Southwest Washington
Regional Transportation Council

Final Report

Regional Transportation Systems Management and Operations Plan for Southwest Washington

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Acknowledgements

The Regional Transportation Systems Management and Operations (TSMO) Plan was guided by a Steering Committee, comprised of RTC staff and the operations and planning staff from transportation agencies in southwest Washington, including Clark County; the City of Vancouver; the Port of Vancouver; C-TRAN; WSDOT; and METRO (Oregon) among others. Many individuals with diverse perspectives contributed to the development of this Plan; their time and efforts are greatly appreciated by RTC and the consulting team.

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Chapter 1
Introduction

What is Transportation System Management and Operations (TSMO)?

- Transportation Systems Management and Operations (TSMO) focuses on low-cost, quickly implemented transportation improvements that aim to better utilize existing transportation facilities. TSMO benefits include a more reliable transportation system, reduced delay, and better incident response.
- Examples of technology-based TSMO strategies include traffic signal coordination; ramp metering; traveler information; smart transit management; advanced technologies; and enhanced incident response, in an effort to improve overall transportation system performance as part of a comprehensive regional transportation investment strategy (Figure 2, following page).
- TSMO also combines many physical elements such as bottleneck improvements; access management; operational policies and procedures; and other operational resources to improve coordination and operation of the multimodal transportation network (Figure 1).

Figure 1: Elements of a TSMO Program:

TSMO integrates Plans, Policies, Resources, and Technologies to effectively manage the multimodal transportation system."

Overview

This Plan presents a ten-year vision and strategy to implement Transportation System Management and Operations (TSMO) as part of a multi-faceted approach to meeting the transportation needs of Clark County, Washington. It has been developed through a collaborative effort led by the Southwest Washington Regional Transportation Council (RTC) in cooperation with partner agencies as listed later in this chapter. The Plan focuses mainly on low-cost, technology-based, real-time transportation management and operations solutions.

The Plan builds upon a proven track record of success with TSMO initiatives in southwest Washington. Most notable is the Vancouver Area Smart Trek (VAST), which is a coalition of state, regional and local agencies that implement intelligent transportation systems (ITS) and operations solutions to the region's transportation system. VAST is an ITS initiative for the region, developed as a cooperative effort by transportation agencies in the Clark County area (the Cities of Vancouver and Camas, Clark County, the Washington State Department of Transportation, the Southwest Washington Regional Transportation Council, the Port of Vancouver and C-TRAN).

The TSMO Plan has a planning horizon of approximately ten years. While this is shorter than the typical planning horizon of many regional planning and capital investment efforts (e.g. Comprehensive Plan), it suggests both the nature of TSMO strategies as viable near-term solutions to transportation deficiencies, as well as the dynamic evolution of ITS technologies and operations practices.

Why is TSMO Important to Clark County and Southwest Washington?

This Plan focuses mainly on technology-based TSMO strategies; however, these can be used in combination with other forms of transportation investments (i.e. non-technology based), such as access management, to address the needs of a given corridor. In urbanized Clark County, limitations in the public rights of way, fiscal constraints and other community factors prevent freeway or arterial capacity expansion as a means of addressing congestion in key corridors. Therefore, TSMO offers agencies in the region a more cost-effective set of strategies with which to address the region's current and future transportation needs.

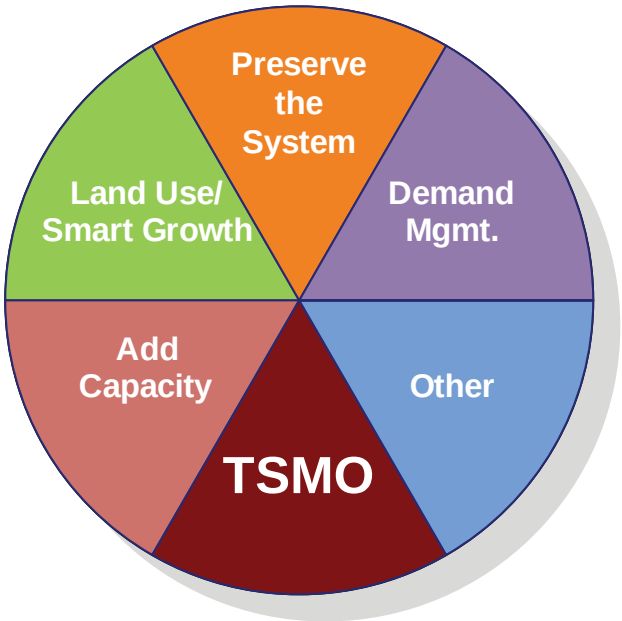


Figure 2: TSMO as a Component of a Regional Transportation Investment Strategy:

TSMO is one of the mutually-supportive elements of the Region's transportation strategy that provides cost-effective, near term alternatives to roadway capacity expansion.

Four key reasons why TSMO is important to the transportation future of Clark County are:

1. **Operational Concerns are a Growing Cause of Regional Congestion.** Real-time events such as traffic collisions, weather, events, construction, and other incidents are a significant cause of congestion and unreliability in the transportation system. Solving these issues requires a more active approach to management of the transportation system.

2. **Funding Current and Future Transportation Needs is a Challenge.** TSMO offers relatively low-cost alternatives to meet transportation system challenges as compared to capital investment in capacity-expanding projects. This is particularly true in corridors that are constrained by physical, environmental, or other constraints that make capacity expansion impractical.

3. **TSMO Promotes Cooperative Solutions to Complex, Multi-Modal and Multi-Jurisdictional Transportation Issues.** Many of the region's most pressing transportation concerns cross jurisdictional boundaries between agencies and modes, and even the Washington-Oregon state line. While many agencies in the region are active in transportation management and ITS deployment today, meeting future challenges and delivering high-quality, seamless service to the traveling public will require even greater levels of cooperation.

4. **A Strong Collaborative Foundation For Operations Exists in the Region Today.** Many examples of interagency operations collaboration exist today in the region, from the VAST consortium, to fiber optic sharing and day-to-day working relationships. A similar foundation exists in the Portland metropolitan area via the participation of ODOT, the City of Portland, and Metro (host of the TransPort regional operations forum) in the development of VAST and this plan. This strong institutional foundation is an immeasurable asset in expanding the scope and profile of TSMO in the region.

A TSMO Vision for Clark County

The TSMO Plan Steering Committee has developed a Vision Statement, plus goals and objectives to guide development of this Plan and the implementation of TSMO strategies and recommendations across the region.

TSMO Vision Statement:

Transportation System Management and Operations (TSMO) promotes better use of the existing transportation system by providing increased accessibility, reliability and safety for people and freight

Integrating Regional Planning and Transportation Operations

To increase the level of coordination between TSMO investments and other forms of transportation investments (i.e. capacity expansion) greater consideration of TSMO in regional transportation planning process and project development is needed.

The regional transportation planning process sets policy priorities and guides future transportation investments; TSMO is one potential path of transportation investment that can help meet these identified priorities. Therefore, it is important to connect transportation planning and operations programs in a deliberate and sustained manner.

TSMO Goals and Objectives

Program Goals:

- Provide viable transportation solutions that advance regional transportation goals, economic vitality, and environmental sustainability.
- Promote operational policies that are responsive to the need and concerns of citizens, industry, and the core missions of participating agencies.
- Maximize the value of existing and future transportation investments to meet transportation needs in a fiscally responsible manner.
- Promote multimodal and interagency cooperation to develop, fund, implement, operate, and maintain TSMO programs.
- Deploy integrated and interoperable Intelligent Transportation Systems (ITS) and communications assets that are shared among agencies to maximize functionality, flexibility, and return on investment for transportation and other public uses.
- Use operations data to continually measure and improve the quality of the transportation system and operational strategies in the region.
- Establish operational strategies that support businesses and are sensitive to adjacent land-uses.

Process Goals:

- Coordinate technology, infrastructure, resources and maintenance investments to implement TSMO strategies.
- Incorporate TSMO into the regional transportation planning, project development, and urban development process.
- Manage the bi-state highway and public transportation system through operational and investment coordination among agencies in southwest Washington and the Portland, Oregon metropolitan area.
- Seek opportunities to engage private enterprise, institutions and other community partners to envision, research, and implement TSMO strategies and user services for the benefit of the region

Figure 3: The Regional Planning and TSMO Lifecycle:

Linking transportation operations to the regional planning process completes a cycle of continuous performance evaluation and improvement.

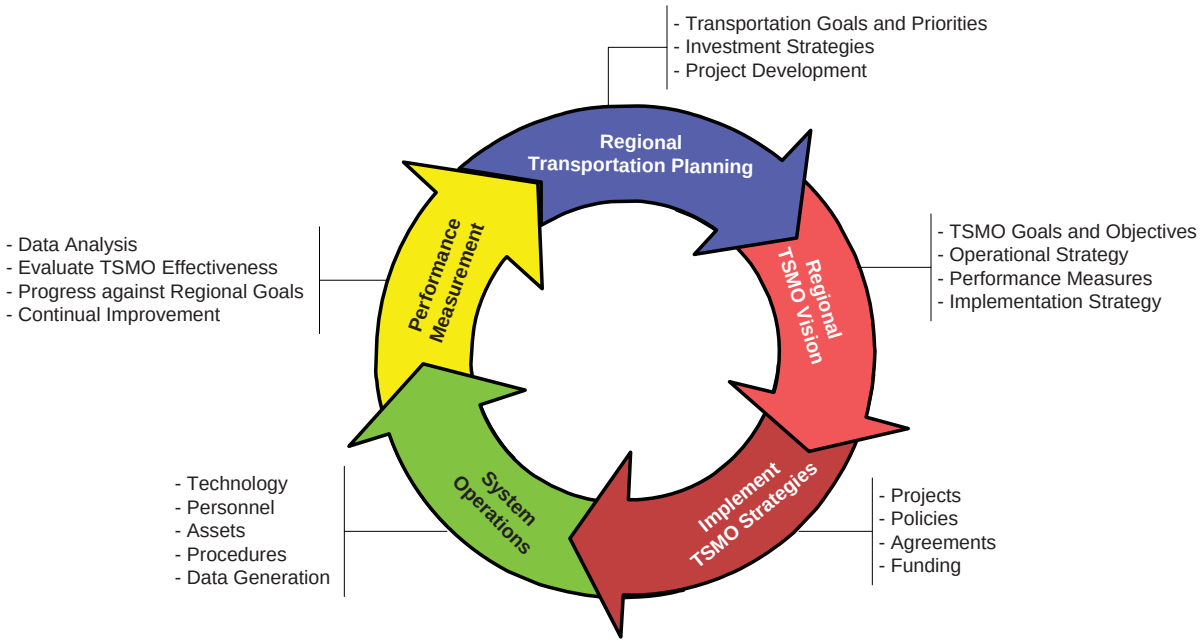


Table 1: TSMO Life Cycle

TSMO LIFECYCLE STAGE	PLANNING-OPERATIONS CONNECTION
Regional Transportation Planning	• Defines overall transportation needs in the region as well as investment priorities to meet those needs. • Develops multi-faceted strategies and projects for addressing regional needs, which may include TSMO in combination with other strategies.
Regional TSMO Vision	• Identifies the potential contribution of TSMO strategies to meeting regional transportation needs and the required investment of resources to implement those strategies.
Implement TSMO Strategies	• Coordinated implementation of TSMO strategies identified in the vision through regional coordination of projects and transportation programs, interagency agreements, and project funding and implementation.
System Operations	• Day-to-day tactical coordination of multiple agencies to effectively operate and manage the transportation system to realize the identified strategies.
Performance Measurement	• Use of data generated through system operations to measure the effectiveness of TSMO strategies in meeting regional transportation objectives. Also feeds back into the regional transportation planning process to inform decisions on future needs/priorities.

