

# TRANSPORTATION SYSTEM MANAGEMENT & OPERATIONS (TSMO) PROGRAM PERFORMANCE MANAGEMENT PLAN

#### **FEBRUARY 2017**



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# EXECUTIVE SUMMARY



This Oregon Department of Transportation (ODOT) Transportation System Management and Operations (TSMO) Performance Management Plan grew out of a capability maturity model (CMM) assessment administered with key ODOT staff in 2014. The performance management component of the TSMO program was determined to be one of the least mature and therefore an appropriate program focus area. Table 1 below illustrates the key action items identified in the CMM workshop to improve ODOT's level score.

**Table 1.** CMM Workshop Actions to Advance to Next Level – TSMO Performance Management

ACTION IDENTIFIED IN CMM	ADDRESSED IN THIS TSMO PERFORMANCE MEASURES PLAN (YES, PARTIAL, OR FUTURE)
Develop comprehensive set of metrics to characterize overall TSMO performance of ODOT and its facilities	Yes
Corporately set goals and define objectives by region	Future (Statewide TSMO Plan)
Reassess what new measures should be included and whether existing ones are still relevant	Yes
Develop an asset management methodology for arriving at appropriate and relevant metrics that capture key operational and performance characteristics	Partial
Prioritize the performance measures that ODOT collects and calculates, based on relevance and feasibility	Yes
Identify or develop a performance measure to characterize travel time reliability	Yes
Identify or develop an arterial performance measure and configure controllers to report this quantity automatically	Yes
Examine what data already exists at ODOT and what performance measures are desired by ODOT groups	Yes
Expand the ITS asset maintenance/management system to include signal maintenance work	Partial

As shown in **Table 1**, nearly all the CMM workshop identified action items were addressed with this TSMO Performance Management Plan. It should be noted that a higher-level statewide TSMO Plan is scheduled for 2017-2018.

This performance management plan started with a national scan of current practice / literature review assessment. Review results revealed, in general, that TSMO Performance Measures are largely ad hoc and not well documented. Traffic incident management (TIM) and mobility performance measures are better documented than the other TSMO areas of transportation operations center (TOC) management, work management, traveler information, and asset management.

Keys to success of TSMO performance measures<sup>1</sup> are:

- Let desired outcomes drive the performance management program,
- Keep it simple with a few useful metrics to start, which is why this plan is constrained to no more than six identified "core" performance measures per ODOT TSMO program area,
- Useful metrics to staff and management, which were vetted through numerous steering committee and stakeholder committees.
- Well-defined metrics meant to provide clarity for implementation and communication.

<sup>1</sup> Improving Transportation System Management and Operations (TSMO) Capability Maturity Model Workshop White Paper, Performance Measurement. USDOT, FHWA, April 2015.

A review of the national state of the practice and ODOT's current TSMO practice formed the basis for analyzing and prioritizing candidate performance measures within ODOT's TSMO Program Areas. These ODOT TSMO Program Areas were stratified and designated as:



TRAFFIC INCIDENT MANAGEMENT (TIM)



TRAVELER INFORMATION



TRANSPORTATION
OPERATIONS CENTER
(TOC) MANAGEMENT



ASSET MANAGEMENT



The national scan results were presented to the project's steering committee and three technical-oriented stakeholder groups. These committees provided a spectrum of ODOT's TSMO related managers and key staff to influence the evaluation and prioritization of the core performance measures to be implemented and acted upon within the department's TSMO program. The three stakeholder groups were:

#### TIM AND TOC MANAGEMENT -

covering ODOT TOC management, dispatch and incident response staff, Oregon State Police (OSP), and Intelligent Transportation Systems (ITS).

#### SYSTEM MOBILITY AND ASSET MANAGEMENT -

covering Traffic Signal System Unit (TSSU), ITS, Traffic, and Transportation Policy and Analysis Unit (TPAU).

#### PROGRAM MANAGEMENT -

covering work management, program operations, traveler information, and asset management, including information services (IS).

Through a series of stakeholder, steering, and project team meetings and collaborations within various ODOT staff groups, a very large set of candidate TSMO performance measures were prioritized based on the criteria of (1) usefulness and (2) practicality of implementation. For example, some performance measures would be extremely useful, such as exact time of crash for TIM metrics, but are not practical to implement due to limitations; while other performance measures are quite easily collected but are not as useful to TSMO program functions. The test for usefulness is if the metric is reported, will anyone bother to actively look at it? Is it important or helpful enough to garner attention from staff?

To this end, this plan lays out in detail the top priority performance measures stratified by usefulness (high, medium, and low) and currently reported or not, as a surrogate for practicality of implementation. Within these six program areas, six or less "core" performance measures were identified. Within this report, the core metrics are expanded to identify an action plan and a communication plan to discern strategy for implementing the new metrics or modifying existing metrics.

The performance measurement goal for this plan is to create actionable performance measures which directly support the stewardship of Oregon's transportation system by improving the efficiency of the transportation system by optimizing operations and management, and actively managing transportation assets to extend their life and reduce maintenance costs.

The following pages provide a summary of the "core" performance measures identified within this TSMO Performance Management Plan to achieve the above performance measurement goal, along with a simplified, lay definition of each.

# PROGRAM AREAS FOR PERFORMANCE MEASUREMENT

EXISTING
Performance Measures

FUTURE Performance Measures

#### TRAFFIC INCIDENT MANAGEMENT (TIM)

MISSION>> IMPROVE THE SAFETY OF EMERGENCY RESPONDERS AND THOSE INVOLVED IN CRASHES; AS WELL AS REDUCE ROADWAY DELAYS DURING INCIDENTS.



CORE PERFORMANCE MEASURES

# ROADWAY CLEARANCE DURATION Time till all land

Time till all lanes opened. Goal is lane blocking crashes cleared within 90 minutes.

#### ROADWAY CLOSURE DURATION

Time to get traffic moving around a crash related closure.

#### INCIDENT CLEARANCE DURATION

ime to completel clear a crash/ incident from roadway and all esponders depar

### NUMBER OF TIM TRAINED

**RESPONDERS** 

ON-SCENE TIME
Roadside
exposure time
for emergency
responders onscene of a crash or

incident.

#### SECONDARY CRASHES

A collision occuring within an incident scene or within a queue of a preceding incident.

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# TRANSPORTATION OPERATIONS CENTER (TOC) MANAGEMENT

MISSION>> EFFECTIVELY COMMUNICATE ACCURATE, TIMELY, RELEVANT INFORMATION TO ODOT STAFF, AGENCY/TIM PARTNERS, AND THE TRAVELING PUBLIC TO PROMOTE SAFE AND EFFICIENT TRAVEL.



CORE PERFORMANCE MEASURES

**DISPATCH TIME**Time from crash

reported to
ODOT responders
dispatched.

#### TOC STAFF WORKLOAD

Actions taken by TOC Operators broken down by day of week and hour of day. MAJOR
INCIDENTS WITH
NO TRAVELER
INFORMATION
MESSAGE (ATIS)

EVENTS WITH NO NOTIFICATION MESSAGE

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EXISTING
Performance Measures

FUTURE Performance Measures

#### **MOBILITY**

MISSION>> PLAN FOR, IMPLEMENT, OPERATE, AND MAINTAIN FACILITIES THAT SUPPORT EFFICIENT AND RELIABLE TRAVEL THAT SUPPORTS OREGON'S ECONOMY AND QUALITY OF LIFE.



#### CORE PERFORMANCE MEASURES

# TRAFFIC VOLUMES Multi-modal traffic counts including autos, trucks, and transit. \*

# TRAVEL TIME Average and percentile travel times, temporally and spatially.

# HOURS OPERATING IN CONGESTED CONDITIONS Hours when

Hours when the average speed is slow or "congested" for the roadway.

#### HOURS OF Multimodal Delay

Number of cumulative hours that drivers, trucks, and transit are delayed over the course of a specified time period.

## TRAVEL TIME RELIABILITY

Regularity or predictability of roadway travel time, often comparing freeflow, average, and 80th/95th percentile travel times.

#### PERCENT OF ARRIVALS ON GREEN LIGHT

Measure the quality of traffic light "progression" as a percentage of vehicles that arrive at a traffic signal on green (inverse is arrivals on red light).

\* The type and collection method of volume data varies across the state. Most of the system does not currently have continuous data. Pedestrian and bicyclist data is also not currently collected for a majority of the system.

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#### TRAVELER INFORMATION

MISSION>> EFFECTIVELY COMMUNICATE ACCURATE, TIMELY, AND RELEVANT INFORMATION TO THE TRAVELING PUBLIC TO PROMOTE SAFE AND EFFICIENT TRAVEL.



#### CORE PERFORMANCE MEASURES

# NUMBER OF PEOPLE VISITING ODOT COMMUNICATION OUTLETS

Measures usage of ODOT traveler information resources, such as TripCheck, 511, and social media (TwitterTM WazeTM).

#### MAJOR INCIDENTS, CONSTRUCTION WITH NO MESSAGE

ATIS NOTIFICATION
DELAY
Time from crash
reported to

reported to
notification made
available for the
traveling public.
ATIS stands for
Advanced Traveler
Information
System.

## CRITICAL STATION ON-TIME REPORT

On-time performance for updating road and weather conditions (most critical in winter operations or major events).

### INFORMATION ACCURACY

Validation program of data accuracy for quality assurance.

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# PROGRAM AREAS FOR PERFORMANCE MEASUREMENT

EXISTING
Performance Measures

FUTURE Performance Measures

#### ASSET MANAGEMENT

MISSION>> PROVIDE ACCURATE AND TIMELY INFORMATION TO EFFECTIVELY MAINTAIN, OPERATE, PROCURE, TEST, REPAIR, AND REPLACE TSMO ASSETS.



CORE PERFORMANCE MEASURES

TSMO ASSET INVENTORY AND LOCATION

#### LABOR HOURS PER ASSET For ITS and Traffic

Signals.

AND SITE RATING

Custom rating
based on
several asset
characteristics
including asset
age, inspection/
testing and
maintenance
request frequency.

**ASSET CONDITION** 

# PERCENTAGE OF ASSETS BEYOND SERVICE LIFE

MONITORED

Number and
percentage of
trafic signals
remotely
monitored via
communication
link (ideally with
automated selfreporting).

TRAFFIC SIGNALS

REMOTELY

#### PERCENT DETECTION MALFUNCTION

Percent of time when TSMO detection is malfunctioning.

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#### **WORK MANAGEMENT**

MISSION>> IMPROVE ABILITY TO MAKE EFFICIENT AND TIMELY STAFFING DECISIONS AND COMPLETE ALL WORK TASKS AND REQUESTS.



CORE PERFORMANCE MEASURES

# ASSIGNED WORK ORDERS BY EMPLOYEE Number of currently assigned work orders per employee.

**CURRENTLY** 

#### RECENTLY CLOSED REQUESTS FOR WORK

Number of recently closed Requests for Work per week.

#### WORK ORDER BACKLOG

Number of Requests for Work that are open in the system per

# TIME TO COMPLETE PRIORITY IT REQUESTS

Duration of time between issuance of priority IT work requests to closing of work request.

# CENTRAL SYSTEMS MAINTENANCE TEAM (CSMT) WORK CLASSIFICATION

Number of Requests for Work and Hours Expended by Work Classification type (e.g. New Infrastructure, etc.)

# CENTRAL SYSTEMS MAINTENANCE (CMST) TEAM RESOURCE TREND ANALYSIS

Metrics that relate CSMT resource demands based on growing infrastructure elements (e.g. cameras, VSL corridors, etc.)

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# PROGRAM AREA PERFORMANCE MANAGEMENT PLANS



## TRAFFIC INCIDENT MANAGEMENT

Traffic incident management (TIM) incorporates several partner agencies, in addition to ODOT, to respond to incidents in the state of Oregon. In coordination with the Oregon State Police (OSP) and other partners, ODOT previously developed an updated TIM Strategic Plan in 2015 that outlines the goals and objectives of the TIM program. Program goals include enhancing the safety of first responders and the traveling public; improving the reliability and efficiency of the transportation system; strengthening the communication, coordination, and collaboration between response agencies; and establishing TIM as a core public safety discipline. TIM is a relatively mature TSMO program for performance measure reporting, informing one of ODOT's key

economic vitality (90 minute roadway clearance duration), and obtaining
regular use within various ODOT
business lines and outside partner
agencies (OSP).

TIM has the most mature TSMO measures





The desired outcomes and objectives of the TIM performance management program are:

Actively measure TIM-related performance to inform management strategies and actions, which improve the safety of emergency/incident responders and transportation system users; as well as reduce roadway delays during incidents.

