn motorists of the potential for bicyclists crossing their path (Class II).
- Bicycle-sensitive detectors within the bike lane (Class II).
- Wide curb lanes of at least 14 feet (Class III).
- Curb lanes 16 feet or wider, the edge line should be stripped (Class III).
- Avoid directing bicyclists onto sidewalks or other streets for short distances (Class III).

Alameda County Congestion Management Authority

Alameda County’s Congestion Management Agency outlined performance measures with their corresponding long-range goal, objective, required data,

¹⁸ Caltrans Highway Design Manual Chapter 1000 Bikeway Planning and Design. June 26, 2006.

¹⁹ Caltrans and Alta Planning and Design. Pedestrian and Bicycle Facilities in California: A Technical Reference and Technology Transfer Synthesis for Caltrans Planners and Engineers. July, 2005.

outcomes, and cautionary notes regarding the use of required data.²⁰ Bicycle performance measures include:

- Completion of County-wide Bike Plan. Required data: Miles and percent completion of Bikeway Plan.
- Roadway Accidents. Required data: Number of accidents/number of miles from Switter/TASIS System

City of Seattle

The City of Seattle monitors performance measures to determine the amount of progress being made toward achieving the goals and objectives of the Bicycle Master Plan.²¹ These measures are designed to quantify the overall goals and objectives of the Plan. For each measure, the City identified a baseline measurement, performance target, data collection frequency, and data collection responsibility. Performance measures include:

- Number of cyclists observed at counting locations throughout Seattle.
- Number of police reported bicycle crashes per total number of bicycles counted and annual traffic volumes.
- Percentage of Bicycle Facility Network completed.
- Number of bicycle racks installed through the SDOT Bicycle Parking Program.
- Number of Seattle Bicycling Guide Maps distributed
- Percentage of targeted SDOT staff who participate in training on bicycle issues.
- Number of bicycle project grant applications applied for and obtained for bicycle programs.
- Number of bicycle spot improvements completed.

Vermont Agency of Transportation

The State of Vermont Department of Transportation's Vermont Bicycle and Pedestrian Policy Plan establishes two performance measures:

- Reported motor vehicle crashes involving bicyclists
- Miles of bicycles fatalities developed

Nationwide Bicycle Performance Measure Survey

The State of Vermont reviewed several other state's bicycle performance measures, such as Arizona, Florida, Maryland, New Jersey, Oregon, Tennessee, Washington, Wisconsin. The survey found that performance measures can address different aspects of the state's bicycle program including²²:

- Safety

²⁰ Alameda County Congestion Management Agency 2008 Countywide Transportation Plan.

²¹ City of Seattle. Seattle Bicycle Master Plan, Chapter 7.

²² Vermont Bicycle and Pedestrian Policy Plan, Technical Memorandum #1. October, 2005.

- Number of serious injury or fatal pedestrian or bicycle crashes within an area.
 - Percentage of all crashes that involve bicyclists.
 - *Note: The best types of safety performance measures account for pedestrian and bicycle usage, or exposure.*
- Usage
 - Number of people bicycling.
 - Percent of all trips that are made by bicycle modes.
 - *Note: these are typically based on count, consensus, or survey data.*
- Facilities - non-motorized facility provision.
 - Miles of roadway with paved shoulders.
 - Miles of greenway paths.
 - Percent of intersections with curb ramps or pedestrian signals.
- Education/Enforcement - measures of the number of people educated on bicycle safety behavior.
 - Percentage of students taught in bicycle safety education classes.
 - Percent of bicyclists wearing helmets
- Land Use - measures of land use development in relation to the location and quality of non-motorized facilities.
- Institutionalization - measures that address operating procedures related to non-motorized transportation within organizations.
 - Total amount spend on bicycle programs by the state DOT
 - Number of employees that are trained on bicycle design.
 - Number of local governments that prepare bicycle master plans.
 - Number of citizens that are members of bicycle advocacy groups.

Potential Bike Performance Measures

Anne Mahaney, Caltrans Bicycle Facilities Unit and member of the PDT, suggested the following potential bike performance measures:

- Ratio of designated bikeway miles to road miles
- Miles of roadway without gaps or barriers for bicyclists
- Number of cities with bicycle parking ordinances
- Ratio of bicycle parking spaces to automobile parking spaces
- Maintenance frequency
- Connections to other travel modes (airports, rail, bus, waterways, parking lots, etc)
- Number of bicycle and motorcycle detection intersections with traffic-actuated signals (Caltrans Traffic Operations Policy Directive, TOPD 09-06)
- Number of local governments with bicycle transportation plans
- Bicycle transportation investments, including maintenance, as a percentage of the total transportation investment for the corridor. Or Number of bikeways planned in a concurrent transportation project
- Number of bicycle fatalities and injuries per X VMT.

VII. Conclusion

The approaches presented in this memorandum are the starting point for future PDT and working group discussions. The results of the best practice review indicate that there are common topics and measurements that appear between different agencies and organizations. Caltrans staff need to determine which topics should have measurements and if the appropriate data is available to make the measurement viable. It is likely this list will be supplemented as additional practices are identified during the stakeholder interviews and throughout the project period.