TSMO and RTC Metropolitan Transportation Plan Goals

Integrating transportation planning and operations begins by strengthening the link between operational strategies and the region's acknowledged transportation priorities.

RTC's Metropolitan Transportation Plan (MTP) amended July 2008, is the region's long-range plan that outlines how transportation systems and services will provide the required mobility and accessibility of people and goods throughout the region.

Table 3 on the following page lists each of the MTP's eight goals and the ways that TSMO strategies can help to achieve those goals.

Intelligent Transportation Systems: The Enabling Tools of TSMO

Over the past ten to 15 years, transportation agencies in southwest Washington have made significant and coordinated investments in ITS. In turn, these technologies support many of the TSMO strategies outlined in this document. Examples include traveler information systems; traffic signal control systems; freeway management systems; and transit management systems.

The TSMO Plan identifies future ITS infrastructure investments based upon the TSMO strategies identified by regional agencies. Compared to many ITS strategic planning efforts in the past, this reflects a more comprehensive view of ITS as the enabling tools that allow agencies to collaborate in actively managing the transportation system. This active management, in turn, reflects operational objectives and strategies that themselves speak to broadly-recognized transportation needs and priorities identified by transportation professionals and decision-makers at the regional level.

Geographic Coverage of the TSMO Plan

Transportation System Management and Operations is most applicable to corridors and areas that show signs of congestion, high levels of collisions, and other deficiencies of an operational nature.

Accordingly, the geographic area covered by the TSMO plan encompasses the urbanized areas and major transportation corridors of Clark County. Participating agencies recognize that other isolated, rural or urbanizing areas of the County with operational needs may also be current or future candidates for implementation of TSMO strategies. Figure 4 on the following page shows the general vicinity of the TSMO Plan.

Participating Agencies

To guide the TSMO planning process, a Steering Committee comprised of the operations and planning staff from transportation agencies in the region was convened, as shown below in Table 2.

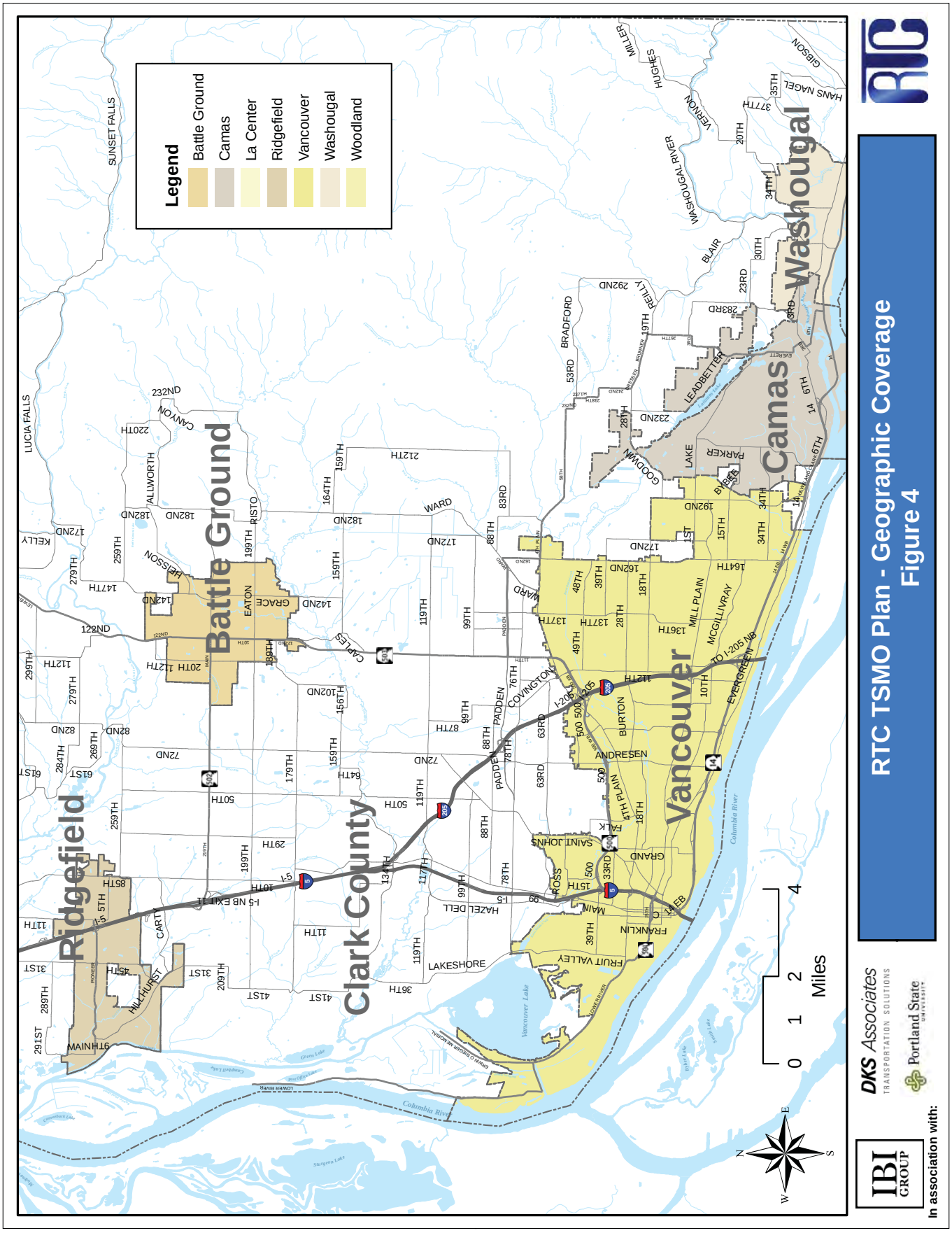
TSMO STEERING COMMITTEE PARTICIPANTS

- Clark County
- SW Washington Regional Transportation Council (RTC)
- Washington State Dept. of Transportation
- City of Vancouver
- Oregon Metro
- C-TRAN
- City of Camas
- Port of Vancouver

The participation and sense of ownership of these diverse agencies – who own, operate, plan and fund the regional transportation system – was vital to the successful development of the TSMO Plan, and will be even more valuable to its implementation. Development of the Plan has relied on key agency personnel (including members of the VAST Steering Committee) and their perspectives, knowledge and feedback, which ensures that the Plan reflects the diversity in the region as well as specific agency priorities and concerns.

Table 3: TSMO Contribution to Regional Transportation Goals

METROPOLITAN TRANSPORTATION PLAN GOALS	TSMO CONTRIBUTION TO MEETING THE GOALS
Maintain, preserve, and improve the existing regional transportation system.	**TSMO focuses** on increasing the efficiency of the region's existing transportation system as a cost-effective alternative to infrastructure expansion.
Provide a safe and secure transportation system that allows for the movement of people and freight.	**TSMO strategies** can reduce the incidence and severity of collisions, especially secondary collisions and weather-related incidents. **ITS technologies** and emergency response strategies are part of an integrated approach to enhance the safety of the transportation network.
Support economic development and community vitality.	**TSMO provides** additional options for maintaining and improving mobility in southwest Washington for both people and goods to contribute to the region's economic vitality.
Provide an efficient, balanced, multi-modal regional transportation system including highway, bus transit, high capacity transit, rail, aviation, marine, bicycle, and pedestrian modes as well as transportation demand management and transportation system management strategies.	**TSMO strategies** will be applied in an integrated fashion across each transportation mode to improve the performance of the entire transportation network. **By improving** the performance of non-automotive transportation modes, TSMO helps to increase their viability as transportation options for travelers in the region.
Provide an acceptable level of mobility for personal travel and freight movement throughout the regional transportation network and adequate access to locations throughout the region.	**TSMO strategies** improve transportation system reliability in parts of the region where it is infeasible or cost-prohibitive to expand capacity, particularly in the near term. **TSMO contributes** to a regional mobility strategy that includes infrastructure expansion blended with other strategies that are appropriate to the context and available resources.
Provide a transportation system that is sensitive to the quality of the environment and natural resources.	**By reducing** the impacts and duration of congestion and delay, TSMO reduces inefficiency in the transportation system and can directly contribute to greenhouse gas reductions and air quality. **By improving** the reliability and quality of transit, carpooling, and other travel behavioral changes, TSMO helps to reduce dependence on single-occupancy vehicle travel.
Provide for the development of a financially viable and sustainable transportation system.	**TSMO responds** to the region's fiscal constraints by providing lower-cost solutions that can reduce, delay, or eliminate the need for expensive traditional infrastructure expansion projects. **Implementation of TSMO** strategies in existing and future corridors improves the flexibility and efficiency of these corridors that offsets capacity expansion requirements.
Provide a transportation system that reflects community values.	**TSMO increases** the breadth of transportation strategies that can be applied to meet the needs of the community. TSMO may present mobility, safety, security, and/or economic development options that can benefit communities and neighborhoods.


Legend
Battle Ground
Camas
La Center
Ridgefield
Vancouver
Washougal
Woodland
Battle Ground
Camas
Washougal
Ridgefield
Clark County
Vancouver
0 1 2 4
Miles
RTC TSMO Plan - Geographic Coverage
Figure 4
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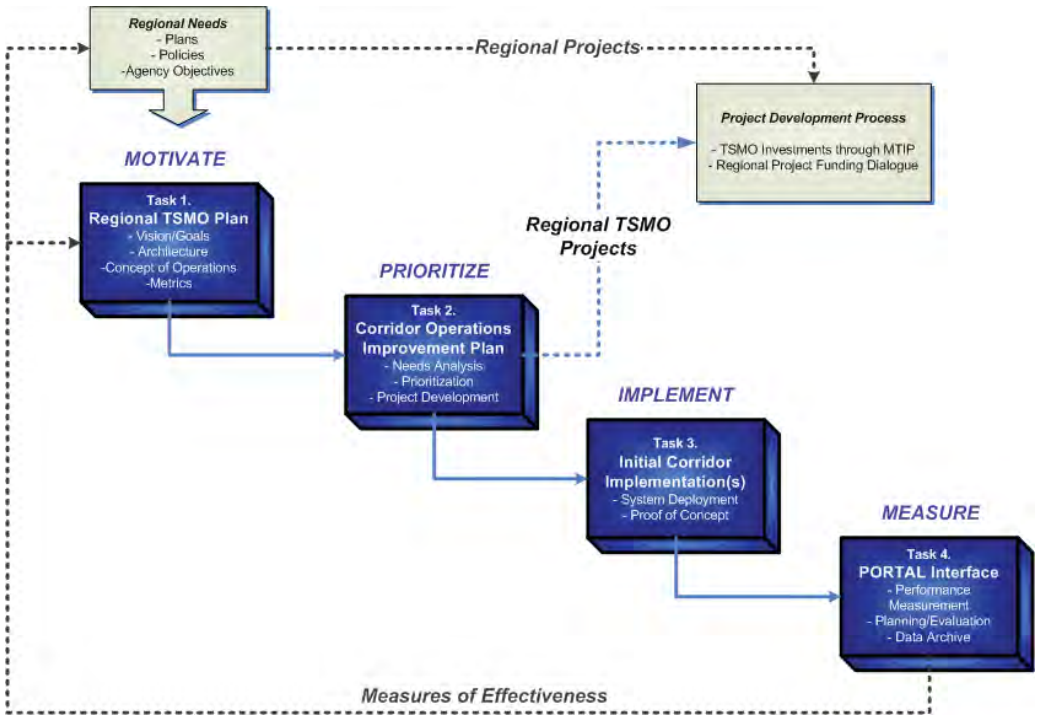
Plan Development Methodology.