When implementing and measuring the progress of the TIM program area towards the above objective, there are four goals that should be used to guide ODOT and partner agency actions. The goals are the following:

- Summarize data in ways that provide actionable information:
- 2. Reduce on-scene time, roadway clearance time, closure time, and incident clearance time;
- Provide information to management and leadership teams regarding incident trends to guide the allocation of resources; and
- 4. Maximize incident responder safety through effective training, smart technology, and effective en-route, on-scene, and post-incident processes.





Through the TIM Strategic Plan and the 2008 Mutual Assistance Agreement between ODOT and OSP, the TIM program has had several key successes in Oregon. In terms

of performance measures, the state has been tracking roadway clearance duration, roadway closure duration, and incident clearance duration. Crashes and fatal crashes that exceed the 90 minute clearance goal are analyzed to determine causes for the longer clearance time. Additionally, over 3,800 incident responders have completed the National TIM Responder Training.

There are four nationally recommended TIM metrics identified in the 2006 Federal Highway Administration (FHWA) Focus State Initiative and the 2011 NCHRP 20-24(37)D report:

- Roadway Clearance Time,
- Incident Clearance Time,
- Secondary Crashes, and
- Arrival Time.

Of the national TIM metrics, ODOT collects and reports on roadway and incident clearance times. Arrival time data is only partially available currently because of inconsistent timeline reporting and check-ins back to the Transportation Operations Centers from ODOT and non-ODOT responders. Secondary crashes are not currently reported as a performance measure, but are sometimes recorded through dispatch notes in transportation operations center software, when on-scene responders indicate it is a secondary crash.

To collect the information to report on the current metrics, a combination of sources are used including ODOT's TOCS, and event history reports which are accessed through Inview. The TOCS Cube within ODOT's data warehouse is currently in place for the TIM performance measures. The TOCS Cube is a Microsoft SQL analysis server that is capable of compiling data from other databases and completing calculations, including Extract Transform and Load (ETL) functions. It works with other ODOT programs to help present collected data or report back on the performance measures on ODOT's reporting server, which is accessed through Inview. Inview is one tool that links to the TOCS Cube that allows TIM staff to access performance measure information.

#### CORE TIM PERFORMANCE MEASURES

The following "core" or most important TIM performance measures, shown in **Exhibit 1**, were identified for prioritization by the TIM & TOC manager stakeholders through a series of workshops. The workshops presented an overview of national best practices, discussion forums on current ODOT, OSP and towing practices, and exercises to present candidate measures, discuss, and rank those considered most useful and actionable to enhancing the TIM program. **Exhibit 1** below also contains a basic definition of each identified core performance measure and distinguishes those which currently are being reported (teal background) from those which are future & require more effort to implement.

It should be noted that the FHWA term of roadway closure duration is planned to replace ODOT's legacy terminology of highway closrue duration, both equivalent in meaning.

**Exhibit 1.** TIM Core Performance Measures

#### **ROADWAY** CLEARANCE DURATION Time till all lanes opened. Goal is lane blocking

## **ROADWAY CLOSURE DURATION** Time to get traffic

### **CLEARANCE DURATION** Time to completely clear a crash/ roadway and all

INCIDENT

#### **NUMBER OF** TIM TRAINED **RESPONDERS**

#### **ON-SCENE TIME** Roadside exposure time for emergency responders onscene of a crash or incident.

## CRASHES A collision occuring

**SECONDARY** 

within an incident scene or within a queue of a preceding incident.

**FUTURE Performance Measures** 

#### **IMPLEMENTATION**

The implementation plan for the recommended TIM program area core performance measures incorporates feedback and guidance from the TIM Strategic Plan, stakeholder meetings, and management discussions. The

following sections outline the data needs and sources and the current and future performance measures. Action items are identified for the core program area performance measures.

#### DATA NEEDS AND SOURCES

ODOT and the OSP have a long standing partnership of sharing data and information for performance management. Continuing and strengthening the partnership with them as well as other TIM responders (e.g. tow companies) will be necessary to accurately report the incident timeline and all major milestones that form the data input for performance management. Key TIM partners include the following:

- Oregon State Police (OSP) and other law enforcement (patrol, crash reconstruction team, etc.),
- Fire and emergency responders,

- 911 emergency dispatch, and
- Tow companies.

It is recommended that ODOT start the conversation with all TIM partners listed above to receive incident timeline data, which is needed to accurately report all core metrics. Moving to a singular interagency, dispatch communication exchange platform at an enterprise level (Oregon Interoperability System, OIS) is an important action that can improve data sharing to support the TIM performance measures program.

**Exhibit 2** shows an ODOT graphic illustrating the incident timeline milestones, key performance measures, and the future desired refinement of time goals for the metrics. This future step is intended to "mine" the data for clearer information which could support actionable and desirable treatments to enhance the TIM program.

Along with the primary data sources discussed above, secondary data sources can be used to better understand and ensure data accuracy. For the TIM program area, data accuracy can be verified using such sources as the reported crash data through the ODOT Crash Analysis Unit, or improved police crash reporting forms allowing law enforcement to identify primary versus secondary crash. Other possible verification sources include WAZE (real-time analysis) and HERE (historical analysis) data.

Overarching TIM Goal = Safe, Quick Clearance of Roadway Incidents

**Exhibit 2.** TIM Key Performance Measures with Future Time Goals

#### Legislative Target \*\*\* (<90 min) Applied Universally Across the State TSMO plan creates multiple subcategories with various targets. Those subtargets are based on historic data. Hwy Closure Duration Roadway Clearance Incident Duration Time Goals Time Goals Time Goals a) Geo: District 🔷 Crew a) Geo: District 🔷 Crew a) Geo: District 🔷 Crew b) Urban or Rural b) Urban or Rural b) Urban or Rural c) Incident Severity c) Incident Severity c) Incident Severity Τo T<sub>2</sub> T<sub>4.5</sub> Τı Тз T5 T6 T7 Τ4 Incident Incident Incident Response All Lanes Normal Traffic Response Response Occurs Reported Verified Identified Arrival Cleared Departs Scene Flow Returns & Dispatched on Scene Start End Performance Performance TSMO Focus Measures Measures \_001 \_ -er -Everything we do occurs inside the TIM Timeline. It contains all actions, SOGs, staffing, etc. \* All Incidents

\*\* Lane Blocking Crashes

On-scene

time is

#### DESIRED, EXISTING, AND FUTURE PERFORMANCE **MEASURES**

Through a series of stakeholder meetings and management discussions, a list of existing and potential TIM performance measures was created. Table 2 shows all performance measures that were discussed through the process, stratified by the identified priority level, high, medium, or low (not necessarily a reflection of importance, but a reflection of usefulness and ability to act on the metric). The table also separates those metrics currently being collected on the top half, while those yet to be consistently and accurately reported shown on the bottom half. The list below of metrics is not considered comprehensive, but rather reflects the state of TIM practice within ODOT and nationally, as well as those considered particularly useful and actionable towards the program goals.

The stakeholder workshops also identified the need to provide different views and breakdowns of the current measures to improve their usability and to help decision makers better identify problem areas and take action. For example, the statewide Roadway Clearance measure can be made more useful by providing the ability to break the measure down further geographically; into separate categories for minor, major and fatalities; or

by urban versus rural highway segments. Better breakdown of the data should lead to a better understanding of the factors driving overall performance and potentially enable the development of additional performance targets for urban versus rural roads or for major versus minor incidents.

There were 19 TIM performance measures identified through stakeholder meetings and guidance from management, consensus as seen in Table 2. Of the 19, ODOT has started to measure top priority or is currently reporting 11 performance measures in a range of maturity levels. For example, roadway clearance duration is a measure very mature measure with both a reporting system in place and a goal set. For events not meeting the goal, there is a process in place to complete a causal analysis. The six "core performance measures" shown in **bold** have been identified as core performance measures and should be implemented first.

**Table 2.** TIM Performance Measures

TSMO PRIOR LEVEL		нібн	MEDIUM	LOW
40 Metric?	Yes	Roadway clearance duration¹ (90-minute causal analysis)  Incident clearance duration  Percent of crash incidents meeting goal for roadway clearance time  Number of responders trained in National TIM training classes  Number of responders trained in specific discipline²	Roadway closure duration  Over 90 minute roadway clearance causes  Incident frequency and distribution	Verification time <sup>2</sup> Dispatch time <sup>2</sup> Percent of incidents with complete Key TIM incident duration milestone records
Current TSMO Metric?	No	Response time  On-scene time <sup>4</sup> On-scene time currently captured for ODOT staff but not other partner agency responders.  Tow arrival time  Tow dispatch time  Tow on-scene time	Secondary crashes <sup>3</sup> Arrival time Incident responder struck-bys and fatalities	

**Bold performance measures** are identified as core performance measures in this program area.

<sup>&</sup>lt;sup>1</sup> Identified as an ODOT Key Performance Measure.

<sup>&</sup>lt;sup>2</sup> Identified in TIM Strategic Plan for future consideration.

<sup>&</sup>lt;sup>3</sup> Identified in TIM Strategic Plan: Near-Term, SE-01, Track Secondary Incidents.

<sup>&</sup>lt;sup>4</sup> On-scene time currently captured for ODOT staff but not other partner agency responders.

### TIM PROGRAM AREA PERFORMANCE MANAGEMENT ACTION ITEMS

Implement the following new "data views" for the Roadway Closure Duration, Roadway Clearance Duration, and Incident Duration performance measures:

#### **NEAR-TERM**

- Data presented at region, crew and district levels.
   Note: ODOT is already publishing Roadway Clearance
   Duration at the district level data for the monthly performance measures.
- Data presented based on urban and rural geographies. Urban geography will be initially defined by Metropolitan Planning Organization (MPO) boundary or City Limits (non-OSP coverage area). The data will be compiled and delivered in to ODOT's source system via geospatial processes through assistance from the ODOT GIS Unit
- 3. Data presented based on **incident severity.** Incident severity was classified into as fatalities, major, and minor incidents. Major incidents are defined as major injuries, minor injuries, hazmat or motor carrier involved incidents. The source incident severity data comes from the Event Attribute dimension in the TOCS cube.

#### **ROADWAY CLEARANCE DURATION**

Including 90 minute casual analysis

#### **NEAR-TERM**

- Change presentation of data from mean to median.
- Implement all three data view recommendations as defined in the previously mentioned at district/crew levels, based on urban and rural geographies, and based on incident severity.

#### INCIDENT CLEARANCE DURATION

#### **NEAR-TERM**

- Change presentation of data from mean to median.
- Implement all three data view recommendations as defied in the previously mentioned near-term implementation steps
- Work collaboratively with OSP to identify and implement a process to improve the information sharing and consistency/accuracy of last person on scene departure (often tow companies) back to ODOT, so this incident clearance duration metric can be improved (as well as the on-scene time metric) by dispatch in TOCS or other database

### NUMBER OF RESPONDERS TRAINED IN NATIONAL TIM TRAINING CLASSES

#### **NEAR-TERM**

- Implement FHWA developed and approved pre & post training survey
- Publish and disseminate

#### **ON-SCENE TIME**

#### **NEAR-TERM**

- Work with TIM stakeholder group to develop On-Scene report. Using arrival duration and clear duration, the difference between the two equals on scene time
- Implement strategies to accurately and consistently collect each TIM incident timeline milestone, but particularly first responder arrival and last responder departure. One specific strategy identified is to increase timer usage frequency and consistency among TOC dispatch

#### **RESPONSE TIME**

#### **NEAR-TERM**

 Work with TIM and TOC management teams to implement strategies to improve the accuracy and timeliness of the time points reported to calculate response time.

#### **ROADWAY CLOSURE DURATION**

#### **NEAR-TERM**

 Change ODOT's Highway Closure duration terminology within TIM and TSMO groups to Roadway Closure duration, to be consistent with national terminology.

#### SECONDARY CRASHES

#### **NEAR-TERM**

- Adopt FHWA definition of "Secondary Incident".
   FHWA definition of a secondary incident is "an
   unplanned incident (starting at the time of detection)
   for which a response or intervention is taken, where
   a collision occurs either a) within the incident
   scene or b) within the queue (which could include
   the opposite direction) resulting from the original
   incidents."
- Develop a method to approximate secondary incidents based on the FHWA definition. GIS software and historic speed/volume data could be used to automate measuring and reporting secondary crashes.
- Conduct a pilot project using dispatched gathered incident data and historical HERE, WAZE or other combination of probe sample speed and incident crowd-sourced data to test the ability of third-party data to accurately reflect known secondary crash events.

#### LONG-TERM

 Create procedures for OSP and other law enforcement to report secondary crashes on crash reports to replace the initial secondary crashes definition created through the near-term action items. See Arizona DPS and Florida Highway Patrol for examples of entities with secondary crash indicators on crash reporting forms.