RTC commenced the multi-agency initiative to develop the TSMO Plan in 2010. The project consists of four distinct phases that are designed to illustrate the applicability and viability of TSMO concepts to Clark County (Figure 5):

1. **Regional TSMO Plan:** A ten-year vision to implement TSMO strategies that address real transportation needs in a coordinated, cost-effective manner.
2. **TSMO Corridor Investment Plan:** Identifies candidate corridors for TSMO implementation. The corridor chosen for the demonstration project was based on several criteria such as rapid time deployment, whether ITS investments can be leveraged in the corridor and the level of multi-agency participation. Additional criteria were used to evaluate the corridors, which are introduced later in this plan.
3. **Demonstration Corridor Implementation:** Implements a high-priority transportation corridor improvement pilot project to demonstrate the viability of TSMO strategies in leveraging multi-agency partnerships, existing infrastructure, and new ITS investment to achieve operational benefits.
4. **Interface to the PORTAL Regional Data Warehouse:** A real-time data interface between transportation agencies in southwest Washington and the PORTAL regional data archive hosted by Portland State University. This connection is a critical link between planning and operations, because it supports collection, storage, and analysis of transportation data generated by ITS systems. It also provides data and analytical capabilities that support the implementation of performance measures to evaluate the efficacy of TSMO and other transportation strategies

Figure 5: TSMO Plan Project Work Flow:

The RTC TSMO initiative defines transportation operations strategies and demonstrates how they can be applied and measured at the project level to evaluate effectiveness.



Chapter 2
TSMO in Clark County: Current Condition and Future Needs

Key Concepts

- The region has a long track record for cooperatively managing the transportation network and funding, building, and operating infrastructure.
- Significant ITS infrastructure exists today to support TSMO strategies.
- TSMO can contribute to meeting regional transportation challenges and opportunities in the next ten years.
- Awareness, policy support, and stable operational funding, and performance measures are key success factors for achieving the region's TSMO vision.

Introduction

Transportation Systems Managements and Operations is an increasingly important part of the solution to Clark County's existing and emerging transportation needs. Ideas presented in the chapter are the result of a TSMO visioning workshop in February 2010, during which stakeholder agencies explored opportunities to build on past operations successes, to advance the state of the practice in transportation operations and rise to the opportunities and challenges.

Operations in Clark County – Key Achievements in the Past Ten Years

TSMO gains have been made possible through ITS as the starting point to furthering these initiatives. Looking back just ten years, regional coordination and ITS efforts were at an early stage. In this relatively short period of time, much progress has been made at the regional and agency level to incorporate operations into the day-to-day activity of agencies in the region.

Table 4 summarizes the ITS investments and operational advancements that have been made by regional stakeholders within the past ten years, as identified in a TSMO visioning workshop. As the list shows, TSMO has gained significant momentum with ITS deployment as the starting point; some of the most important successes have been realized through cooperation and joint investment by transportation agencies in the region.

Table 4: Key Operations and ITS Achievements in Clark County since 2000

ARTERIAL TRAFFIC OPERATIONS

- Adoption of standardized signal controller technology by operating agencies
- Implementation of City of Vancouver and Clark County central traffic signal system
- Interagency corridor optimization
- Transit Signal Priority (TSP) supportive capabilities on most intersections
- Initiating C-TRAN Transit Signal Priority (TSP) Pilot
- Mutually-supportive access management improvements such as median curbs
- WSDOT traffic signal interconnection and coordination
- WSDOT traffic signal timing review/real-time program
- Video sharing between WSDOT, City of Vancouver and Clark County

TRAVELER INFORMATION

- Establishment of the Southwest Region Traffic Management Center (TMC)
- Adoption of a WSDOT incident clearance policy – Joint Operations Policy Statement (JOPS)
- Field ITS deployment including CCTV (Closed-Circuit Television) Surveillance, variable message signs (VMS), and traffic detection
- Sharing of traffic video via shared TMC and Washington State Patrol dispatch co-location
- Development of regional and statewide Emergency Operations Centers (EOCs)
- WSDOT Regional Incident Response Program

TRAVELER INFORMATION

- Deployment of WSDOT 511 Traveler Information (Phone/Web)
- Deployment of ODOT TripCheck 511 Traveler information (Phone/Web)
- WSDOT deployment of a Vancouver/Portland bi-state traffic flow map and CCTV camera
- Development of a WSDOT 'govdelivery' email-based subscription notification service
- VMS – variable message sign (VMS) deployment on regional freeways
- Emerging use of other social media
- WSDOT Traveler Information Website

TRANSIT IMPROVEMENTS

- Extensive C-TRAN and TriMet technology investments
- Deployment of Computer Aided Dispatch / Automatic Vehicle Location (CAD/AVL)
- Deployment of Automatic Passenger Counting (APC)
- Deployment of Interactive Voice Response (IVR) Transit Information
- Deployment of Automatic Stop Announcement (ASA)

COMMUNICATIONS IMPROVEMENTS

- Deployment of an extensive, multi-agency regional fiber optic backbone
- Development of a regional data and video sharing network
- Implementation of a fiber sharing program, with resulting in an estimated $11 - $14 million in savings in the last three years
- Implementation of a shared Local Area Network (LAN)
- Support of control center and communications redundancy as well as portability of ITS system control
- Cooperation and communications connectivity with agencies in Oregon.

OTHER KEY ACCOMPLISHMENTS

- Development of the Vancouver Area Smart Trek (VAST) interagency coordination committee
- Successful interagency partnerships to obtain funding for ITS projects (e.g. through CMAQ)
- Evaluate system management solutions using four years' worth of data for analysis
- Development of an RTC data warehouse (traffic counts, travel-times, vehicle occupancy, etc.)

Existing Regional ITS Infrastructure

Efforts over the past ten years have led to the implementation of ITS devices, traffic management centers and supporting communications infrastructure throughout the region. Figure 6 shows existing ITS and communications devices in the region today, representing the cumulative efforts of state and local transportation operations agencies.

Regional ITS Devices and Communication Infrastructure

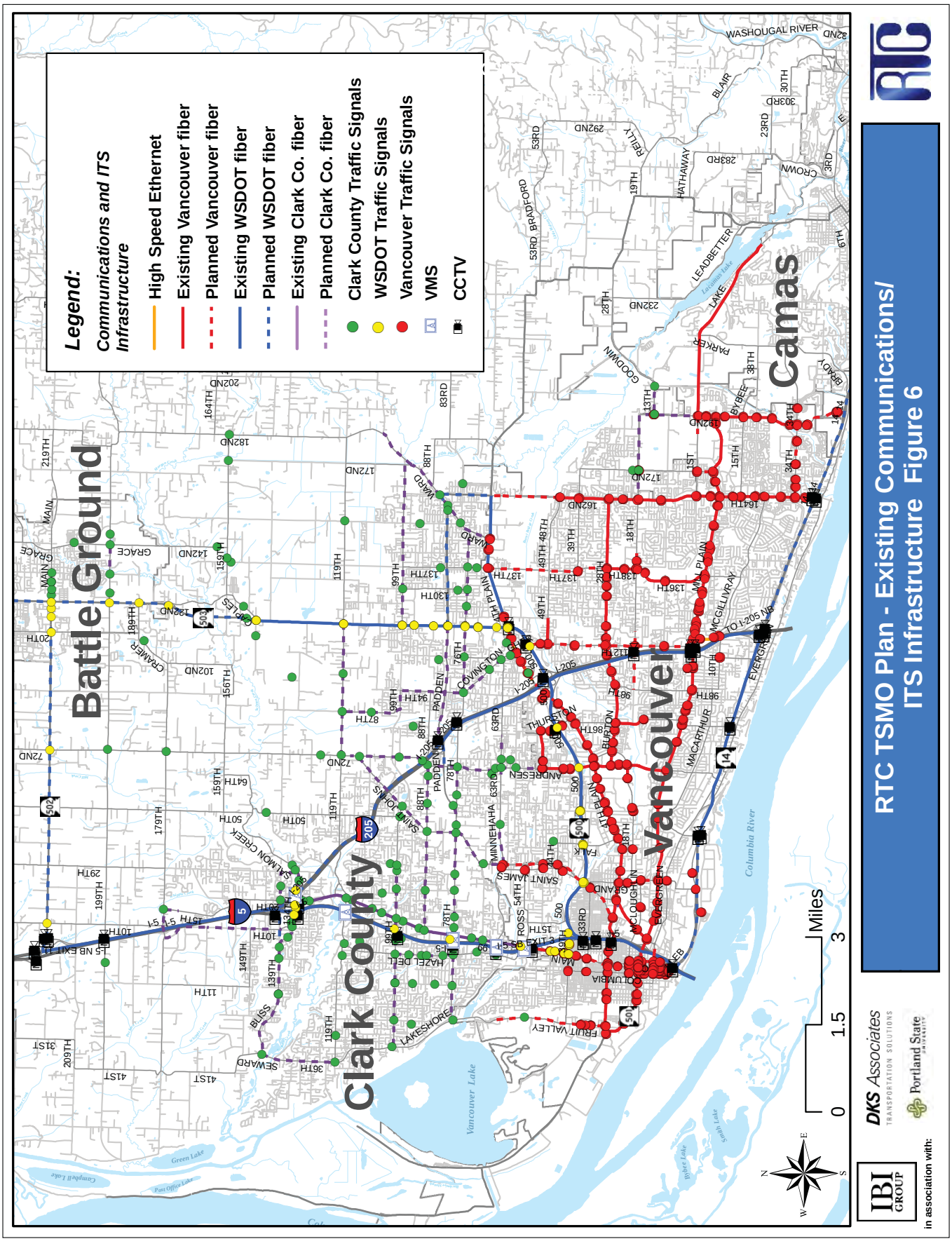
A number of ITS projects have been initiated and/or deployed in Clark County over the last ten years. Several corridors in Vancouver have an interconnected traffic signal system to facilitate traffic flow. Fiber optic cable installation is ongoing for most programmed and planned projects in the metropolitan area and cameras have been installed in the I-5/Highway 99 corridor to better manage traffic. In addition, variable message signs (VMS) at 134th St. and 99th St. are used to notify drivers of incidents as traffic is diverted from I-5.

Transportation and Emergency Management Centers

In addition to field infrastructure, there are numerous existing management centers in the region that support TSMO activities, as shown in Table 5.

Table 5: Existing Management Centers in the Region

REGIONAL MANAGEMENT CENTER	DESCRIPTION
WSDOT Southwest Region Traffic Management Center	Responsible for traffic and incident management on state freeways and highways in the region
City of Vancouver Traffic Management Center	Manages traffic signals and arterial operations within the City of Vancouver
Clark County Traffic Management Center	Manages traffic signals and corridor operations within the County
C-TRAN Transit Operations Center	Manages dispatch and operations of C-TRAN public transportation.
CRESA Emergency Operations Center	911 Public Safety Access Point (PSAP) for Clark County that also coordinates emergency response. Coordinates with the Statewide Emergency Operations Center in the event of large-scale emergencies.
Washington State Patrol Operations Center	Handles dispatch of WSP personnel for highway and emergency incident response. Co-located with the WSDOT SWR


Legend:
Communications and ITS Infrastructure
High Speed Ethernet
Existing Vancouver fiber
Planned Vancouver fiber
Existing WSDOT fiber
Planned WSDOT fiber
Existing Clark Co. fiber
Planned Clark Co. fiber
Clark County Traffic Signals
WSDOT Traffic Signals
Vancouver Traffic Signals
VMS
CCTV
Battle Ground
Clark County
Vancouver
Camas
Columbia River
Vancouver Lake
Miles
0
1.5
3
RTC TSMO Plan - Existing Communications/ ITS Infrastructure Figure 6
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Transportation Challenges in Clark County

During the February 2010 Visioning Workshop, participating stakeholder agencies articulated a wide range of operational needs and challenges looking forward over the next ten years. Looking back at the accomplishments of the past ten years, participants also noted the possibilities for dramatic evolutions in ITS technologies, operational programs, policies and funding that underscore the need for a forward-looking vision for TSMO.

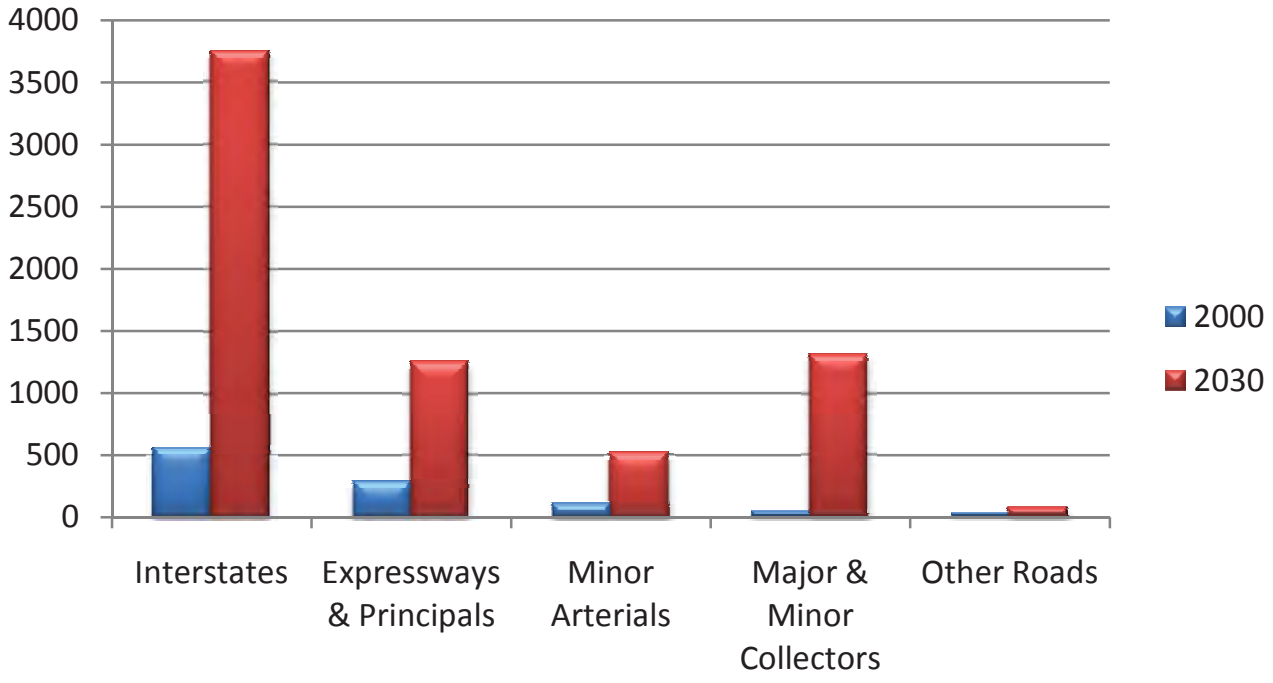
Key Regional Transportation Challenges

From a general transportation perspective, there are several significant challenges facing Clark County in the future, including:

- A severely constrained fiscal environment, which has generated a search for more cost-effective alternatives to meet transportation needs;
- Steady growth trends in Vehicle Miles Traveled (VMT) in the region, which is outpacing growth in roadway capacity;
- Growing concern about environmental sustainability and reduction in greenhouse gases in response to climate change; and
- The need for a more diversified, equitable, and robust transportation network.

Figure 7: PM Peak Vehicle Hours of Delay:

As travel demand outpaces expansion of roadway capacity, proactive TSMO strategies are increasingly important to maintaining the efficiency and viability of the transportation system.



Forecasted Vehicle Delay Hours*

*Source: MTP for Clark County

Growth in congestion is a specific concern for operating agencies, as it is a leading cause of transportation delay and is projected to grow significantly in the region. The number of intersections with an average delay of 30 seconds or greater in Clark County has increased from 26 to over 100 intersections in the last few years. As growth in travel demand and VMT increases, corridor travel speeds continue to decline. Clark County's Metropolitan Transportation Plan (MTP) forecasts even more congestion by 2030, as seen in Figure 7.

Looking Forward: Operational Challenges and Opportunities in the Next Ten Years

In developing the TSMO plan, stakeholder agencies were asked to consider the following question: Where does Clark County want to be in Transportation System Management and Operations and ITS in ten years? This future vision has informed the plan development; key issues raised in this conversation are summarized below:

Traffic Operations

Promote increased regional cooperation and integration to more seamlessly operate the combined freeway and arterial highway systems in the region.

- Implement more robust and integrated signal timing programs to meet changing conditions and to address cross-jurisdictional issues.
- Develop parallel route plans for improved detour/diversion management.
- Expand arterial management capabilities using ITS devices (e.g. arterial variable message signs and arterial traffic surveillance cameras).
- Improve event management, particularly in downtown Vancouver and in the vicinity of the Clark County Amphitheater.
- Improve bi-state operations by updating existing operational plans involving Oregon agencies, and making appropriate infrastructure investments.
- Consider the challenges and opportunities of the Columbia River Crossing (CRC) project, including construction-phase mitigation, electronic tolling, active traffic management, and increased bi-state coordination.
- Explore the applicability of Active Traffic Management (ATM) on freeways, similar to what has been deployed in the Puget Sound region.

Incident/Emergency Response Improvements

Improve incident response and coordinate quick clearance programs.

Conduct more outreach/coordination with the emergency management community (drills, quick clearance, etc.) to improve incident response and traffic restoration, especially at the local level.

Develop a regional/bi-state incident management/clearance program that builds upon existing automated event and traffic management functionality through TMC software and bridge management coordination.

Build out the roadway surveillance network to complete freeway coverage to support incident detection and verification.

Make greater use of ITS and ATMS.now capabilities for detour/diversion management.

Traveler Information

Provide information to travelers in diverse formats, in the format they want it, and in the location they need it.

- Increase provision of traveler information systems suitable to increasingly-prevalent mobile and in-vehicle technologies.
- Leverage applications and initiatives by third-parties as both data sources and traveler information dissemination channels.
- Explore strategies to provide consistency across the bi-state Vancouver/Portland Metro area, taking into account the policy coordination implications for WSDOT and ODOT.

- Improve traveler information on freeways, arterials, and multi-modal transportation (transit, trains, etc.).
- Develop more personalized traveler information messages, tailored to location- or user-specific parameters.
- Explore deployment of predictive traveler information, including its applications for operating agencies in a control center environment.
- Explore development of a regional traffic flow map, including both arterial and freeway information for an enhanced user experience.

Transit Operations

- Pursue Transit Signal Priority (TSP) deployment and expansion across the region to promote transit system reliability.
- Use of TSP to support high capacity transit (HCT) implementation, such as Bus Rapid Transit.

Regionalization of Operations

- Develop a 24/7 Regional Multi-Agency Traffic Management Center (TMC).
- Provide support and management for both State and Local Agency regional traffic management needs.
- Develop an integrated regional traffic operations system to actively manage infrastructure owned by multiple agencies in a centralized fashion
- Achieve regional cost savings by consolidation of regional operations agencies, particularly for off-hours operations.

Freight Management Improvements

Use ITS to support the ability of local shippers and industry to achieve "Just-in-Time" freight delivery systems/services in response to transportation congestion and unreliability.

- Implement truck signal priority programs to promote freight mobility.
- Make real-time and predictive traveler information available to freight interests.
- Disseminate real-time information from ports on vessel arrival/departure times.
- Coordinate with Commercial Vehicle Information System Network (CVISN) programs to obtain freight data or in other applications that can improve freight mobility.
- When new technology is available, expand weigh in motion (WIM) capabilities to expedite the inspection process for trucks and to protect roadway infrastructure and promote safety.
- Develop and monitor performance measure targets for key freight corridors.

Planning and Policy Considerations

- "Mainstream" planning for ITS and TSMO in regional project development.
- In corridor and project planning, new capital projects should consider the TSMO Plan's goals and objectives.
- Institutionalize TSMO in the planning process to improve long-term funding availability and stability for TSMO programs.
- Leverage TSMO data to help the region meet the objectives of anticipated Federal performance-based transportation funding programs.
- Consider that TSMO strategies may prompt the need for spot capital improvements (e.g., spot added ITS device for providing traveler information at a particular location).
- Consider how TSMO supports the least-cost planning rule in Washington State that mandates consideration of lower cost improvements when considering large transportation capital projects.
- Coordinate TSMO improvements with mutually-supportive access management improvements to improve overall corridor operations (e.g. improving land access connectivity within development through connected driveways).

- Improve transportation demand management (TDM) and coordinate with Clark County's trip-reduction program.
- Consider TSMO, as well as TDM and transit, in land-use decisions and planning.
- Use operations data to improve congestion management process (CMP) planning, and to identify future TSMO improvements.
- Consider emerging programs and technologies, such as the USDOT's Connected Vehicle Technology, in planning and implementation of TSMO programs.

Summary – Factors for Success of the Regional TSMO Vision

Stakeholders identified several keys to the success of the TSMO Vision for Clark County, which are listed below. These factors, as well as the other needs, opportunities and challenges described above, formed the basis for the Regional TSMO Vision for Clark County presented in the previous chapter.

- Equipping policy makers with knowledge about proposed TSMO systems is vital to the success of the plan. TSMO can offer new solutions to policy makers looking to achieve a solution with fewer resources.
- Coordination of TSMO with other transportation strategies, investments, and policy priorities is both a challenge and an opportunity.
- A viable TSMO plan and strategy can be a tool to attract sustainable capital and operational funding that provides significant benefits to the region in terms of cost-effectiveness. It is critical to address the long-term operations and maintenance needs of TSMO, and to explore new opportunities for financing and resource sharing.
- Given limited resources, it is important to agree on the most important and achievable uses of agency staff, assets and funds.
- Future ITS technology implementation must be driven by the TSMO strategies that this investment supports.
- Performance measures will provide both evidence of the value of TSMO to decision makers, and also inform future transportation investments for both TSMO and non-TSMO strategies.