#### TIM AUDIENCES

The main audiences identified for the TIM program area performance measures are

- Regional TIM teams (both internal and external partners),
- ODOT district staff,
- TOC management,
- · The ITS unit, and
- · Oregon State Police.

#### DELIVERY OPTIONS

The needs for reporting and delivery options depend on the audience who will be viewing and making decisions based on the information. Discussion between the reporting agency lead and the audience is recommended to ensure that the reports created are actionable and informative. The TIM user-group's time is often so limited, that there is a strong need to make the results of any performance management report as intuitive and useful as possible.

The TIM/TOC stakeholders agreed that safety should be the main point in performance management, emphasizing results and trends around on-scene time to gauge exposure and correlating results to trends in incident frequency and severity (which may be a separate ODOT analysis unit for crash data).

The delivery should be consistent and useful for TIM program area users within ODOT and externally (e.g. OSP). Whenever new reports, dashboards or displays of TIM performance measures occur, this should be communicated in writing and/or via in-person meeting to explain/train the visualization's meaning and discuss potential applications or enhancement features. A staged approach for piloting the new or altered metric report(s)/dashboards, should be used to vet usefulness and functionality. This may involve collaboration with software programmers or other IT-related entities managing the associated databases.

#### TIM COMMUNICATIONS ACTION ITEMS

The communication action items below are all Near-Term efforts (to be completed within two years), with the exception of some of the technology components which will be addressed separately.

#### **NEAR-TERM**

#### · Data on demand:

- Through a process of evaluation and identification from key stakeholders and management, document all production level TIM performance measure reports.
- Ensure all production level reports are accessible through Inview. Inview is the agency's operations portal and has been established as the repository for TIM and other TSMO performance measures. Since Inview is only accessible within the ODOT domain, work with external customers to see how they would like to interact with performance measure reports.
- Work with TOC managers to capture requirements and develop resources (modification to Inview or SSRS) for advanced ad hoc data extracts. Completing this task will allow TOC managers and others to extract data from TOCS more quickly when responding to external data requests.
- Create Performance Measures tab or page on the agency's external TIM web page. Links to Inview or another website that hosts the reports available to customers outside the ODOT domain via the Jefferson portal. Note: users must have active ODOT domain account to access content from the Jefferson portal.
- Create link to the Inview performance measures page on the agency's internal TIM page.

#### Region, District and Crew monthly reports:

- Create and deliver presentations to each district management team and explain TIM performance measures. Suggested this action be completed within six months.
- Solicit feedback from districts on frequency and format of region/district/crew level reports.
- Work with crews, district management, and regional management to ensure monthly performance reports are meeting their needs. Recommend continued outreach and coordination efforts through leadership teams like MLT Incident Response/TIM Task force, District Managers meetings, and TIM quarterly meetings. Share new reports with crews and elicit feedback to ensure reports are being used and are meeting the needs of customers.

- TIM/IR Quarterly meetings: The TIM and Performance Measures coordinator need to decide on a standard format for TIM quarterly reports. Currently each TIM/IR team has a slightly different version of reports based on user feedback and maturity of reports. It is recommended that through stakeholder outreach, a single set of uniform reports will be generated and disseminated. Uniformed reports will help build the TSMO Performance Measures brand and will reduce workload on the program staff.
- Dashboard(s) for management teams: The Performance Measures program needs to develop a series of TIM dashboards that cover both frontline and management needs. Currently there is no dashboard program in operation at ODOT that is connected to the Data Warehouse, but according to the Strategic Business Service Group, SSRS 2016 will allow users to publish dashboard to an internal web server. Note: SSRS2016 and associated dashboards will not be available outside the ODOT domain.
- TIM Performance Measures yearly report to management teams: Develop and disseminate yearly TIM performance measures report to management teams. While the final detailed requirements need to be vetted by the MLT Incident Response/TIM Task Force and others, the intent of this yearly report is to highlight accomplishments and challenges within the TIM program in terms of TIM performance measures. The report should highlight areas where we are meeting or exceeding performance measure goals and highlight areas for continued improvement and focus.



 Create external performance measures site that doesn't require credentials: Work with information services (IS) partners to create a new external website that can be accessed without ODOT credentials. Reference TIM sites like Tennessee and Virginia which all have mature external performance measures sites.

#### LONG-TERM

- Predictive analytics: It is recommended that
  the Performance Measures program develop a
  strategy to implement a predictive analytics tool.
  The use of predictive analytics in TIM is becoming
  more common and has been recently highlighted
  by the Tennessee DOT. Case studies have shown
  that predictive analytics can be an effective tool in
  helping shape resource allocation and staging of
  resources.
- IT software for visualizations, business intelligence and predictive analytics: Continued work is needed to mature the program's tools for visualizations, business intelligence, and predictive analytics. It is recommended that the Performance Measures program engage with IT and get access to the SSRS 2016 Sandbox environment.





TIM/TOC stakeholders agreed that safety should be the main point

# TRANSPORTATION OPERATIONS CENTER MANAGEMENT



ODOT's Transportation Operations Centers (TOCs) support a safe and efficient state transportation system by providing a regional point of contact for monitoring of transportation system operations. TOCs also handle coordination of transportation related communications and services among internal and external customers. Staff performs tasks using multiple systems to ensure accurate information is provided to other ODOT staff, agency partners, and the public. TOCs Managers need effective performance measures related to resource allocation and quality control of TOC work. The logging or recording of incident data is the foundation for useful and actionable performance measures to improve agency TSMO actions.



The desired outcome and objective of the TOC management performance management program is:

Measure TOC performance and ability to communicate accurate and timely information to incident responders (both internal and external), to ODOT staff, and to the traveling public for effective incident response and appropriate resource allocation.

There are three goals that should be used to guide ODOT and partner agency actions when implementing and measuring the progress of the TOC management program area toward the above objective. The goals are the following:

- Ensure accurate and timely tasks completed through the TOC:
- 2. Keep incident responders and the public safe and upto-date with event information; and
- 3. Provide information for resource and staffing needs.





ODOT currently collects data and reports on a multitude of TOC Management performance measures. These include dispatch time, TOC total staff work load by hour of day and

day of week, employee workload by hour of day and day of week, lane blocking incidents with no traveler information message (ATIS), events with no notification message, median time to notification, and notification in less than ten minutes (as discussed in the Standard Operating Guidelines [SOG]). Staff can review reports and data through a link to the reporting server made available on InView.

TOC operators are the direct link between on-scene events and ODOT for a majority of the information collected for both TOC management and TIM performance measures. An ODOT-internal program, TOCS, is used to coordinate, collect, and report the information collected by TOC operators. In addition to

TOCS, TOC operators communicate with other partner agencies using the Pantel Radio System. Although many event milestones and actions are initiated through TOCs and their operators, the amount of and quality of the data collected is greatly influenced by the TIM incident responders, both internal to ODOT and

external, and their ability to

report back about on-scene

conditions and milestones.

All four TOC management core performance measures are currently being reported.

#### CORE TOC MANAGEMENT MEASURES

The following "core" or most important performance measures, shown in **Exhibit 3**, for the TOC management program area were identified through a series of stakeholder workshops to present candidate measures, discuss, and rank those considered most useful and actionable to enhancing the program area. **Exhibit 3** contains a basic definition of each core performance measure and distinguishes those which are currently being reported (teal box) from those which are would require more effort to be implemented in the future (white box). Through stakeholder workshops, no new performance measures were identified. Efforts for the TOC management program area will be to continue and enhance these existing performance measures and their reporting.

**Exhibit 3.** TOC Management Core Performance Measures

|--|

#### IMPLEMENTATION

The TSMO performance management implementation plan for the TOC management program area's core performance measures incorporated feedback and guidance from stakeholder and steering committee meetings. As seen

above, the TOC management program area is already reporting on all identified core performance measures, therefore much of the implementation section discusses how to enhance those existing reports. The following sections discuss data source, all performance measures considered through this plan's development, and action items for each of the core program area performance measures.

#### DATA NEEDS AND SOURCES

The TOC management performance measures, both for current practices and those identified for the future, rely heavily on TOC operators and TOCS for information. Actions taken by a TOC Operator in the TOCS software are time and date stamped and is the source of data for the TOC Management performance measures.

#### DESIRED, EXISTING, AND FUTURE PERFORMANCE MEASURES

Through a series of stakeholder meetings and management discussions, a list of existing and potential TOC management performance measures was created. **Table 3** shows all performance measures that were discussed through the process, stratified by the identified priority level: high, medium, or low (not necessarily a reflection of importance but a reflection of measure usefulness and ability to act on the metric.) The table also separates those measures that are currently being collected (top half) from those yet to be consistently and accurately reported (bottom half).

There were seven TOC management performance measures identified through this process, as seen in **Table 3.** ODOT is currently measuring and reporting on all performance measures. These reports are fully developed currently and accessible through InView. Many of these TOC metrics have a partial or complete overlap with ODOT's Traveler Information (TI) and Traffic Incident Management programs and thus coordination should continue.

Of the seven performance measures, three have been identified as high priority and four as medium priority. As seen above in **Exhibit 3**, four core performance measures have been identified for implementation. These four measures are identified in **Table 3** and are shown in **bold.** In addition, the employee workload can roll up into the TOC total workload, allowing both performance measures to be reported on. Action plans for each core performance measure are further detailed in the sections below.

**Table 3.** TOC Performance Measures

TSMC PRIO LEVE	RITY	нібн	MEDIUM	LOW
Current TSMO Metric?	Yes	TOC total workload by hour of day and day of week  Employee total workload by hour of day and day of week or month  Dispatch time	Lane blocking crashes with no ATIS message  Median time to notification  SOG Compliance: notification in less than 10 minutes  Events with no notification	
	No			

**Bold performance measures** are identified as core performance measures in this program area

# TOC MANAGEMENT PROGRAM AREA PERFORMANCE MANAGEMENT ACTION ITEMS

Program area overarching action items that apply to all TOC management metrics:

#### MID-TERM

 Develop process to extract and fuse data from Pantel into system for integration with TOCS data for future enhancement of TOC total workload measure.



#### **DISPATCH TIME**

The dispatch time is the number of minutes from the crash or event being identified to when emergency responders are dispatched by the TOC.

The TOC management team, along with the ITS coordinator is expected to coordinate as the agency lead. Enhancement of this measure is covered in the above TOC management program area action items.

#### TOC TOTAL STAFF WORKLOAD

Staff workload would be a series of metrics, such as time allocation to different projects, tasks and functions recorded to analyze effectiveness towards agency goals and objectives.

The TOC management team is expected to coordinate as the agency lead on these metrics. Specific enhancement action item was covered above in the TOC management program area action item of integrating Pantel data into the TOCS for more robust TOC staff work load management.

#### MAJOR INCIDENTS WITH NO NOTIFICATION MESSAGE (ATIS) AND ALL EVENTS WITH NO NOTIFICATION MESSAGE

Both measures identify the number of major events that occur without an Advanced Traveler Information Systems (ATIS) message being available to the public via TripCheck.

The TOC management team is expected to coordinate as the agency lead. General action items for this metric are covered in the TOC management program area overview, above, and in the following Traveler Information program area section.

#### **CRITICAL STATION ON-TIME REPORT**

This measures records ODOT's performance in updating the road and weather conditions at critical stations

It is an established ODOT performance measure that is measured and reported. The TOC management team is expected to be the agency lead.



# TOC MANAGEMENT AUDIENCES

The main audiences identified for the TOC management program area performance measures are

- · TOC management team,
- TIM teams,
- Traveler information team, and
- ITS team.

#### **DELIVERY OPTIONS**

The reporting of TOC management performance measures is an established process for ODOT. As seen above, five of the six identified core performance measures already have reports that are created through SSRS 2014, Tableau, and PowerBI.

The ability to aggregate information into different views will be important in enhancing the existing reports in the future. This allows for communication of performance measurement at the individual TOC operator level, to the TOC level, to the regional level, and up to the state level.

### TOC MANAGEMENT COMMUNICATION ACTION ITEMS

For each action item, the TOC management lead ODOT unit should work with the ITS unit to fuse databases with coming dynamic Power BI, Tableau, or other big data visualization tools for custom reporting to meet desired messaging of resultant performance measures, for each core performance measure. The following are specific action item towards enhanced communication of TOC management performance measures:

#### MID-TERM

- ITS unit and ITS Operations Coordinator to assess the functionality of current reports and identify gaps or needs for future TOC core performance measure reports.
- Define and automate report that shows total events per year responded to by TOCs.
- Create dashboard for TOC managers showing high level measures with ability to drill down to specifics.
- Develop strategy for self-service data portal for road and weather information. Information included would be incident history, chain conditions, and road conditions.