Chapter 3
Regional TSMO Strategies

Key Concepts

- A toolkit of TSMO strategies has been developed to respond to transportation operations challenges and opportunities.
- Many of the TSMO strategies are most effective when applied regionally and across the multi-modal transportation network.
- There are mutually-supportive strategies, such as Access Management and Transportation Demand Management, which complement TSMO to cost-effectively meet regional transportation needs.
- 'Emerging' TSMO strategies such as Performance Measurement, Freight Information, and Bi-State Incident Management, are opportunities to advance the existing state of the practice.

Introduction

Achieving the TSMO Vision involves a diverse set of operational strategies to make the most efficient use of the region's multi-modal transportation capacity. This chapter describes a regional 'toolkit' of TSMO strategies that can contribute to meeting the transportation needs of Clark County. Strategies in the toolkit are technology based, but like all TSMO concepts, require close alignment of plans, policies, personnel and operational resources to be most effective. The strategies in the TSMO toolkit are mutually-supportive of other low cost transportation strategies that can be tailored to meet the needs of a particular corridor, neighborhood, or agency.

Regional TSMO Strategies Toolkit

The TSMO strategies that could be applied Clark County focus on technology-based, real-time approaches to improving operations and system performance, but also include mutually-supportive (i.e. non-technology based) and other strategies that have policy implications. Also presented is the regional vision for strategy implementation and a discussion of the TSMO strategies that the stakeholders most actively want to pursue for the region.

- **Regional Management & Operations:** Involves multi-jurisdictional coordination to implement regional system management programs.
- **Roadway Management & Operations:** Targets active management of regional limited- access and arterial corridors and requires some multi-jurisdictional coordination depending on the corridor.
- **Transit Management & Operations:** Seeks to improve transit operations and performance and to enhance passenger convenience.
- **Freight Management & Operations:** Seeks to improve travel conditions information and travel times to support just-in-time freight services.
- **Traveler Information**: Strives to provide travelers with personalized information to support informed travel choices.

Although the strategies are organized into these main focus areas, there are many instances where strategies overlap. For example, the data collected and used to support roadway management and operations may also be used to provide traveler information.

For each strategy listed in Table 6, there is a corresponding description of how the strategy could be applied to the region and the expected benefits. The evaluation and selection of TSMO strategies for a particular corridor must account for the needs of stakeholders, local conditions, safety, and adjacent businesses.

Regional TSMO Toolkit

Regional Management & Operations

- Regional Multi-Agency Transportation Management Center (TMC)
- Bi-State Incident Management
- Regional Incident and Emergency Management
- Event Management
- Work Zone Management
- Regional Performance Measures and Supportive Data Collection

Roadway Management & Operations

- Active Traffic Management (ATM)
- Freeway/Arterial Integrated Corridor Management (ICM)
- Ramp Metering
- Enhanced Traffic Signal Operations
- Traffic Surveillance
- Road Weather Information Systems (RWIS)

Transit Management & Operations

- Automated Vehicle Location (AVL) and Computer Aided Dispatch (CAD)
- Automated Passenger Counting (APC)
- Transit Signal Priority (TSP)
- Transit Speed Reliability
- Regional Transit Fare Integration

Freight Management & Operations

- Real-Time and Predictive Freight Information
- Roadside Truck Electronic Screening/ Clearance Programs
- Truck Traffic Signal Priority
- Freight Data Collection

Traveler Information

- Bi-State Traveler Information Interoperability
- Roadside Traveler Information Dissemination
- Regional Traveler Information
- Real-Time Transit Arrival Information
- Predictive Traveler Information
- Transit Trip-Planning Website
- Parking Availability Information

Table 6: TSMO Strategies, Descriptions and Applicability

TSMO STRATEGY	WHY APPLY STRATEGY TO REGION?	EXPECTED BENEFITS
REGIONAL MANAGEMENT & OPERATIONS		
Regional Multi-Agency Transportation Management Center (TMC) Develop a TMC concept to support traffic operations on state, county, and city roadways and to coordinate with police/emergency services from multiple jurisdictions.	WSDOT and WSP are co-located and operate 24 hours a day. The WSDOT TMC also includes workstations for CRESA. The WSDOT TMC could be expanded operationally or virtually to allow for resource sharing with Clark County and the City of Vancouver for more complete management of the region's roadways.	• Supports coordination and operation of the region's transportation systems • Collaboration between traffic and emergency agencies • Resource sharing
Bi-State Incident Management WSDOT SW Region ITS Plan includes future projects for responding to incidents that impact bi-state travel.	Incidents on I-5 and I-205 greatly impact passenger and freight mobility between Washington and Oregon since these are the only two connections across the Columbia River. WSDOT and ODOT coordinate today when I-5 and I-205 incidents occur but are developing plans to enhance incident response.	• Efficient coordination of incidents that impact traffic in Washington and Oregon • Reduces average incident duration by 25 to 70 percent • Reduces secondary crashes by 25 to 70 percent
Regional Incident and Emergency Management Expand on WSDOT's incident response program to support quick clearance (e.g. multi-agency program, more responders, staged towing, outreach, training); Many other roadway and traveler information strategies in the toolbox support incident management	WSDOT's incident response program could be expanded to regional arterial roadways to support the National Unified Goal for Traffic Incident Management (although there are various legal matters to consider). In particular, to support quick, safe clearance, responder safety and prompt, reliable incident communications.	• Reduces average incident duration by 25 to 70 percent • Reduces secondary crashes by 25 to 70 percent • Reduces delay due to quicker incident response • Potential to improve travel-time reliability • Improves travel-time and less congestion during an evacuation
Event Management Automate traffic control using changeable lane assignment, reversible lanes, or enhanced signal operations at venues such as the Amphitheater	Events at the Sleep Country Amphitheater and the Clark County Event Center cause congestion and travel delays for interstate traffic on I-5 and local traffic on 179th Avenue.	• Reduces delay during high traffic demand • Potential to improve travel-time reliability • Increases attractiveness of event attendance
Work Zone Management Use variable speed limits, automated enforcement, and traveler information dissemination for work zones that impact regional mobility and safety	Washington averages almost 1,000 highway work zone injuries each year. Most injuries and deaths in work zones are caused by rear-end collisions and 99 percent of people injured or killed are drivers and their passengers. (Source: WSDOT Give 'em a Brake) The Port has an interactive listserv system that posts route restrictions.	• Reduces travel speed across work zone by 10 miles-per-hour • Improves safety • Reduces delay by 45 to 55 percent • Potential to improve travel-time reliability • Improves freight route planning

TSMO STRATEGY	WHY APPLY STRATEGY TO REGION?	EXPECTED BENEFITS
REGIONAL MANAGEMENT & OPERATIONS		
Regional Performance Measures and Supportive Data Collection The PORTAL portion of this project will include data archiving and performance measurement development for roadways, transit, and freight	Limited data is currently available to support benefit-to-cost ratio analysis for TSMO improvements. Other systems produce data that needs to be archived and needs tools to analyze the data in a cost-effective manner.	• Ability to identify effectiveness of TSMO investments and to better target future policies and system improvements • Supports regional planning efforts

TSMO STRATEGY	WHY APPLY STRATEGY TO REGION?	EXPECTED BENEFITS
ROADWAY MANAGEMENT & OPERATIONS		
Active Traffic Management (ATM Manage congested corridors with lane use control, reversible lanes, or variable speed limits (e.g. Seattle, San Diego, Los Angeles and Minneapolis have implemented)	Locations with recurring congestion (e.g. I-5 southbound at Columbia River Crossing) are candidates for active traffic management, which can improve safety and reduce driver frustration. This strategy has been effective in Europe.	• Reduces primary incidents by 3 to 30 percent • Reduces secondary incidents by 40 to 50 • Increases average throughput during congested periods by up to 7 percent • Increases overall capacity from 3 to 22 percent
Freeway/Arterial Integrated Corridor Management (ICM) WSDOT SW Region ITS Plan includes project to manage traffic on parallel routes; ICM typically includes route/mode diversion, real-time information, and system adjustments (e.g. signals, ramp meters)	WSDOT and Clark County have developed a plan for ICM along the I-5/Highway 99 corridor and are working on the first phase of implementation. Other potential corridors for ICM include SR-14/Mill Plain, SR-500/Fourth Plain, I-205/112th, I-5/I-205 and SR-502/SR-503.	• Reduces travel-time and delay • Potential to improve travel-time reliability • Supports alternate travel routing for incident management
Ramp Metering Meter traffic flow rate on freeway on-ramps	Ramp metering is most applicable at on-ramps adjacent to freeway sections with recurrent congestion (e.g. at new southbound I-5 on-ramps via future Columbia River Crossing project).	• Reduces mainline travel delay during peak periods • Increases freeway speed by 10 to 25 percent • Improves freeway capacity by 10 percent • Reduces congestion duration • Reduces vehicle conflicts by 25 to 50 percent • Potential to improve travel-time reliability
Enhanced Traffic Signal Operations Improve existing signals through re-timing/ optimization, adaptive systems, or better detection	The National Traffic Signal Report Card recommends updating traffic signal timing at least every three years to keep up with changing traffic patterns and to achieve optimal system performance.	• Reduces travel-time by 10 to 25 percent • Potential to improve travel-time reliability • Reduces fuel consumption and vehicle emissions • Benefit-to-cost ratio can range from 15:1 to 40:1

TSMO STRATEGY	WHY APPLY STRATEGY TO REGION?	EXPECTED BENEFITS
ROADWAY MANAGEMENT & OPERATIONS		
Traffic Surveillance Add video and detection equipment (e.g. detectors, vehicle/cell phone probes) for more complete network coverage (WSDOT SW Region ITS Plan includes projects for freeways)	Traffic surveillance has been used successfully in the region to support the management of traffic, transit, incidents, and emergencies as well as provide traveler information and data for planning. Technologies such as Bluetooth are making it possible to collect traffic flow information on arterial roadways with minimal public agency infrastructure improvements.	• Improves incident detection and verification • Reduces incident response times • Provides real-time and historic system operations information • Supports the dissemination of real-time traveler information • Improved visual information for decision makers and travelers
Road Weather Information Systems (RWIS) Monitor and predict roadway conditions to mitigate impacts of adverse conditions (WSDOT SW Region ITS Plan includes projects for freeways)	Adverse winter weather in the region requires additional maintenance resources to provide a safe and accessible transportation network. RWISs and road condition cameras at these locations can help plan for and support resource allocation.	• Reduces vehicle speed by up to 5 mph during adverse weather • Potential to improve travel-time reliability • Improves safety by reducing crashes up to 15 percent • Provides information for decision-makers and travelers • Improves maintenance resource allocation

TSMO STRATEGY	WHY APPLY STRATEGY TO REGION?	EXPECTED BENEFITS
TRANSIT MANAGEMENT & OPERATIONS		
Automated Vehicle Location (AVL) and Computer Aided Dispatch (CAD) C-TRAN uses AVL and CAD on their fixed route and paratransit fleet.	C-TRAN plans to continue the use of AVL and CAD because of the many benefits to their system operators and transit users. Service planners can also analyze data to determine if the current route structure is providing the greatest efficiencies and if service changes are having the desired effect.	• Improves on-time performance • Reduces operations and maintenance costs • Enhances passenger convenience because it supports real-time transit arrival information
Automated Passenger Counting (APC) C-TRAN uses APC to count the number of passengers entering and exiting a transit vehicle.	C-TRAN uses data from its APC system to calculate ridership and assess passenger loading on a stop-by-stop basis. APC data supports federal reporting requirements.	• Allows assessment of existing traveler demand • Supports transit route and stop planning