#### **NEAR-TERM**

 Develop comprehensive report for listing historic roadway closure events.





#### MOBILITY

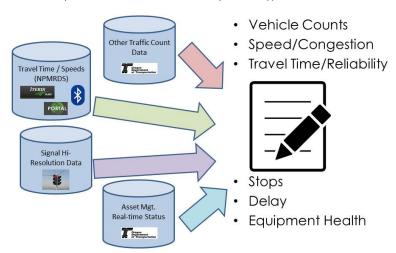
The core mission of ODOT's Operations Program is to provide safe and efficient travel. The TSMO performance measures within the Mobility program area reflect the core mission to plan for, implement, operate and maintain facilities that support efficient travel supporting the state's economy and quality of life. There are traditional data sources manually collected through groups like the ODOT Transportation Development Division (TDD), and there are many emerging data sources like HERE™ or Inrix<sup>™</sup> probe data, roadside Bluetooth<sup>™</sup> readers (ODOT ITS Unit), and advanced traffic signal controller's highresolution event-based signal performance measures (ODOT Traffic Section), and other traffic or weather sensors associated with TSMO systems. In addition, there are improved tools that are automating the processing of this data and turning it into information that enhances the capability of Operations staff to identify and address the mobility needs of the state's roadway users. Some of these tools include Iteris iPeMS $^{™}$ , through the ODOT Transportation Planning and Analysis Unit (TPAU) probe data contract), ODOT's internal data warehouse/business intelligence system, ODOT's new central signal system, and the PORTAL system operated by Portland State University (PSU).

Opportunities exist to enhance the availability and use of mobility performance measures by integrating the various, related data sources and blending them into a useful database(s) and reporting systems. **Exhibit 4** illustrates an example of the data fusion and thus cross-business line collaboration that is necessary to develop the envisioned, long-term comprehensive mobility program management capability within ODOT. These database sources (left-side) and the desired mobility "outcomes" (right-side bullet list) were identified through the national literature review and conversations with the system operations stakeholder group.

The evaluation of Mobility performance measures can show whether the system is running efficiently and reliably or if a project, or other system modification (i.e. change in signal timing), had the intended result. In addition to the Operations Program uses for the data, the measures are equally useful to transportation planners.

It is worth discussion that the TPAU along with the Performance Measure Chief, is taking on the "system performance/freight movement" mobility-related draft performance measures released recently by USDOT to be in compliance with both MAP-21 and the current FAST Act legislation, which is only applicable to the interstate and national highway system (NHS). This report will not be explicitly addressing these metrics.

**Exhibit 4.** Mobility Data Sources to be Fused in Mobility Database(s)





The desired outcome and objective of the Mobility performance management program is:

To support ODOT Operations staff with making day-to-day decisions about operation of traffic control systems and to inform planning for future system enhancements through improved understanding of trends and system performance.

When implementing and measuring the progress of the Mobility program area towards the above objective, there are four goals that should guide ODOT actions. The goals are the following:

- Promote efficient and reliable transportation system operations;
- 2. Metrics should be inclusive of auto, truck, pedestrian, bicycle and transit modes, as appropriate;
- 3. Improve accessibility of system operations data to support evaluation of transportation improvement (e.g. capital projects); and
- 4. Improve availability and accessibility of operations data to support transportation system planning (e.g. regional travel model calibration).



EXISTING PRACTICES

Mobility performance measures are currently conducted at ODOT through the ITS, TDS, Traffic, and TPAU units.

ODOT has been tracking and collecting data in an established reporting fashion to support program needs for:

- Traffic speed, volumes, and classification;
- Vehicle miles traveled;
- Facility and lane closures;
- Road and weather conditions, work zones; and
- Incidents.

These metrics support programs such as Traffic Incident Management (TIM), <u>Highway Performance Monitoring System (HPMS)</u>, ODOT planning, Traffic Operations and Investigations, and other <u>ODOT key performance measures (KPMs)</u>. These metrics have reports and applications for their respective performance measures.

ODOT's system operations stakeholder group has identified other existing mobility performance measures which are collected in ad-hoc, non-standard fashion, often using more than one data input, data output, and data application. These measures are often associated with newer automated reporting databases/tools, and thus establishing a more uniform approach to their collection and application within ODOT is very important:

- · Travel time and travel time reliability,
- Running speed (space-mean speed) and point speed (point-mean speed),
- Highway/arterial congestion (locations, magnitude, direction, and duration),
- Multi-modal delay (vehicles, pedestrians, bicyclists)
- Quality of signal timing (percent arrivals on green lights, vehicles waiting through more than one green light), and
- Health of traffic control infrastructure (traffic signals, traffic signal/ITS detection sensors, ITS communications, ITS gates, signage, striping).

Most of the data for the above metrics either is not available, available only in specialized cases or systems, or is in disaggregate databases. We will discuss this challenge further in the implementation section.

#### CORE MOBILITY PERFORMANCE MEASURES

The following "core" or most important mobility performance measures, shown in **Exhibit 5**, were identified for prioritization by the system management stakeholders through a series of workshops. The workshops presented an overview of national best practices, discussion forums on current ODOT practices, and where candidate measures were presented, discussed, and ranked for the most useful and actionable to enhancing the ODOT Mobility program. **Exhibit 5** shows which performance measures are currently reported (teal background) compared to those that will require

more effort to establish for the future (white background). Basic definitions of each core performance measure are also included.

**Exhibit 5.** Mobility Core Performance Measures

#### TRAFFIC VOLUMES Multi-modal traffic counts including autos, trucks, and transit. \*

# TRAVEL TIME Average and percentile travel times, temporally and spatially.

# HOURS OPERATING IN CONGESTED CONDITIONS Hours when

Hours when the average speed is slow or "congested" for the roadway.

# HOURS OF MULTIMODAL DELAY

Number of cumulative hours that drivers, trucks, and transit are delayed over the course of a specified time period.

### TRAVEL TIME RELIABILITY

Regularity or predictability of roadway travel time, often comparing freeflow, average, and 80th/95th percentile travel times.

#### PERCENT OF ARRIVALS ON GREEN LIGHT

Measure the quality of traffic light "progression" as a percentage of vehicles that arrive at a traffic signal on green (inverse is arrivals on red light).

\* The type and collection method of volume data varies across the state. Most of the system does not currently have continuous data. Pedestrian and bicyclist data is also not currently collected for a majority of the system.

EXISTING Performance Measures

**FUTURE Performance Measures** 

#### **IMPLEMENTATION**

The implementation plan for the recommended Mobility program area core performance measures incorporated feedback and guidance from the system management stakeholder and project steering

committee meetings. The following sections outline the data needs and sources, the current and future performance measures, and action items for each of the core program area performance measures.

# HIGHWAY DATA NEEDS AND SOURCES

ODOT highway performance measurement for mobility has largely centered around traffic volumes collected through <u>ODOT's traffic counting program</u>, largely using automatic traffic recorder (ATR), through TDD, and stored on the PTV TCM software database. This count database may change in the near future, so interoperability with ODOT's other performance management databases is critical as a requirement.

In ODOT Region 1, additional performance measure data is available on the freeway system due to wide-spread count, speed, and length-measuring (approximates truck volumes, speeds) sensors. This data is aggregated and shared with <u>PSU's PORTAL</u> system as both a data warehouse and performance measure visualization tool.

Region 2 had a pilot project to share similar freeway data from Eugene into PORTAL, but that project has not maintained momentum. Region 4 is planning on developing a data warehouse strategy to analyze and store counts and other performance measures data upcoming in 2017-18.

ODOT TPAU recently procured probe travel time, running speed, and travel time reliability data statewide as an enhanced version of the National Performance Management Research Data Set (HERE™), displayed through the <a href="Iteris iPeMS™ tool">Iteris iPeMS™ tool</a>. This tool is new, so TPAU and others are in the early stages of performance measure validation and establishing guidelines for using the tool as well as common applications. One unique element of this data source is the capability to distinguish freight metrics from auto metrics, useful for understanding this form of multi-modal performance. This promising data source could provide statewide input data to support the following core performance measures:

- Travel Time,
- Travel Time Reliability,
- Hours Operating in Congested Conditions, and
- Hours of Multi-Modal (truck v. auto) Delay

# ARTERIAL DATA NEEDS AND SOURCES

Arterial performance measures have long lacked uniformity or much comprehensiveness with respect to national practice. Interrupted flow, particularly along signalized corridors has posed a challenge. ODOT has invested resources through their ITS unit to develop a strong baseline of arterial performance measures through recent adaptive signal control evaluations. These metrics, coupled with emerging new technologies, provide promise for a more comprehensive view of arterial and traffic signal performance measures in the future.

The following core performance measures for arterials, along with potential data sources shown in parenthesis, have been identified with the system management stakeholder committee:

- Travel Time and Travel Time Reliability (Bluetooth<sup>™</sup>/WiFi, Iteris iPeMS<sup>™</sup>, Floating Car Method);
- Hours Operating in Congested Conditions, through speed (Bluetooth<sup>™</sup>/WiFi, Iteris iPeMS<sup>™</sup>);
- Hours of Multi-Modal Delay for vehicles, bikes, pedestrians (Advanced Traffic Controller, ATC Controller High-Resolution Event-Based Data and Signal Performance Measures Software); and
- Percent Arrivals on Green Light/Quality of Signal Timing (ATC Controller High-Resolution Event-Based Data and Signal Performance Measures Software).

A metric not listed as core in mobility, but having often a direct impact on arterial mobility is Traffic Signal Infrastructure Health, which would include performance measures of signal infrastructure and communications infrastructure uptime, time spent in

detector failure mode, age of infrastructure, age of signal timing plans, etc.

Outside of a smarter traffic signal controller, such as the advanced traffic signal

Other units outside of the ITS/TSMO group will lead the management and reporting for MAP-21 performance measures. controller (ATC); there are other emerging products which can do arterial performance measures with the technology in the sensor and/or another black-box within the signal cabinet (e.g. GridSmart™, Miovision™, Wavetronix™). ODOT will need to test products and determine where and how to collect automated performance measures within their arterials to meet various application needs.

Similar to the third-party probe (Iteris iPeMS $^{\text{TM}}$ ) tool, there are also emerging products through traffic signal central management systems or as standalone platforms, often in the "cloud", offering multi-modal performance measurement for mobility as a service. These data sources are newer, but with emerging capabilities (e.g. Econolite's Clarity $^{\text{TM}}$ ).

#### DESIRED, EXISTING, AND FUTURE PERFORMANCE MEASURES

Through a series of stakeholder meetings and management discussions, a list of existing and potential Mobility performance measures was created. **Table 4** shows all performance measures that were discussed through the process, stratified by the identified priority level: high, medium, or low (not necessarily a reflection of importance but feasibility to be implemented and useful to ODOT.) The table also separates those measures that are currently being collected (top half) from those yet to be consistently and accurately reported (bottom half). The list below is not considered comprehensive.

The rightmost column of the table identifies the seven relevant performance measures from the final FAST Act/MAP-21 rulemaking published in January 2017 (RIN: 2125-AF54, CFR: 23 CFR Part 490). It has been determined through stakeholder meetings and management discussions that other units outside of the ITS/TSMO group will lead the measurement and reporting for FAST Act/MAP-21 performance measures. Due to the close relationship between the FAST Act/MAP-21 measures and those identified as core Mobility performance measures in this plan, coordination and communication between those leading these two separate efforts will be important.

**Table 4.** Mobility Performance Measures

TSMO PRIOR LEVEL		нібн	MEDIUM	LOW	REQUIRED BY FAST ACT / MAP-21 Final Rulemaking (To be Led by Others)
ric?	Yes	Vehicle volume  Truck volume  Median travel time  Free flow travel time  95th percentile travel time  Planning Time Index	Turning movement counts  Average segment speed  Travel Time Index  Percent arrivals on green  Phase/split failures	Lane utilization  Average point speed  Planning time  Buffer time	
Current TSMO Metric?	No	Hours operating in congested conditions	Bicycle volume  Vehicle delay  Pedestrian delay  Bicycle delay	Average intersection delay  Average delay by movement or signal phase  Pedestrian volume  Stop frequency (% arrival on red)  Percent of Urban State Highways with bicycle lanes or dedicated bicycle facilities!  Percent of Urban State Highways with sidewalks or dedicated pedestrian facilities!	Percent of the person-miles traveled on the Interstate that are reliable  Percent of person-miles traveled on the Non-Interstate NHS that are reliable  Percent change in tailpipe CO2 emissions on the NHS compared to the calendar year 2017 level  Truck Travel Time Reliability (TTTR) Index  Annual hours of peak hour excessive delay per capita  Percent of non-SOV travel  Total emission reductions

**Bold performance measures** are identified as core performance measures in this program area.

There were 26 Mobility performance measures (excluding those from the FAST Act/MAP-21 final rulemaking) identified through stakeholder meetings and guidance from management, as seen in Table 4. Of the 26, ODOT has started to measure or is currently reporting 15 performance measures at a range of maturity levels. For example, data needed to measure and report on the Planning Time Index (PTI) is currently collected through HERE™, Bluetooth™ devices, and the recently acquired Iteris iPeMS™ data source. However, this data collection has not matured into a full performance measure that is reported in a widespread or uniform manner. This is the case for the majority of the 15 "current TSMO" metrics" identified in **Table 4**, where the applicable data is being collected but the process to produce analysis and reports for the performance measures has not been completed yet.

Of the 26 performance measures, seven have been identified as high priority and nine as medium priority. As seen above in **Exhibit 5**, those performance measures correlating directly to the "core performance measures" for mobility have been identified in **bold**, and should

be implemented first. For example, the core measure of "traffic volumes" is further stratified in the table above into vehicle volume, truck volume, bicycle volume, and pedestrian volume. Vehicle volume and truck volume are bolded as the first implementable measures of the core "traffic volumes" measure. As technology advances, more multimodal performance measures can be implemented. The core performance measures range in ease of implementation and level of effort necessary to establish within ODOT's system. Action plans for each core performance measure are further detailed in the sections below.

**Appendix A** contains further support materials for establishing mobility performance measures and an overview of the FAST Act/MAP 21 mobility rulemaking.

<sup>&</sup>lt;sup>1</sup>Identified as a legislative Key Performance Measure.

# MOBILITY PROGRAM AREA PERFORMANCE MANAGEMENT ACTION ITEMS

In addition to the action items listed below that relate to each individual identified core performance measure, there are several program area overarching action items that apply to all Mobility metrics:

#### **NEAR-TERM**

- Develop a TSMO plan to guide application and recommended practice for use of identified mobility performance measures in the larger agency program.
- Identify measurement gaps and address these gaps with new technology, sensors, or data sources.
- Identify funding streams and resource requirements.
- Begin initial reporting to management teams.

#### LONG-TERM

- Integrate or fuse data sources into a common analysis database and data warehouse for storage from all programs and units for mobility purposes. This will mean modifying an existing ODOT tool, creating a custom ODOT tool, or using an outside database tool (e.g. Iteris iPeMS<sup>™</sup>, Intelight<sup>™</sup>, PORTAL, etc.).
- Develop and implement a data validation program to regularly check/ground truth data sources for accuracy and usefulness for mobility purposes.
- Ensure ODOT has a program plan and perhaps pilot project to ingest broadcast messages from Connected and Autonomous Vehicles, defined in SAE J2735, such as the Basic Safety Message set, to leverage its information into useful performance measurement data (count, speed, weather, etc.).

As technology advances, more multi-modal performance measures can be considered for implementation.

# TRAFFIC VOLUMES - VEHICLE VOLUME, TRUCK VOLUME, AND TURNING MOVEMENT COUNTS

Traffic volumes are counts of specific users of a facility, whether personal vehicles, trucks, or cars making a specific movement along a facility segment or at an intersection.

Vehicle and truck volumes can be measured for both freeways and arterials. Turning movement counts can be measured for arterials only. The TDD and ITS/TSMO units are expected to act as the agency leads in the implementation stages. Enhancement of this measure would include the following action items:

#### **NEAR-TERM**

- Expand automated data sources through further implementation of data collection devices, such as ATR stations, ATC controllers, and detection sensors. Consider augmenting programmed capital and preservation projects to add count devices/systems.
- Identify stable databases and warehouses (e.g. current PTV TCM or replacement) to store and process count data into information and reports on highway / arterial trends and needs. Interoperability and ease of use should be emphasized.
- Explore ATC-driven arterial count software in traffic signal central management software (e.g. Intelight MaxView<sup>TM</sup>) and <u>Signal Performance Measures</u> <u>Software</u>. Modify if needed for visualizing/querying arterial traffic count data.

#### LONG-TERM

- Develop a data fusing automated tool to visualize and query traffic volume data across travel modes and facilities from multiple databases and sources.
   ODOT will need to collaborate to clearly identify needs and requirements to support the goals of the Traffic Counting Program, which may include blending of or replacement with third-party providers (e.g. Connected Vehicle big data set).
- Conduct pilot and/or research project(s) to test and validate accuracy and usefulness of various count technologies and third party data sources. Develop adjustment factors as needed to correct automated sources (e.g. ATC turning movement counts).

#### TRAVEL TIME - AVERAGE PEAK PERIOD, MEDIAN, FREE FLOW, AND VARIOUS PERCENTILES

Travel time is the number of minutes or hours it takes a vehicle to travel a certain road segment.

With the same data set, average, median, free flow, and various (e.g. 95th) percentile travel times can be calculated and reported. The travel time performance measures can be reported for both freeways and arterials. ODOT TPAU and ITS/TSMO units are expected to coordinate as the agency leads. Enhancement of this measure would include the following action items:

#### **NEAR-TERM**

- Develop reporting segments for desired travel time reporting routes on ODOT facilities.
- Develop consistent mobility analysis methodology to include the agreed-upon definitions for free flow speed and congested conditions.
  - Update processes and tools with the newly defined free flow speed: free flow speed equal to the posted speed limit.
  - Define congested conditions and distinguish degrees of congestion. Florida DOT uses 45 mph or below as "congested", but is applied to freeways only. It may be reasonable to tie the "congestion" threshold to a percentage of posted speed, (e.g. 50% of posted speed = congested).
- Conduct pilot project to gauge baseline travel time results over a minimum of six months of results and conduct comparative analysis to identify "top 10" best and "top 10" worst travel time segments in the state. Analyze correlating factors to results, such as bottlenecks, traffic volume, and grade, to identify actionable treatment solutions.

#### LONG-TERM

- Develop automated analysis and reporting processes for travel times along key routes. Establish travel time targets for the reporting routes. On interval, ground truth automated travel time for key segments (e.g. prior to project-based decisions).
- Increase the sample size and accuracy of travel time results through the fusion of added data sources and/or additional sensors.

### HOURS OPERATING IN CONGESTED CONDITIONS

The measure of hours operating in congested conditions is the number of hours of proportion or hours where measured speeds fall below a defined threshold for "congested conditions".

This measure is focused solely on freeways. ODOT TPAU and ITS/TSMO units are expected to coordinate as the agency leads. Implementation of this measure would include the following action items:

#### **NEAR-TERM**

- Conduct pilot project to gauge hours of congestion and degrees of congestion statewide on various routes, districts, regions, in order to set a baseline, which should be collected over six months at a minimum. Develop "top 10" worst and best hours of congestion comparison statewide.
- Continue to explore existing tools such as Iteris iPeMS<sup>™</sup> and PORTAL for data needs and potential reporting platforms and consider specific enhancement opportunities to make tools more useful for hours of congestion purposes, perhaps akin to the <u>RITIS visualizations</u>.

#### LONG-TERM

- Develop repeatable hours of congestion analysis methodology and report(s).
- Select a long-term tool or suite of tools/data sources to support statewide needs for probe data for travel time, speed, and origin-destination analysis.

#### HOURS OF VEHICLE DELAY

The measure of hours of vehicle delay is the number of cumulative hours that system users spend stopped or delayed in their travel during a defined time period.

This measure can be reported for both freeways and arterials, though arterials are the point of emphasis. ODOT TPAU is expected to coordinate as the agency lead. Implementation of this measure would include the following action items:

#### **NEAR-TERM**

- For arterials, expand implementation of ATC controllers and ATSPM software to measure and aggregate data.
- If needed, ground-truth validate ATSPM vehicle hours of delay for measuring and reporting. This could be accomplished through probe data sources that have been previously validated (for example Texas A&M Transportation Institute's Annual Urban Mobility Scorecard procedure), or other direct manual measurement.
- Conduct a vehicle hours of delay pilot using ATC controller event-data for ATPSMs and probe data (Iteris iPeMS™, Bluetooth™). Identify baseline and trends over a minimum of 6 months to gauge performance along key arterials. Look for causal factors between the different results across arterials or within an arterial (ATSPM data).

#### LONG-TERM

Automate reporting of hours of vehicle delay.
 Develop a "top 10 list" of locations with highest hours of vehicle delay overall and per vehicle.

It should be noted that medium priority performance measures for bicycle and pedestrian delay are important, but technology to support their direct measurement is not yet mature. A few pilot projects have been implemented within the state, but the visualization and consistency within the methodology is lacking. One mechanism is to approximate pedestrian or bicycle delay by comparing the time when detection is activated, such as pedestrian push button or exclusive bike facility detector, to the time when the pedestrian traffic signal phase or bicycle traffic signal phase receives a "go" indication.

Transit delay will require better collaboration between ODOT and transit agencies and their databases to collect and report on transit specific measures which contribute to calculating and reporting on transit delay. Transit stop delay would ideally be excluded from this report for ODOT's TSMO purposes.

# TRAVEL TIME RELIABILITY - PLANNING TIME INDEX AND TRAVEL TIME INDEX

Planning Time Index (PTI) is the ratio of 95th percentile travel time to free flow travel time, conveying the total amount of time to plan for a trip due to variances. Because the free flow travel time (approximated as the posted speed over the route length) is a uniform or constant value, the PTI is considered a better representation of travel time reliability across multiple time periods and locations due to its single dependent variable (95th percentile travel times).

Travel Time Index (TTI) is the ratio of peak period average travel time to free flow travel time. Travel time reliability measures can be reported for both freeways and arterials.

ODOT arterial evaluations using Bluetooth™ travel time readers, located at intersections has revealed some nuances with respect to arterial travel time reliability metrics using the 95th percentile travel times, which are often associated with non-through movements (e.g. side-streets or mainline left-turns). This should be accounted for when relaying travel time reliability metrics such as PTI, TTI, and Buffer Time. This is believed to be a non-factor for other probe data sources which are constrained to links/traffic message channels, such as HERE™, Iteris iPeMS™, or even Bluetooth™ on freeways.

ODOT TPAU is expected to act as the agency implementation lead. Enhancement of this measure would include the following action items:

#### **NEAR-TERM**

- Develop consensus through discussion and/or testing of desired travel time reliability methodology(s), inclusive of analysis periods. Document guidelines to encourage uniform practice so that the metrics can be compared across projects, corridors, and geographic areas of the state. Recommendations are:
  - Establish free flow travel time as the travel time at posted speed to traverse the study segment length.
  - Collect and report on PTI for all segments and projects at a minimum so that reliability can be gauged across locations, as well as familiarize staff with PTI results and degree of unreliability.
  - Conduct additional study into the effect of side-street and left-turn traffic (which has longer delays) at signalized intersections and their impact on 95th percentile travel times.
     Potentially consider using 85th percentile or other percentile travel times or different outlier filtering for probe data, if one desires through traffic travel time reliability.

- Establish key travel time routes to regularly measure travel time reliability. Develop pilot comparison test of travel time reliability across interstate and the national highway system in Oregon to establish a solid performance baseline. Prepare a "top 10" worst and best list of routes for travel time reliability and conduct causal analysis to determine contributing factors and candidate solutions/treatments.
- Report on reliability on key routes for holidays and special events (e.g. US 20 in Sisters for the 4th of July, Interstate-5 for University of Oregon or Oregon State University home football games).

#### LONG-TERM

 Establish statewide methodology for automated reporting of travel time reliability measures. Maintain and update ranked list of travel time reliability segments for comparative performance. Link to programmed or aspirational candidate projects to improve travel time reliability.

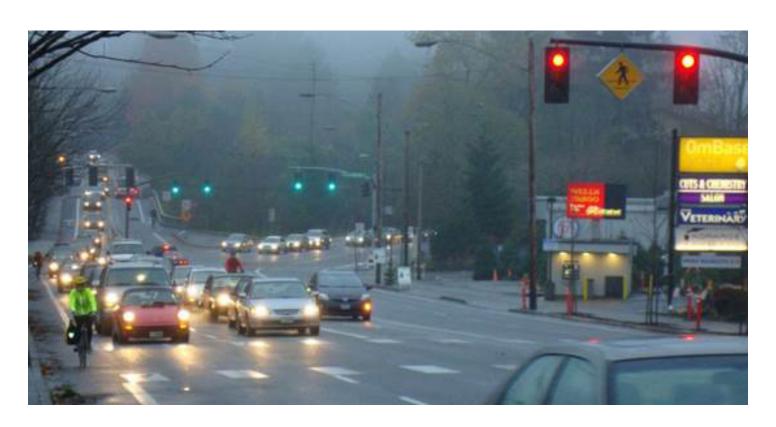
#### QUALITY OF TRAFFIC SIGNAL TIMING - PERCENT OF ARRIVALS ON GREEN LIGHT & PHASE/SPLIT FAILURES

ODOT identified two primary performance measures to support the discernment of the quality of traffic signal timing & operations:

- Percent Arrivals on Green (Purdue Coordination Diagram) and
- 2. Events where queued traffic waits through more than one green light (Purdue Split Failures)

These are based on extensive national traffic signal timing and evaluations, in combination with best practices from Utah DOT, Indiana DOT and Purdue University, and system management stakeholder group discussions. Use of these and other supporting metrics AS A STARTING POINT will allow ODOT Traffic and ITS unit to focus staff and infrastructure resources at the most problematic locations before deciding about signal retiming or maintenance efforts. Use of these ATSPMs should reduce the guesswork out of longitudinal traffic signal performance management.