TSMO STRATEGY	WHY APPLY STRATEGY TO REGION?	EXPECTED BENEFITS
TRANSIT MANAGEMENT & OPERATIONS		
Transit Signal Priority (TSP) C-TRAN has a pilot project underway and most signalized intersections are equipped to support TSP	The use of TSP will reduce delay to C-TRAN buses to improve travel-time reliability and increase passenger throughput at signalized intersections.	• Reduces delay at traffic signals by up to 45 percent • Reduces transit travel-time by 5 to 25 percent • Improves travel-time reliability • Increases passenger throughput • Reduces system operational costs if fleet can be reduced
Transit Speed Reliability Add transit lanes or queue jumps at bottleneck locations on high ridership routes or use freeway shoulders for additional transit capacity for transit, particularly during stop-and-go conditions	This strategy will provide preferential treatment to C-TRAN buses over other modes at congested locations to support transit travel-time reliability. The High Capacity Transit study recommends that C-TRAN use the shoulders on I-205 during congested periods. C-TRAN is also investigating this possibility for I-5.	• Reduces transit delay • Improves transit travel-time reliability • More efficient use of existing roadway pavement and capacity • Increases transit ridership • Business Access Transit (BAT)
Regional Transit Fare Integration Use smart cards or magnetic stripe technologies to collect transit fare payments for the entire Vancouver and Portland metropolitan region	A large number of transit riders use both C-TRAN and TriMet to travel between and within the southwest Washington and Portland metropolitan area. C-TRAN and TriMet have some shared pass programs today and are discussing a more integrated approach.	• Enhances passenger convenience • Improves money handling efficiencies
Regional Performance Measures and Supportive Data Collection The PORTAL portion of this project will include data archiving and performance measurement development for roadways, transit, and freight	Limited data is currently available to support benefit-to-cost ratio analysis for TSMO improvements. Other systems produce data that needs to be archived and needs tools to analyze the data in a cost-effective manner.	• Ability to identify effectiveness of TSMO investments and to better target future policies and system improvements • Supports regional planning efforts

TSMO STRATEGY	WHY APPLY STRATEGY TO REGION?	EXPECTED BENEFITS
FREIGHT MANAGEMENT & OPERATIONS		
Real-Time and Predictive Freight Information Enable Port users to post and receive information on the location and status of freight shipments	"Just-in-time" freight systems are increasingly prevalent. Improved freight information, coupled with improved roadway system information, will help support these systems.	• Improves freight route planning • Improves freight movement efficiency • Increases customer satisfaction
Roadside Truck Electronic Screening/ Clearance Programs Use truck-to-roadside communications at check stations to transfer regulatory data or weigh-in-motion	Screening/clearance programs can help reduce delay to freight in the region as well as improve the efficiency of oversight agencies.	• Reduces inspection time by 15 to 65 percent • Reduces freight travel-time, delay, and vehicle emissions
Truck Traffic Signal Priority Apply truck signal priority on regional freight corridors to allow green phase extension to reduce the frequency of truck stops at traffic signals	Many trucks use Mill Plain Boulevard to travel between the regional freeway system and the Port of Vancouver. The City of Vancouver is currently testing truck signal priority at two traffic signals on Mill Plain Boulevard.	• Reduces number of truck stops at signals (truck stops cost approximately $3/stop) • Reduces start-up lost time for trucks and general traffic
Freight Data Collection Collect data to track freight movement throughout the region.	More data is needed to study freight movement and to plan for future improvements to support the freight industry.	• Improves freight route planning • Increases customer satisfaction

TSMO STRATEGY	WHY APPLY STRATEGY TO REGION?	EXPECTED BENEFITS
TRAVELER INFORMATION		
Bi-State Traveler Information Interoperability WSDOT SW Region ITS Plan includes a project to address bi-state traveler information	I-5 and I-205 are heavily used for travel between the southwest Washington and Portland metropolitan areas. WSDOT and ODOT traveler information systems have links to one another and both agencies are exploring options for making these systems more seamless for travelers.	• Provides information for travelers to make informed choices • Increases attractiveness of alternate modes • Potential to improve travel-time reliability
Roadside Traveler Information Dissemination Add variable message signs (VMSs) and highway advisory radio (HAR) for more complete network coverage (WSDOT SW Region ITS Plan includes projects for freeways)	WSDOT has successfully used DMSs and HAR in the region to provide en-route traveler information.	• Provides information for travelers to make informed choices • Reduces delay • Potential to improve travel-time reliability

TSMO STRATEGY	WHY APPLY STRATEGY TO REGION?	EXPECTED BENEFITS
TRAVELER INFORMATION		
Regional Traveler Information Provide static and real-time traveler information (e.g. incidents, maintenance, construction, transit arrivals) from all regional agencies from one central system that provides a third party gateway; WSDOT SW Region ITS Plan includes projects for: • local agency data entry tool • 511 system expansion • private partnership for information delivery • mobile device application • subscription traveler information	Today's society has become accustomed to having up-to-date information at their fingertips. Providing traveler information using a variety of technologies (whether publicly or privately managed) allows travelers to make informed decisions about trip departure times, routes, and travel mode.	• Reduces delay by up to 20 percent • Reduces the number of stops and vehicle emissions by up to 5 percent • Potential to improve travel-time reliability • Reduces crashes • Provides information for travelers to make informed choices • Increases attractiveness of alternate modes • Increases traveler satisfaction with the transportation network
Real-Time Transit Arrival Information Provide real-time transit arrival information by a variety of means such as wayside signs, in-vehicle systems, and interactive online/personal device applications	C-TRAN is currently implementing automated stop annunciation (ASA) on its buses and integrated voice response (IVR), which provides real-time bus arrival information for fixed-routes and confirms paratransit reservations.	• Enhances passenger convenience • Increases attractiveness of transit
Predictive Traveler Information Develop models/tools that can predict travel conditions	As more data is archived in PORTAL, it may be possible to develop a tool that predicts travel conditions based on historic information. Public/private partnerships may also be explored because there are private companies (e.g. INRIX) that use available data to provide cutting edge traffic information.	• Provides information for travelers to make informed choices • Increases traveler satisfaction with the transportation network
Transit Trip-Planning Website WSDOT SW Region ITS Plan includes a project for regional trip planning. C-TRAN's website already includes a trip planning feature that they plan to enhance	Transit trip planning tools enable travelers to make informed travel decisions both pre-trip and en-route.	• Increases attractiveness of transit • Enhances passenger convenience
Parking Availability Information Provide real-time information about parking availability for high demand parking areas. Real-time parking information could potentially be included as a link on the aforementioned transit trip-planning website	Parking information supports traveler decisions related to route and mode choice, which in turn helps the overall transportation system operate more efficiently.	• More efficient use of roadway capacity adjacent to high demand parking areas • Improves traffic flow • Increases attractiveness of transit

Mutually-Supportive Strategies that Strengthen TSMO

Table 7 identifies mutually-supportive (i.e. non-technology based) strategies that could be used in combination with the TSMO strategies listed in Table 6 to improve the performance of the regional transportation system. These are distinct from the TSMO strategies described in the previous section and do not involve real-time management of the transportation system. Mutually-supportive strategies may have higher costs or a lengthy implementation period, and in some cases may require physical changes to the roadway. For example, access management strategies could be used along with enhanced traffic signal operations to improve traffic flow that can be disrupted by turning vehicles accessing businesses.

Table 7: Mutually-Supportive Strategies that Strengthen TSMO

Shared communications network	Continue to share communications infrastructure between agencies to support transportation network.	WSDOT, Clark County, and the City of Vancouver have found their communications sharing efforts beneficial. The current network, plus expansion, supports the systems and inter-agency coordination included in many TSMO strategies.	• Enables system integration and information sharing • Capital and maintenance cost-sharing between agencies reduces costs for each agency
Bottleneck removal	While typically a capacity strategy, bottleneck removal can also support systems management and operation and may include geometric improvements, new lanes, and temporary shoulder use.	Bottleneck removal should be considered to support TSMO strategies as applicable. For example, an additional turn lane may be needed for extra capacity to support the detour of traffic from a major route to a parallel route.	• Reduces crashes • Reduces delay • Potential to improve travel-time reliability
Access management	Access management includes many sub-strategies such as access closure, access restriction (i.e. medians, channelization, right-in / right out), access sharing and consolidation, and street connectivity.	Access management is primarily addressed during the development review process. Region wide access management standards and policies may be established to help support system operations at a broader level (e.g. along with a corridor improvement project).	• Reduces crashes because it reduces the number of potential conflict points for vehicles, bicyclists, and pedestrians • Increases capacity, traffic flow, and travel speed • Potential to improve travel-time reliability
High capacity transit/Enhanced fixed-routes	C-TRAN's 2030 Transit Development Plan includes light rail, bus rapid transit and enhancements to fixed-routes.	High capacity transit itself helps manage system demand and can be used in conjunction with a number of TSMO strategies.	• Increases passenger throughput • More efficient use of roadway capacity

TSMO Strategies with Political and Policy Implications

Although the TSMO strategies described in Table 8 (automated enforcement, congestion pricing, and electronic toll collection) have been successfully implemented in other regions, implementation of these strategies requires changes at the policy level. The key transportation stakeholders involved in the development of this plan understand that these strategies may benefit future traffic operations as long as policymakers and the general public support their use.

Table 8: TSMO Strategies that require Political and Policy Changes to Implement

Automated enforcement	Automatically issue tickets for red light running, speeding, or toll avoidance at locations with compliance issues	Public opinion surveys in the U.S. in 2001 found that approximately 60 to 80 percent of drivers approve the use of automated enforcement.	• Reduces red light violations by 10 to 75 percent • Reduces severity and number of turning and angle crashes • Reduces travel speeds • Increases legal compliance
Congestion pricing	To manage demand on congested facilities a number of pricing strategies may be used at all times or by time of day: variable priced lanes, variable tolls on entire roadways or roadway segments, cordon charging, or area-wide charging.	This strategy may be an option for facilities that are over capacity for extended periods of time and capacity improvements are not practical or feasible to fund.	• Diverts traffic to other modes or off-peak time periods • Improves level of service during peak periods • Potential to improve travel-time reliability
Electronic toll collection	Apply where tolling or congestion pricing may be considered (e.g. Columbia River Crossing)	If tolling or congestion pricing are applied to any regional facilities, electronic toll collection reduces impacts to traffic flow while also keeping system administration costs lower.	• Reduces travel delay and vehicle emissions • Potential to improve travel-time reliability • Cost savings for electronic toll lane over staffed toll lane