The TSSU and Regions units are expected to coordinate as agency leads for these measures.



#### PERCENT ARRIVALS ON GREEN

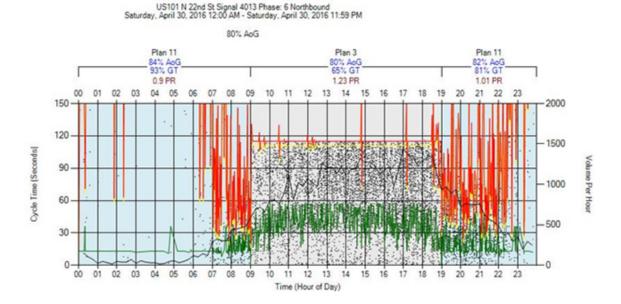
Percent arrivals on green are the number of user actuations on green traffic signal indication, expressed as a percentage of actuations over time.

When coupled with the proportion of green time allocated, one can calculate the platoon ratio, percent of arrivals on green to percent of green time for that movement. Values in excess of 1.0 indicate a productive use of green time and quality of progression in general. The percent arrivals on green should have a direct impact on delay experienced at the intersection for that movement. Purdue University established a popular visualization chart, shown in Exhibit 6, known as the Purdue Coordination Diagram, mapping vehicle actuations over a sensor for a movement to the traffic signal indication (red, yellow, or green) across all times of day, so that the proportion of arrivals on green can easily be determined. These results can be contrasted with overall traffic signal timing and arterial operation objectives (see Traffic Signal Timing Manual, Chapter 2) to determine if action is needed to adjust signal timing or address faulty infrastructure (e.g. broken detection).

The inverse to percent arrivals on green is percent arrivals on red, which are equivalent to stops for that movement. Percent arrivals on red directly impacts delay and emissions along an arterial and should be considered as a secondary metric.

**Exhibit 6.** Purdue Coordination Diagram, US 101 Lincoln City, OR (ATSPM Software)



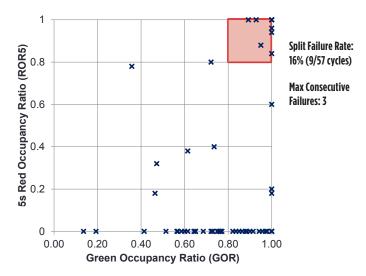


#### **PURDUE SPLIT FAILURE**

Phase/split failures occur when queued vehicles must wait through more than one green indication to proceed through an intersection.

This is approximated in a clever fashion with the Purdue Split Failure metric, which plots the percent occupancy of a stop bar detector on green (GOR) and the percent occupancy of the same stop bar detector on the first 5 seconds of red (ROR<sup>15</sup>), as shown in **Exhibit 7.** 

**Exhibit 7.** Purdue Split Failure Diagram, ATSPM Presentation, Dr. Darcy Bullock



The user can identify the threshold of GOR and RORt5 to classify as a problematic movement (Indiana DOT and Purdue propose an 80% threshold for each). The selected value will need to take into consideration contributing causes, if green time can be reallocated to help, and if the location is in fact controlling or critical to corridor operations.

#### Enhancement of these measure, would include the following action items:

#### **NEAR-TERM**

- Expand implementation of ATC controllers and software to measure and aggregate quality of signal timing data.
- Create performance measure that tracks regions deployment of the latest traffic signal controller (roadside computer) technology, Linux Advanced Transportation Controllers (ATCs)
- Develop baseline metric results across pilot corridors to compare typical results for arterials at various levels of congestion. Identify proportion of conditions where signal timing detection may be broken.
- For at least one corridor, ground-truth automated ATSPM software results with another data source (e.g. video/manual observation) to validate ATSPM tool.
- Develop implementation guidance for arterial ATSPMs, inclusive of detection design, prioritization of metrics for different arterial issues (e.g. red light running versus bad progression).
- Validate and monitor in real-time detector and communication health for measurement locations to collect and transport data.
- Create an inventory of intersections without communications.

#### LONG-TERM

- Automate the reporting of these measures, including alerts triggered to send to ODOT Traffic or signal managers/staff when unusual conditions occur.
- Develop baselines for typical conditions and recommended thresholds and target goals. Develop "top 10" list of split failure locations statewide on the national highway system. Develop "top 10" list of poorest percent arrival on green for coordinated movements along the national highway system. Use these metrics as indicators to drive action to address poor arterial operations and tell the story to ODOT decision makers.



#### MOBILITY AUDIENCES

The main audiences identified for the Mobility program area performance measures are

- · Region and statewide traffic units,
- Planning and Policy,
- Transportation Data Section,
- · ITS unit,
- TSSU,
- District maintenance staff, and
- Statewide and Region Leadership Teams.

#### DELIVERY OPTIONS

Through stakeholder meetings, it was highlighted that there should be different "views" for each data set or performance measure. This would allow for staff, managers, and decision makers to access the graphic or information that would be most actionable for their respective jobs. Where a decision maker might need a snapshot of the statewide performance to make budget decisions, a traffic signal engineer might need a more detailed view of a corridor or individual signal's performance. It is recommended to set measure methodologies to allow for data to be aggregated up to higher levels and support all audience levels.

Several reporting tools, both existing and newly acquired, can be expanded to visualize data and performance measures statewide through interactive maps and dashboards. A dashboard is also one way to provide several views of the same information or provide the ability to drill-down or aggregate information to different audience level views. Example dashboards that could be expanded on by ODOT are Bluetooth<sup>TM</sup> software, PORTAL, HERE<sup>TM</sup> probe (Iteris iPeMS<sup>TM</sup>) platforms, ODOT central management software (TransSuite<sup>TM</sup> and Intellight MaxView<sup>TM</sup>) and the Signal Performance Measures (ATSPM) software.

When creating performance measures reports and dashboards, it is recommended to make all definitions and targets clear.

### MOBILITY COMMUNICATIONS ACTION ITEMS

For each action item, the lead ODOT unit should work with ITS unit to fuse databases with coming dynamic Power BI, Tableau or other big data visualization tool for custom reporting to meet desired messaging of resultant performance measures, for each core performance measure.

#### MID-TERM

- Create mobility performance measurement task force: Develop a task force with membership from ITS, Traffic Unit (which includes headquarters and Regions), TPAU, TDS, and potentially one external MPO stakeholder. Task force will develop a work plan and disseminate information and products to various stakeholders and leadership teams.
- Mobility Performance Measures yearly report to management teams and public: Implement a pilot project to define and develop a yearly mobility performance measure report. While the final detailed requirements need to be vetted by the mobility performance measurement task force and others, the intent of this yearly report is to highlight mobility accomplishments and challenges. Existing reports and efforts like the Washington DOT Gray Book and Region 1 corridor capacity report should be referenced as similar products.
- ITS unit and TDD to identify traffic count report needs and requirements for modifying existing tool or procuring new count reporting tool. Discuss counting reporting and visualizations with Traffic group to potentially fuse:
  - "Pedestrian phase actuations",
  - Bike lane counts or bike count technologies, and
  - Intersection turning movement counts (e.g. ATSPM, MaxView<sup>™</sup>, GridSmart<sup>™</sup>).

Count graphics should start as a report, perhaps growing into a summary dashboard. These may be separated by mode or fused as multi-modal. Exploration into off-the-shelf products as inspiration may prove beneficial (e.g. RITIS, Iteris iPeMS $^{\text{TM}}$ , Inrix $^{\text{TM}}$ ).

- TPAU to lead assessment of Iteris iPeMS<sup>™</sup> reporting capabilities and summarize usefulness for core performance measures identified, such as travel time, reliability, and travel speed. TPAU should also communicate additional reporting or dashboard enhancements desired in the form of requirements.
- Traffic group in central office or Region should lead an assessment of ATSPM reporting capabilities through traffic signal central management software (Intelight MaxView™, TransSuite™) and ATSPM software. Traffic should also communicate additional ATSPM reporting or dashboard enhancements desired in the form of requirements.

# TRAVELER INFORMATION



ODOT has developed a full suite of traveler information systems that provide critical information to the traveling public. Travelers can make better traveling choices, based on information from ODOT's traveler information systems, by being able to select safer routes and avoid adverse weather and road conditions. This program is particularly important to the state's trucking industry, supporting freight mobility, on-time delivery, and a vibrant Oregon economy.

TSMO performance measures for traveler information are largely reflective of these general areas:

- Resource use (call volume, website hits), which reflects the usefulness of the data,
- Timeliness of data updates (Advanced Traveler Information Systems (ATIS) updates within a threshold),
- Accuracy of data, and
- · Accessibility of data.

Active measurement of the effectiveness of these components allows it to assess its performance relative to internal goals, objectives and policies, and national peers. National peers are experimenting with new mediums and procedures as they evolve from a phone-based 511 system to things more web-based and ondemand for customers. Performance measures and implementation procedures should be flexible enough to capture metrics from a variety of sources.



The desired outcome and objective of the Traveler Information performance management program is:

Collect, analyze, and summarize performance measures which effectively measure ODOT's ability to communicate accurate, timely, and relevant information to the traveling public, promoting safe and efficient travel.

There are two goals that should be used to guide ODOT and partner agency actions when implementing and measuring the progress of the Traveler Information program area toward the above objective. The goals are the following:

- 1. Ensure the program is delivering accurate and timely information to the traveling public; and
- 2. Provide information to management, leadership teams, and the legislature regarding trends in viewership and use of the various Traveler Information services.

Traveler information is particularly important to the State's trucking industry and supporting a vibrant Oregon economy.



ODOT provides traveler information in multiple formats, allowing users to determine the method best suited to their situation. Some of those formats are:

- Website, including TripCheck.com, TripCheck TV, and TripCheck Mobile;
- Phone (511);
- · Social media (Twitter); and
- TripCheck Traveler Information Portal (TTIP).





### CORE TRAVELER INFORMATION MEASURES

The following "core" or most important traveler information performance measures, shown in **Exhibit 8**, were identified and prioritized through a series of stakeholder workshops. The workshops presented an overview of national best practices and current ODOT practices. Candidate measures were also presented, which were discussed and ranked using criterion of most useful and actionable to enhancing the ODOT Traveler Information program. **Exhibit 8** shows which performance measures are currently reported (teal background) compared to those that will require more effort to establish for the future (white background). Basic definitions of each core performance measure are also included.

**Exhibit 8.** Traveler Information Core Performance Measures

# NUMBER OF PEOPLE VISITING ODOT COMMUNICATION OUTLETS

Measures usage of ODOT traveler information resources, such as TripCheck, 511, and social nedia (TwitterTM, WazeTM).

### MAJOR INCIDENTS, CONSTRUCTION WITH NO MESSAGE (ATIS)

Time from crash reported to notification made available for the traveling public. ATIS stands for Advanced Traveler Information

ATIS NOTIFICATION

**DELAY** 

# CRITICAL STATION ON-TIME REPORT

On-time
performance for
updating road and
weather conditions
(most critical in
winter operations
or major events).

### INFORMATION ACCURACY

Validation program of data accuracy for quality assurance.

XISTING Performance Measures

**FUTURE Performance Measures** 



### **IMPLEMENTATION**

The implementation plan for the recommended Traveler Information program area incorporates feedback and guidance from the stakeholder meetings and management discussions.

### DATA SOURCES AND NEEDS

The existing Traveler Information data sources reside in the agency's databases. In addition to these sources, data validation sources are a main need for the program. Waze data and other third party data sources are one potential way to validate or even replace other traveler information data sources.

### DESIRED, EXISTING, AND FUTURE PERFORMANCE MEASURES

Through a series of stakeholder meetings and management discussions, a list of existing and potential Traveler Information performance measures was created. **Table 5** shows all performance measures that were discussed and stratified by feasibility and usefulness to ODOT: high, medium, or low. The table also separates those measures that are currently being collected (top half) from those yet to be consistently and accurately reported (bottom half).

There were 13 Traveler Information performance measures identified through stakeholder meetings and guidance from management, as seen in **Table 5**. Of the 13, ODOT has started to collect data or is currently reporting six performance measures at varying maturity levels.

In **Table 5**, "Core performance measures" for traveler information have been identified in **bold**, and should be implemented first.

**Table 5.** Traveler Information Performance Measures

TSMO PRIORITY LEVEL		нібн	MEDIUM	LOW
Current TSMO Metric?	Yes	Visits to TripCheck  Calls to 511  Lane blocking events with no ATIS message	ATIS delay  Critical Station On-Time Report	Percent of events reported to the public through TripCheck
	No		Frequency of traveler info updates during an incident  Social media metrics  Average response time to inquiries  Information accuracy	Percent of construction events that haven't been updated in over a week

**Bold performance measures** are identified as core performance measures in this program area

# TRAVELER INFORMATION PROGRAM AREA PERFORMANCE MANAGEMENT ACTION ITEMS

There are several program area overarching action items that apply to all Traveler Information metrics:

### **NEAR-TERM**

- Leverage existing data sources and reporting systems to continue current metrics: Number of People Visiting ODOT Traveler Information products, Major Incidents with No Notification Message (ATIS), and ATIS Notification Delay.
- Develop dashboard and reports for storm reporting during and immediately after events
- · Link TripCheck usage report to Inview.
- For a more complete picture of social media engagement and penetration, coordination with ODOT communications teams and Ask ODOT to report how many retweets
- Define specific metrics surrounding "number of people/citizens", "users" and "machines/devices" and "organizations".
- Create a pilot project to test the potential use of Waze<sup>™</sup> and/or statewide Iteris iPeMS<sup>™</sup> HERE<sup>™</sup> probe data analytics tool for data validation to address CFR 23 511 for data accuracy, as well as statewide data coverage.
- Implement TTIP API to allow tracking of partner usage of TTIP data. Google/Waze may have two million users ODOT has not captured directly, but who are actually using ODOT data.
- Develop an hourly report that tracks traveler information updates (ATIS) during events.
- Develop report that tracks mean time between updates to lanes impacted or impact update and ATIS notification

### LONG-TERM

- Implement and document the procedure to use Waze<sup>™</sup> or other useful third party data source for data validation and coverage (CFR 23 511) across the state.
- Continue to develop and expand TTIP API to allow tracking of partner usage of TTIP data.
- Compare the time difference in time first reported and incident clearance between Waze<sup>™</sup> reported events and TOC events.
- Identify way to track which images are being hot linked from TripCheck servers, or displayed on TripCheck TV, in order to drive priority level for camera repair

## NUMBER OF PEOPLE VISITING ODOT TRAVELER INFORMATION OUTLETS

This measure is an established ODOT performance measure that is measured and reported. The ITS unit is expected to be the agency lead.

# MAJOR INCIDENTS WITH NO NOTIFICATION MESSAGE (ATIS)

This measure records the number of major incidents that do not receive a notification through Advanced Travel Information Systems (ATIS).

If all procedures and processes are followed, this measure should equal zero. It is an established ODOT performance measure that is measured and reported. The ITS unit is expected to be the agency lead.

### ATIS NOTIFICATION DELAY

ATIS notification delay is the time from incident verification to when an ATIS message is made available to the public through ODOT Traveler Information outlets.

The ITS unit is expected to be the agency lead.

### **CRITICAL STATION ON-TIME REPORT**

This measure records ODOT's performance in updating the road and weather conditions at critical stations.

It is an established ODOT performance measure that is measured and reported. The ITS unit is expected to be the agency lead.

### INFORMATION ACCURACY

Information accuracy measures the validity of the information provided to the public through duplicate sets of data from different sources.

The ITS unit is expected to be the agency lead.



The main audiences identified for the Traveler Information program area performance measures are:

- ITS unit,
- FHWA,
- · Communication unit,
- · TOCS dispatch and management teams, and
- District and crews responding to incidents and road and weather reports.

### **DELIVERY OPTIONS**

Through stakeholder meetings, it was highlighted that there should be different "views" for each data set or performance measure. This would allow for staff, managers, and decision makers to access the graphic or information that would be most actionable for their respective jobs. Where a decision maker might need a snapshot of the statewide performance to make budget decisions, ODOT staff needs a more detailed view of the traveler information performance. It is recommended to set measure methodologies to allow for data to be aggregated up to higher levels and support all audience levels.

# TRAVELER INFORMATION COMMUNICATIONS ACTION ITEMS

For each action item, the lead ODOT unit should work with the ITS unit. The following are specific action items towards enhanced communication of traveler information performance measures:

### MID-TERM

- ITS unit and Traveler Information program coordinator to assess the functionality of current reports and identify gaps or needs for future core performance measure reports.
- More web based interfaces for cross-outlet portability and scalability.
- Push and Pull reports: email static PDF reports, text alerts, and notifications versus dashboard views, and custom reports/infographics.
- Work with ITS manager and other key stakeholders and develop tool and methods to disseminate "Google Analytics™-style" dashboards for easy access and viewing without google account.

Ease of use and clarity for the traveling public is very important for the traveler information program area.

# ASSET MANAGEMENT



The purpose of asset management programs is to effectively monitor and manage assets over their lifecycle. Effective asset management programs are able to monitor overall asset condition trends and assist with identifying critical investment needs from both a maintenance and capital program perspective. ODOT asset management for TSMO assets varies in maturity across the TSMO asset categories with none of the asset categories considered fully mature. The performance management plan will assist in leading the agency towards a comprehensive, proactive TSMO asset management program by defining the asset management measures that are necessary for effectively managing the program. Useful and implementable asset management performance measures will greatly aid in prioritizing maintenance and capital project resources and making the business case for necessary funding level to keep the state's valuable TSMO assets in acceptable condition.

**Table 6** summarizes how ODOT categorizes its TSMO assets. While there are many different groups responsible for various aspects for the TSMO asset management program, the table also summarizes the primary resources responsible for program management and for maintenance. Program management means responsibility for overall asset management and investment strategy. Maintenance responsibility means day to day responsibility for keeping the asset category in operational condition.

**Table 6.** ODOT TSMO Asset Categories

CATEGORY	EXAMPLES	PROGRAM MANAGEMENT	MAINTENANCE
ITS	VMS, Drum signs, RWIS, HAR, Remotely operated gates	System Operations and ITS	TAD/TSSU
Traffic Signals	Traffic Signals, ramp meters, beacons	Traffic - Roadway	Region Electrical
Signs	Major and minor road signs	Traffic - Roadway	Region Sign
Communications	Routers, Switches, Cellular routers, wireless Ethernet radio	System Operations and ITS	TAD and ET
Illumination	Highway and Tunnel lighting	Traffic - Roadway	Region Electrical
Traffic Structures	Major support structures for traffic control equipment	Traffic - Roadway	Region Bridge Crews
TSMO Software	Central software systems, servers	System Operations and ITS	TAD



The desired objectives of the TSMO asset management performance management program are:

- Monitor and report on trends in TSMO asset condition;
- During the statewide transportation improvement program (STIP) update process, provide region staff data on TSMO asset related capital project needs;
- Use system data to proactively identify system maintenance needs; and
- Provide accurate inventory (e.g. count, classification, install dates and location) information about TSMO assets.





Existing practices vary across the TSMO asset categories. ODOT has a statewide asset management software tool (MicroMain™), which is largely used for asset management and work order

management for ITS. This tool has the capability to do certain TSMO asset management functions like:

- Asset Location,
- Asset Attributes,
- Asset Condition,
- Work Order History, and
- Labor hours per asset.

ODOT is currently using this tool in a comprehensive manner for ITS asset management and is currently working toward implementing the tool for traffic signals. Traffic signal inventory data is also currently kept in the Traffic Signal Information System (TSIS) database. Asset data for some signals is also kept in central signal system databases. A more comprehensive strategy for Traffic Signal asset management is needed. ODOT maintains a comprehensive sign database which is integrated into ODOT's Transinfo system. Certain IT assets are tracked in a separate IT work order management system called Remedy. ODOT also maintains a separate inventory of traffic structures. Software inventory is kept in a software maintenance work order system called Request for Work (RFW). No inventory of illumination exists.

While the fact that there are multiple inventory systems isn't necessarily a problem, what is missing is a consistent strategy for the performance measures necessary to manage the TSMO program effectively. Across all TSMO asset categories, a method to measure and report on trends related to asset condition is needed.



### CORE ASSET MANAGEMENT MEASURES

The following "core" or most important TSMO asset management performance measures, shown in **Exhibit 9**, were identified for prioritization by the system operations manager & TOC manager stakeholders through a series of workshops. The workshops presented an overview of national best practices, discussion forums on current ODOT practices, and exercises to present candidate measures, discuss, and rank those considered most useful and actionable to enhancing the program. **Exhibit 9** below also distinguishes those which currently are being reported (teal background) from

TRAFFIC SIGNALS

REMOTELY

**MONITORED** 

Number and

percentage of trafic signals

remotely monitored via communication link (ideally with automated selfreporting).

those which are future and require more effort to implement.

**Exhibit 9.** Asset Management Core Performance Measrures

T	SMO	ASS	ET
INV	ENT	ORY	AND
	LOC	ATIO	N

LABOR HOURS PER ASSET	ASSET CONDITION AND SITE RATING	PERCENTAGE OF ASSETS BEYOND
For ITS and Traffic	Custom rating	SERVICE LIFE
Signals.	based on	
	several asset	
•	characteristics	
•	including asset	
	age, inspection/	
	testing and	
	maintenance	
	request frequency.	
•		• •

### PERCENT DETECTION MALFUNCTION

Percent of time when TSMO detection is malfunctioning.

**EXISTING Performance Measures** 

**FUTURE Performance Measures** 

### MPLEMENTATION

The following sections outline the data needs and sources and the current and future performance measures.
Action items are identified for the core program area performance measures, based on feedback and guidance from the

stakeholder meetings, and steering committee discussions.

### DATA NEEDS AND SOURCES

Most TSMO assets are a part of a dynamic system, with multiple points of failure, and in some cases requiring a specialized knowledge base to maintain and operate. It is difficult to summarize the data needs and sources for such a broad range of TSMO assets. In general terms, the agency needs proactive, accurate, and effective information on the asset's lifecycle. There needs to be a robust inventory complete with locations and sufficient details.

There also needs to be a consistent process developed to assess asset condition with a rating to determine (1) design life and (2) estimated life remaining, so that true cost of ownership can be discerned, along with programming for repairs/replacement, maintenance needs, and staff monitoring purposes.

Sources for TSMO asset management should be automated to the extent possible and kept in an

enterprise database, consistent platform to promote interoperability and data access. Potential sources for asset management data gathering include:

- Staff preventative maintenance (PM's) or reactive maintenance,
- · Agency work order management software,
- Software or systems for active alert/alarms for failures or status updates.
- Proactive inventorying or assessment effort(s), or
- Network monitoring software.

**Table 7.** Asset Management Performance Measures

TSMO PRIORITY LEVEL		нібн	MEDIUM	LOW
Current TSMO Metric?	Yes	Asset inventory Asset location Labor hours		
	No	Asset condition and site rating  Percent asset beyond service life  Total or percent asset downtime (ATM, VMS & Drum Signs; Signals, Communication)  Traffic signals remotely monitored  Percent detection malfunction	Percent proactive maintenance (ATM, VMS & Drum Signs; Signals)  Percent of signs meeting retro reflectivity goals  Percent of illumination beyond service life  Structure rating (Traffic Structures)	

**Bold performance measures** are identified as core performance measures in this program area.

### DESIRED, EXISTING, AND FUTURE PERFORMANCE MEASURES

Through a series of stakeholder meetings and management discussions, a list of existing and potential TSMO asset management performance measures was created. **Table 7** shows all performance measures that were discussed through the process, stratified by the identified priority level, high, medium, or

low (not necessarily a reflection of importance, but a reflection of usefulness and ability to act on the metric). The table

The majority of identified core asset management performance measures are not mature or currently non-existing.

fulness and ability to act n the metric). The table also separates those metrics currently being collected on the top half, while those yet to be consistently and accurately reported shown on the bottom half.

There were 13 TSMO asset management performance measures identified through stakeholder meetings and guidance from management, as seen in **Table 7**. ODOT has started to measure or is currently reporting only the asset inventory, location, and labor hours per asset metrics. The "core performance measures" shown in **bold** have been identified as core performance measures and should be implemented first.