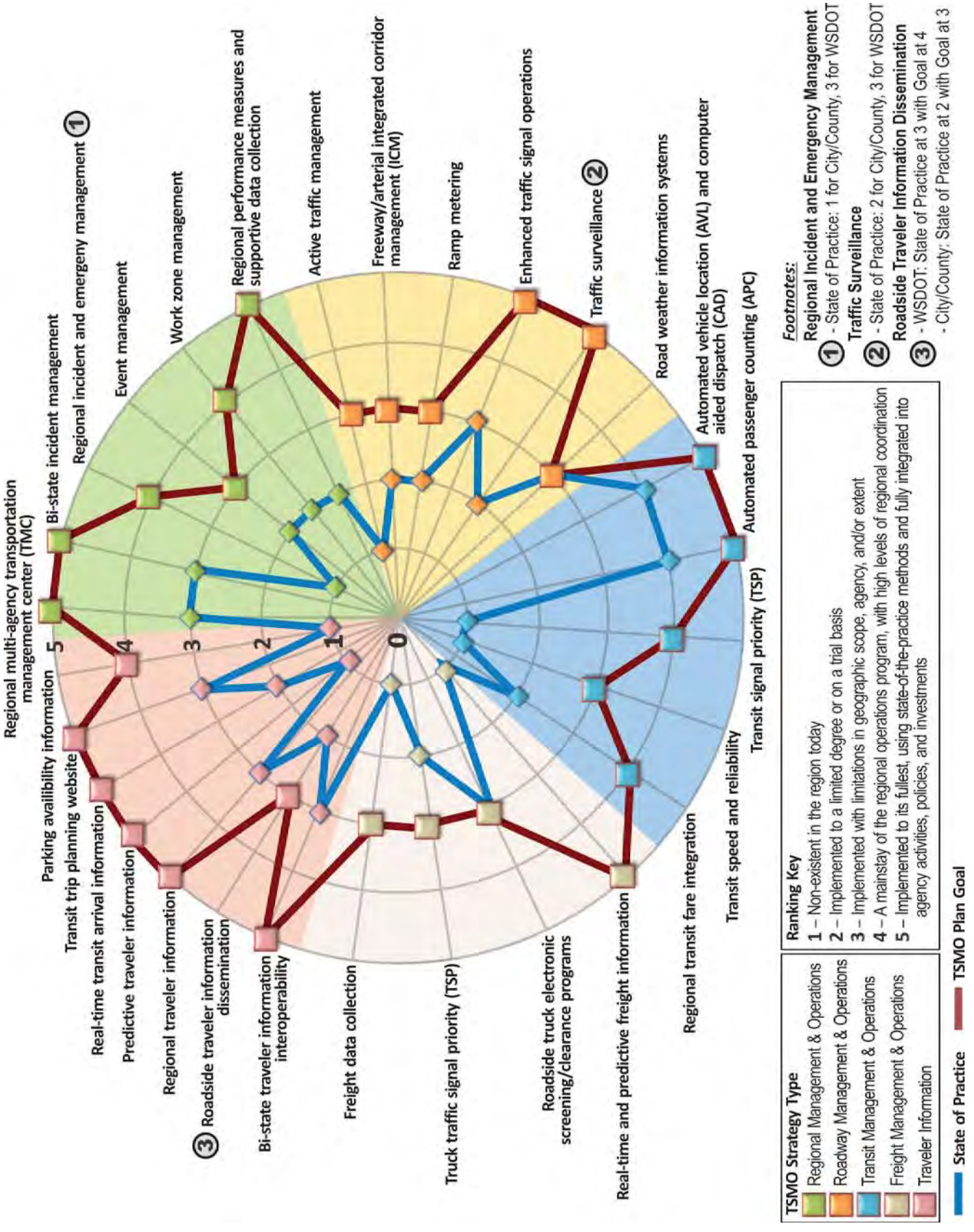


Figure 8: TSMO Strategies Implementation State of Practice and Future Vision

Vision for TSMO Strategy Implementation

At the beginning of the planning process, stakeholders were asked to evaluate the TSMO strategies in Table 6 to rate the current state of practice in the region for each strategy, and the degree to which they would like to see the strategy implemented in the future. The evaluation scale ranges from zero (strategy is non-existent in the region today) to five (strategy is implemented to its fullest). Figure 8 on the previous page illustrates the current state of practice and goal for each strategy and includes a legend describing the evaluation scale.

The graphic notes several strategies where the evaluation differs for WSDOT compared to Clark County and the City of Vancouver. These distinctions recognize that WSDOT operates a mostly limited-access roadway network, while the County and City operate arterial and collector roadways with numerous traffic signals. It is also recognized that the benefits of some strategies will differ depending on the type of roadway network.

Emerging TSMO Strategies

As seen in Figure 8, there are a number of strategies that agencies would like to implement to their fullest extent; likewise, there are many strategies that stakeholders want to expand from a limited use today to a more region-wide application in the future. The strategies with the largest change in degree of implementation (score of one today and five in the future) include:

- Predictive traveler information
- Real-time and predictive freight information

Other key emerging strategies with a large change in degree of implementation (score of two today and five in the future or score of one today and four in the future) include:

- Regional performance measures and supportive data collection
- Regional incident and emergency management
- Traffic surveillance
- Real-time transit arrival information
- Transit signal priority
- Parking availability information

In addition, other future implementation with a moderate change compared to today include:

- Active traffic management
- Enhanced traffic signal operations
- Regional transit fare integration
- Freight data collection
- Bi-state traveler information interoperability
- Regional multi-agency transportation management centers (TMC)
- Transit speed and reliability

Chapter 4
TSMO Performance Measures

Key Concepts:

- Performance Measures help regional agencies evaluate the effectiveness of TSMO strategies in meeting regional Transportation Needs.
- Data generated by ITS systems and collected though the PORTAL regional data archive are a rich source to evaluate transportation system and TSMO performance.
- A proactive approach to data collection and instrumentation is required to effectively implement a TSMO performance measurement program.

Introduction

A key objective of the TSMO Plan is to enable better measurement of the effectiveness of TSMO strategies in meeting transportation needs. In the next few years, the rich data set generated by field ITS systems can be stored and analyzed in ways that were never before possible, thanks to the integration of southwest Washington agencies with the PORTAL regional data archive. This chapter presents candidate performance measures for the regional TSMO program, which promote continual evaluation and performance of the contributions of TSMO to meeting the goals of the regional transportation strategy.

Role of Performance Measures in TSMO

Generally, the benefits of TSMO strategies have been difficult to quantify due to a lack of data, undefined methods, or simply a lack of acknowledged and adopted performance measures. Compared to conventional transportation infrastructure investment, for which a wide array of analytic tools, models and decision-making methods exist, the quantitative evaluation of TSMO measures is in its formative stages. This increases the difficulty of 'making the case' for TSMO in the regional transportation decision making process, because the benefits of TSMO investments are not easily compared or captured.

Performance measurement of the transportation system provides transportation professionals and decision-makers with an ongoing understanding of the effectiveness of TSMO strategies. This is needed so they can identify which strategies most benefit the transportation network and allocate resources accordingly. It also supports the sharing of real-time

and archived data to support active management and operation of the transportation system.

The U.S. Department of Transportation (U.S. DOT) strongly advocates that transportation agencies throughout the country adopt performance-based outcomes, particularly for TSMO. They encourage this approach by allocating funding to programs that support the national transportation strategic goals :

- Safety
- Reduced congestion
- Global connectivity
- Environmental stewardship
- Security, preparedness and response
- Organizational excellence

For each strategic goal the U.S. DOT has identified strategies, desired outcomes, and performance measures. Each fiscal year federal transportation budgets are devised on how well programs are meeting the performance measures under each strategic goal.

The U.S. DOT provides suggestions for establishing a performance measurement program :

- Create a performance measurement committee within the MPO
- Borrow ideas from other regions
- Identify key measures and develop data collection tools to support them
- Publish a performance report regularly
- Develop performance measures with input from the managers involved in day-to-day system operations

Agencies within the southwest Washington urban area measure transportation system performance in a variety of ways and in varying degrees today, but they envision a more robust regional performance measurement program in the future as stated in the goals at the outset of this plan.

Regional TSMO Performance Measures

Table 9 lists the candidate performance measures that stakeholders have identified for monitoring transportation system performance in the region. The candidate performance measures column includes the key performance measurement areas important to stakeholders and the sample measurement column provides examples of how these areas may be measured.

Table 10 identifies how the candidate performance measures link to each of the regional TSMO strategies from Chapter 3. Many of the performance measures may be used to evaluate the performance of multiple TSMO strategies.

Table 9: Candidate Performance Measures

CANDIDATE PERFORMANCE MEASURES	SAMPLE MEASUREMENT
Incident response	• Number/type of incident responses • Incident duration • Incident response time • Average incident clearance time
Collision rate	• Rate/number of primary collisions • Rate/number of secondary collisions • Rate/number of fatalities • Rate/number of injuries
Travel-time	• Average travel-time • Average speed
Travel-time reliability	• Travel-time index • Planning time index • Buffer time index • On-time transit performance
Recurring delay	• Vehicle delay • Person delay • Freight delay
Non-recurring delay	• Vehicle delay • Person delay • Freight delay
Throughput – vehicles	• Vehicle volume per hour
Throughput – passengers	• Passenger trips per vehicle revenue hour and mile • Passenger load (ridership/capacity)
Throughput – freight	• Freight volume • Travel-times on key freight corridors
Hours of congestion	• Duration of congestion
Greenhouse gas emissions	• Vehicle miles traveled • Vehicle emissions- CO2, CO, NOx, VOC • Transit vehicle fuel efficiency
Customer satisfaction	• Percent of population highly satisfied or satisfied with travel conditions • Complaint/compliment rate • Number/type of calls to 511 or transit advisory telephone • Number/type of hits on traveler information website

Table 10: Linking the Candidate Performance Measures to TSMO Strategies

TSMO STRATEGIES		CANDIDATE PERFORMANCE MEASURES										
		INCIDENT RESPONSE	COLLISION RATE	TRAVEL-TIME	TRAVEL-TIME RELIABILITY	RECURRING DELAY	NON-RECURRING DELAY	THROUGHPUT- VEHICLE	THROUGHPUT- PASSENGER	HOURS OF CONGESTION	GREENHOUSE GAS EMISSIONS	CUSTOMER SATISFACTION
REGIONAL MANAGEMENT & OPERATIONS	Regional multi-agency transportation management center (TMC)	✓		✓	✓	✓	✓	✓	✓	✓	✓	
	Bi-state incident management	✓	✓				✓				✓	
	Regional incident and emergency management	✓	✓				✓				✓	
	Event management			✓	✓		✓				✓	
	Work zone management		✓	✓	✓		✓			✓	✓	
	Regional performance measures and supportive data collection											✓
ROADWAY MANAGEMENT & OPERATIONS	Active traffic management		✓	✓	✓	✓		✓	✓	✓	✓	
	Freeway/arterial integrated corridor management (ICM)			✓	✓	✓		✓	✓		✓	
	Ramp metering			✓	✓	✓	✓			✓		
	Enhanced traffic signal operations			✓	✓	✓	✓			✓	✓	
	Traffic surveillance	✓		✓	✓							
	Road weather information systems		✓	✓	✓							

TSMO STRATEGIES		CANDIDATE PERFORMANCE MEASURES										
		INCIDENT RESPONSE	COLLISION RATE	TRAVEL-TIME	TRAVEL-TIME RELIABILITY	RECURRING DELAY	NON-RECURRING DELAY	THROUGHPUT- VEHICLE	THROUGHPUT- PASSENGER	HOURS OF CONGESTION	GREENHOUSE GAS EMISSIONS	CUSTOMER SATISFACTION
TRANSIT MANAGEMENT & OPERATIONS	Automated vehicle location (AVL) and computer aided dispatch (CAD)			✓	✓							
	Automated passenger counting (APC)								✓			
	Transit signal priority (TSP)			✓	✓				✓			
	Transit speed and reliability			✓	✓				✓		✓	
	Regional transit fare integration											✓
FREIGHT MANAGEMENT & OPERATIONS	Real-time and predictive freight information			✓	✓			✓				
	Roadside truck electronic screening/clearance programs			✓	✓							
	Truck traffic signal priority (TSP)		✓	✓	✓			✓			✓	
	Freight data collection			✓	✓							
TRAVELER INFORMATION BI-STATE TRAVELER INFORMATION INTEROPERABILITY	Bi-state traveler information interoperability				✓					✓	✓	✓
	Roadside traveler information dissemination				✓					✓	✓	✓
	Regional traveler information				✓					✓	✓	✓
	Predictive traveler information				✓						✓	✓
	Real-time transit arrival information				✓				✓			✓
	Transit trip planning website				✓				✓			✓
	Parking availability information											✓

Regional Data Sources

Table 11 lists the regional data sources that are available to support TSMO performance measurement or that are planned for development. Both Clark County and the City of Vancouver recently upgraded their central traffic signal system to ATMS.now, which has the ability to generate many types of performance measurement reports or to provide data to calculate performance measures as described here.