### ASSET MANAGEMENT PROGRAM AREA PERFORMANCE MANAGEMENT ACTION ITEMS

There are several program overarching acion items that apply to all asset management metrics:

### **NEAR-TERM**

- Develop and implement a comprehensive strategy for managing Traffic Signal inventory data that minimizes duplication across the various systems (Micromain, TSIS, Central System, ADA) that utilize traffic signal inventory data.
- Develop a methodology for calculating and reporting average, newest, oldest, and percentile asset age by asset category as a proxy for condition rating until a condition rating methodology can be implemented.
- Develop a report showing network infrastructure that is at or beyond expected service life.
- Develop a report showing ITS assets beyond their expected service life.
- Develop a report showing percentage of traffic signals that are remotely monitored.
- Evaluate traffic signal central management software (MaxView<sup>™</sup>) capabilities for automated detector health and reporting capabilities (for core measure).
- Investigate whether or not the retro-reflectivity data gathered for ODOT's sign inventory can be used as a condition rating indicator.
- Create inventory of signals with and without communications.



#### MID-TERM

- Develop a condition rating methodology for traffic signals and directly related signal assets.
- Develop a condition rating methodology for ITS assets.
- Develop a report showing average percentage up time for specific asset classes and systems as a way of measuring and monitoring system reliability.
- Develop a report that evaluates performance goal on detector health.
- Develop a report that automates the STIP splits spreadsheet.

#### LONG-TERM

- Investigate the availability of bridge inspection reports for major traffic structures to use for reporting condition of major traffic structures.
- Develop an inventory for illumination assets.
- Percentage of proactive maintenance (not a core measure at this point).
- Develop a report that lists communications failures (data from solar winds, central system, and others).
- Develop asset management tool for communications infrastructure (i.e. underground conduit, fiber, etc.).



# ASSET MANAGEMENT AUDIENCES

The main audiences identified for the Asset Management program area performance measures are

- · ITS unit,
- Maintenance and Operations unit,
- Traffic signal systems unit,
- · Region and statewide traffic units,
- · District and Region Maintenance Managers,
- · Region Electrical Managers, and
- Traffic operations leadership team.

### **DELIVERY OPTIONS**

Through stakeholder meetings, it was highlighted that there should be different "views" for each data set or performance measure. This would allow for staff, managers, and decision makers to access the graphic or information that would be most actionable for their respective jobs.

MicroMain is the current, most utilized central database and asset management software. Current asset reports are built in SSRS (SQL Server Reporting Services) Report Builder 3.0. As stated in the implementation plan, ODOT needs to identify the specific needs, gaps, and enhancements to create or enhance a TSMO asset management tool to meet their needs. For example, it's possible that Intelight or other software provider could create an asset management specific tool for the TSMO business lines, which could work on tablets to support easy submission of electronic data entry during PMs or trouble calls, as well as link eventually to automated summary reports. A consistent software platform, with definitions and core performance measures identified will allow for a clear understanding of TSMO asset management. These reports should tell a story on performance and highlight areas of change for which action is needed.

## ASSET MANAGEMENT COMMUNICATIONS ACTION ITEMS

For each action item, the lead ODOT unit should fuse databases with Power BI, Tableau or other big data visualization tool for custom reporting to meet desired messaging of resultant performance measures, for each core performance measure. The asset management reporting must clearly identify useful trends to assist in resource/budget allocations, such as the STIP process.

### MID-TERM

- Improve awareness and accessibility of TSMO asset reports for ODOT regions during the STIP development process.
  - Develop list of potential TSMO asset replacement needs for regions on STIP development cycle.
- Develop operations program funding needs report based on asset conditions.
- Automated connection of asset data to Enterprise GIS/TransGIS to provide updated GIS layers for TSMO assets.
- Develop annual TSMO asset report that highlights trends and challenges associated with assets.



# WORK Management



Work Management is necessary to understand the balance between labor and workload needed to manage the TSMO program and its assets. The performance measurement through this program area provides leadership with guidance for staffing and funding decisions as well as providing the ability to forecast needs in the future.

Work
management
is necessary
to understand
the balance
between labor
and workload.



The desired outcome and objective of the Work Management performance management program is:

Collect, analyze, and effectively communicate metrics which improve ability to make efficient and timely staffing decisions and measure performance against level of service targets for completed work tasks and requests.

There are four goals that will guide ODOT actions when implementing and measuring the progress of the TOC management program area toward the above objective. The goals are the following:

- Ensure management staff has access to accurate and timely information about work load backlog to effectively make staffing decisions and facilitate decisions about work order priorities;
- 2. Link the ITS/TSMO tracking systems to the ODOT timecard systems;
- 3. Measure performance against work order completion time targets; and
- Provide information to forecast future labor and budget needs as the quantity of TSMO assets continue to grow.



To manage an efficient and safe transportation system, ODOT has implemented several systems to help keep track of requests for work, work order backlog, and work activity. ODOT's IT

staff utilizes both a Request for Work (RFW) System and Team Foundation System (TFS) for tracking future work items which means that work orders for TSMO software systems is split and in some cases duplicated across two systems. The RFW system does track work orders by work order priority. Report capability is not yet mature, but possible report capabilities include:

- Work order backlog by priority,
- Average work order completion by priority,
- Work order backlog by system, and
- Work order completion by employee over a specified time period.

Micromain is the work order system used by ITS Field Maintenance staff. Micromain tracks preventative maintenance work orders in addition to repair work orders. Micromain also tracks work orders by work order priority. Recently, ODOT electrical crews have initiated a process to implement Micromain for traffic signal maintenance work. Existing reports available using Micromain data include:

- Total labor hours per asset,
- Preventative maintenance complete,
- Average hours by asset by region, and
- Work order backlog for ITS Field Maintenance, by assigned employee, and by shop.

Although at a fairly high level, ODOT captures maintenance information about other TSMO assets such as signs and illumination in its Maintenance Management System. The system does not track data at the asset level but instead tracks data about labor hours and costs broken down by activity and highway segment.

### CORE WORK **MANAGEMENT MEASURES**

The following "core" or most important Work Management performance measures, shown in Exhibit 10, were

identified for prioritization by ODOT stakeholders through a series of workshops. Exhibit 10 below also contains a basic definition of each identified core performance measure and distinguishes those which currently are being reported (teal background) from those which are future and require more effort to implement (white background).

**Exhibit 10.** Work Management Core Performance

### CURRENTLY **ASSIGNED WORK ORDERS BY EMPLOYEE** Number of

### **RECENTLY CLOSED REQUESTS FOR** WORK recently closed Requests for Work per week.

## **WORK ORDER BACKLOG** Requests for Work that are open in

# TIME TO COMPLETE : **PRIORITY IT** REQUESTS

Duration of time between issuance of priority IT work requests to closing of work request.

### CENTRAL SYSTEMS MAINTENANCE TEAM (CSMT) WORK CLASSIFICATION

Number of Requests for Work and Hours Expended by Work Classification type (e.g. New Infrastructure, etc.)

### **CENTRAL SYSTEMS** MAINTENANCE (CMST) TEAM **RESOURCE TREND** ANALYSIS

Metrics that relate CSMT resource demands based on growing infrastructure elements (e.g. cameras, VSL corridors, etc.)

**FUTURE Performance Measures** 



The implementation plan for the recommended Work Management program area core performance measures incorporates feedback and guidance from the stakeholder meetings and management discussions. The

following sections outline the actions needed to implement the desired improvements to the Work Management Performance measures.

### DATA NEEDS AND SOURCES

As seen in **Exhibit 10**, the majority of the core Work Management performance measures are currently reported on. The data systems in place, the RFW system (software systems) and Micromain (roadside assets), collect the data required.

# DESIRED, EXISTING, AND FUTURE PERFORMANCE MEASURES

Through a series of stakeholder meetings and management discussions, a list of existing and potential Work Management performance measures was created. **Table 8** shows all performance measures that were discussed through the process, stratified by the identified priority level: high, medium, or low (not necessarily a reflection of importance but feasibility to be implemented and useful to ODOT). The table also separates those measures that are currently being collected (top half) from those yet to be consistently and accurately reported (bottom half).

There were 11 Work Management performance measures identified through stakeholder meetings and guidance from management, as seen in **Table 8**. Of the 11, ODOT has started to collect data or is currently reporting seven performance measures at a range of maturity levels. For example, a majority of the performance measures in the Micromain Work Management system are currently reported on and have reached a level of maturity where they are useful to managers and employees within ODOT.

As seen above in **Exhibit 10**, those performance measures correlating directly to the "core performance measures" for work management have been identified in **bold**, and should be implemented first. The core performance measures range in ease of implementation and level of effort necessary to establish within ODOT's system. Action plans for each core performance measure are further detailed in the sections below.

**Table 8.** Work Management Performance Measures

TSMO PRIORITY LEVEL		нібн	MEDIUM	LOW
	Yes	Currently assigned RFWs per employee	CSMT Resource Trend Analysis	
6:		Recently closed RFWs per day/week/or month	Annual maintenance costs by asset	
TSMO Metric?		ITS Work order backlog by month	Time to complete work orders by priority and asset type	
	No	CSMT Work Classification	Work activity tracking	Staff vs work order ratio
Current			Priority work order effort compared to other work efforts	
			Annual number of hours expended by work classification and system	

**Bold performance measures** are identified as core performance measures in this program area.

### WORK MANAGEMENT PROGRAM AREA PERFORMANCE MANAGEMENT ACTION ITEMS

The following lists the priority work management performance measures implementation items:

### **NEAR-TERM**

- Continue efforts to enhance Micromain to work for Traffic Signal work management.
- Develop a report showing the average time to complete work orders by work order priority for both field maintenance and central systems maintenance.
- Create a dashboard for summarizing key TSMO program work management measures on one page.
- Work towards a common nomenclature for both CSMT and Field Support for work classification.
- Continue efforts to develop reports showing work effort expended (hours) per work classification.

#### MID-TERM

- Provide training for staff using the RFW or TFS systems to understand the work flows associated with each system.
- Complete data warehouse work to allow Transportation Environment Accounting and Management System (TEAMS) data with Micromain data to allow reporting of cost per asset in addition to labor hours per asset.
- Develop trend analysis reports that predict CSMT operational workload based on infrastructure growth data.

### LONG-TERM

 Create a report forecasting future maintenance costs based on historic average cost per asset type per region to assist with budgeting.



# WORK MANAGEMENT AUDIENCES

The main audience identified for the Work Management program area performance measures are

- ITS Manager,
- TAD ITS Program Manager and Team leads,
- · Region Electrical Managers,
- TOC Managers,
- Region Maintenance & Operations Teams, and
- Region Traffic Managers.

### **DELIVERY OPTIONS**

Through stakeholder meetings, it was highlighted that there should be different "views" for each data set or performance measure. This would allow for staff, managers, and decision makers to access the graphic or information that would be most actionable for their respective jobs. Where a decision maker might need a snapshot of the statewide performance to make budget decisions, a IT engineer might need a more detailed view of an ITS system's performance.

# WORK MANAGEMENT COMMUNICATIONS ACTION ITEMS

The following are specific action item towards enhanced communication of work management performance measures:

### MID-TERM

- Continue distribution of monthly ITS field maintenance assigned work order report (TOC Managers Report).
- Distribute monthly report of CSMT work order assignments to ITS Manager, TOC Managers, and ITS Program Leads.
- Work with work management audience to explain and identify automated reports and subscriptions.
- Create a dashboard for summarizing key TSMO program work management measures on one page.
- Create annual report summarizing TSMO maintenance accomplishments and work backlog.

# APPENDIX A MOBILITY METHODOLOGY AND FAST ACT/MAP-21 OVERVIEW

# ESTABLISHING MOBILITY PERFORMANCE MEASURE METHODOLOGIES

One of the program area-level action items above is to establish consistent and repeatable methodologies to calculate and report on the performance measures identified. One resource that ODOT can use or reference in creating the methodologies is the Texas A&M Transportation Institute's Annual Urban Mobility Scorecard (Reference 1). Since 1982, the scorecard and its methodology have been shared nationally and are generally accepted as a national best practice. The mutual performance measures between this plan and Annual Urban Mobility Scorecard are TTI, PTI, and travel delay.

Another resource for establishing methodologies for the core Mobility performance measures is WSDOT's Handbook for Corridor Capacity Evaluation (Reference 2). The handbook provides details and methodologies that WSDOT uses for their annual Gray Notebook that reports performance measures for the state. The mutual performance measures between this plan and the handbook are travel time and travel delay.

### COORDINATION WITH MAP-21/FAST ACT SYSTEM PERFORMANCE

In addition to the state's current performance measure practices, FHWA released their final rulemaking for measuring performance of the National Highway System required by FAST Act/MAP-21. ODOT's agency lead for this effort will be the TPAU unit. As ODOT prepares for the final rulemaking and progresses this plan and the TSMO program, it is important to coordinate the two efforts to minimize data collection needs and efficiently report both to the state and nationally.