Table 12 details the performance measures that are available through the ATMS.now signal system.

Table 11: Regional Data Sources for Performance Measures

DATA SOURCE	NOTES
System detectors (speed, volume, occupancy)	Speed, volume, and occupancy data available from WSDOT, Clark County, and City of Vancouver; WSDOT detectors also provide truck volumes; Communications needed to older County and City detectors to access the data. Some older detectors will require new wiring to provide individual lane information.
24-hour and turn movement counts	Mostly available in hard copy or PDF format; The central traffic signal system can be configured to automatically collect turn movement counts, but in some cases modifications to existing detectors will be required. In the future agencies should request this data in its native electronic format.
Bicycle and pedestrian counts	In the future agencies should request this data be included with vehicular counts; ATMS. now can report how many pedestrian calls are made on each leg of a traffic signal.
ATMS.now traffic signal system	Please see Table 12.
Truck origin-destination data	The Port of Vancouver is working with the University of Washington to develop data collection methodology.
WSDOT incident data	Available from radio log and CAD system.
WSP accident reports	Accident reports for all jurisdictions are sent to and are available through WSP.
C-TRAN systems	Data available to evaluate the transit performance measures included in the early portion of this document.
Greenhouse gas emissions	The City of Portland is currently developing methodology that may also be used in southwest Washington.

Table 12: Potential Performance Measures Available with ATMS.now Traffic Signal System

CANDIDATE PERFORMANCE MEASURES		ATMS.NOW DATA		NOTES
		AVAILABLE DIRECTLY	REQUIRES CALCULATIONS	
INCIDENT DURATION	Incident Duration	✓		Incident triggers must be set up to provide start time and stop time (see section 5.15 of the Naztec Operations manual for ATMS.now)
	Incident Response Time			
	Average Incident Clearance Time			
COLLISION RATE	Rate/Number of Primary Collisions			
	Rate/Number of Secondary Collisions			
	Rate/Number of Fatalities			
	Rate/Number of Injuries			
TRAVEL TIME	Average Travel-time		✓	Can be calculated from average speed
	Average Speed	✓		Available in report format from detectors
TRAVEL-TIME RELIABILITY	Travel-time Index			
	Planning Time Index			
	Buffer Time Index			
	On-Time Transit Performance			
RECURRING DELAY	Vehicle Delay	✓		LOS and v/c ratios are provided by intersection for selected time period; Cycle and green time are available to allow for an automated HCM calculation
	Person Delay			
	Freight Delay			
NON- RECURRING DELAY	Vehicle Delay	✓		LOS and v/c ratios are provided by intersection for selected time period
	Person Delay			
	Freight Delay			

CANDIDATE PERFORMANCE MEASURES		ATMS.NOW DATA		NOTES
		AVAILABLE DIRECTLY	REQUIRES CALCULATIONS	
THROUGHPUT-VEHICLE	Vehicle Volume per Hour	✓		Available by intersection for selected time period (resolution down to one minute)
THROUGHPUT-PASSENGER	Passenger Trips per Vehicle Revenue Hour and Mile			
	Passenger Load (Ridership/ Capacity)			
HOURS OF CONGESTION	Duration of Congestion	✓		Available by lane, by intersection, or by occupancy for selected time period (see section 4.8.41 of the Naztec Operations manual for ATMS.now)
GREENHOUSE GAS EMISSIONS	Vehicle Miles Traveled			
	Vehicle Emissions – CO2, CO, NOx, VOC		✓	May be calculated from average travel-time and average speed
	Transit Vehicle Fuel Efficiency			
CUSTOMER SATISFACTION	Percent of Population Highly Satisfied or Satisfied with Travel Conditions			
	Complaint/Compliment Rate			
TRANSIT SIGNAL PRIORITY	Number of Transit Priority Requests	✓		With transit priority module a report is provided; without transit priority module the measure equals the number of buses requesting priority regardless of whether they have been served
	Transit Priority Events Served	✓		With transit priority module a report is provided
	Duration of Green Times	✓		Provided as a report or can be watched with real-time graphical split monitoring (see section 4.3.1.7 of the Naztec Operations manual for ATMS.now)

Role of the PORTAL Regional Data Archive

The PORTAL data archive, developed in 2004 and operated/maintained by Portland State University (PSU), is the official transportation data archive for the Portland/Vancouver metropolitan area and plays a key role in performance measurement. It supports:

- Building a performance-based long-range transportation plan
- Increased focus on better management of the transportation system
- Decision making beyond traditional level-of-service analysis

Today PORTAL includes freeway data, incident data, traffic counts, parking data and weather information.

RTC is one of the PORTAL partners and they represent the interests of transportation agencies in the Vancouver urban area. TSMO Steering Committee members are collaborating with PSU to assess data capabilities and reporting needs to expand the functionality of PORTAL in order to achieve the following goals:

- Validate WSDOT detector data
- Develop methodology and begin archiving arterial data from Clark County and Vancouver
- Develop methodology and begin archiving C-TRAN data
- Support data download so agency personnel have access to data stored in PORTAL for customized reporting
- Develop tools to improve user interface and automate performance measurement reports

Users of PORTAL include researchers, local transportation planners and engineers, and the local news media. PORTAL is set up to allow downloading of raw data, which is of particular interest to researchers, but is also set up to generate reports based on user parameters, which is of interest to the operators of the transportation network. Currently PORTAL analysis capabilities include:

- Performance monitoring
- Comparison of data across time from field devices
- Comparison of design performance
- Measurement of traffic incident impacts

PSU has been rolling out PORTAL 2.0 to further enhance the performance measurement reports based on input from the transportation operators, including southwest Washington agencies.

The key benefits of using PORTAL as the centralized transportation data archive in southwest Washington are:

- Accessibility of transportation data;
- Performance measures that support regional transportation planning, operations and investment decisions; and
- Financial savings due to regional partnerships.

Chapter 5
Regional Concept of Operations

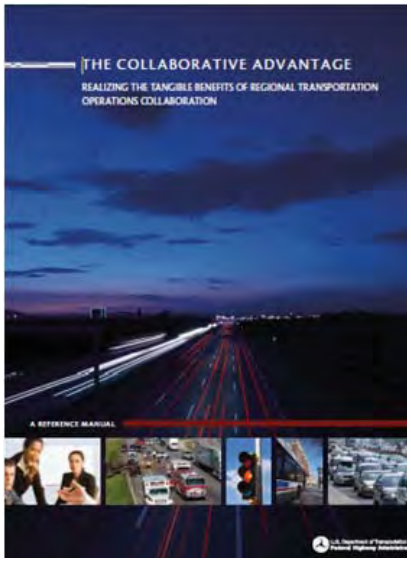
Key Concepts

- Regional TSMO services are delivered through the actions of individual agencies with specific and agreed upon roles and responsibilities.
- Agency responsibilities include planning, funding, owning, operating, and maintaining TSMO resources and infrastructure.
- Regional Concepts for Transportation Operations have been developed for five TSMO focus areas: Regional Management and Operations; Roadway Management and Operations; Transit Management and Operations; Freight Management and Operations; and Traveler Information.

Introduction

The success of Transportation System Management and Operations (TSMO) strategies is as contingent upon successful interagency working relationships as it is about implementation of enabling ITS technologies. This chapter describes the operational relationships among stakeholder agencies necessary to support TSMO strategies in southwest Washington, also known as a Regional Concept for Transportation Operations (RCTO).

The idea of a RCTO grew out of work by the Federal Highway Administration to facilitate the implementation of TSMO strategies to optimize the use of existing infrastructure across modes. The objective of an RCTO is to focus on an operational area of regional significance (e.g., traveler information) over a relatively short planning horizon of 3-5 years. The RCTO complements the Regional ITS Architecture by focusing on an institutional view, rather than solely an ITS view, of transportation operations.



The Vancouver Area Smart Trek (VAST) program in Clark County has been nationally recognized as a model for regional transportation operations collaboration.

Clark County is in an admirable position in terms of its track record of regional cooperation in transportation operations. It has been nationally recognized for its collaborative approach to ITS implementation and transportation system operations, both in day-to-day operations and in strategic coordination through VAST for project development and funding . This collaboration extends across the state line to include planning, operations, and response agencies in Oregon. These relationships make possible the implementation of coordinated incident response plans, infrastructure sharing, and data interfaces among regional ITS devices – all tactics that support a regional, collaborative approach to operations.

Purpose of the Regional Concept of Transportation of Operations

As the region moves forward to implement newer and more sophisticated TSMO strategies, the Regional Concept for Transportation Operations provides framework guidance for the type of inter-agency coordination that will be required to support those strategies.

Comparing the current state of TSMO practice in the region, implementation of the TSMO strategies identified in this plan suggests that in the future:

- There will be a greater degree of agency collaboration across jurisdictional boundaries to implement TSMO strategies in meeting regional needs.
- There will be a need for more formalized real-time operational response and coordination plans involving multiple agencies (e.g., integrated corridor management, traffic diversions, and event management).
- There will be more numerous system-to-system interfaces across agency jurisdictions requiring design, operation, and maintenance (e.g. transit signal priority).
- There will be a higher degree of data analysis to support performance measurement and planning, drawing upon multiple data source systems and agencies.

The RCTO serves as a blueprint for key intra-agency and agency-to-agency relationships in delivering TSMO services in the region. Some of these relationships may merit the development (or update) of formalized interagency agreements among the parties.

The RCTO also describes the nature of a specific agency's participation in supporting the implementation of TSMO strategies in the region (e.g. direct operational roles, technology support and maintenance roles, etc). The roles of an agency in supporting future TSMO initiatives may require different resource allocation, staff resources, training, and capital infrastructure as compared to current practices.

From the perspective of an individual agency as well as the region, it is important to understand the implications of TSMO implementation as described in the RCTO on transportation policies, practices, and resource allocation.

Relationship of the Regional Concept of Transportation Operations

A key point in understanding the Regional Concept for Transportation Operations is that it is not intended to replace the "Concept of Operations" developed as part of an ITS project design process. The RCTO is more regional in scope, and presents a broader framework for institutional coordination. By contrast, a project concept of operations more explicitly describes the detailed technical functioning and relationships of a specific ITS project or system being implemented.

The RCTO provides a reference point for project-level systems engineering and concepts of operation by describing the regional context in which any individual project exists. Efforts at the project level may also result in more specific interagency agreements for that project, such as data interface standards or day-to-day operational responsibilities of agency staff. The RCTO is a management tool to help partnering agencies reach consensus on what they want to achieve with the Plan, and what they need to get there. By implementing an RCTO, partners put operations strategies into action that will be sustained over the long-term.

Organization of the Regional Concept of Transportation Operations

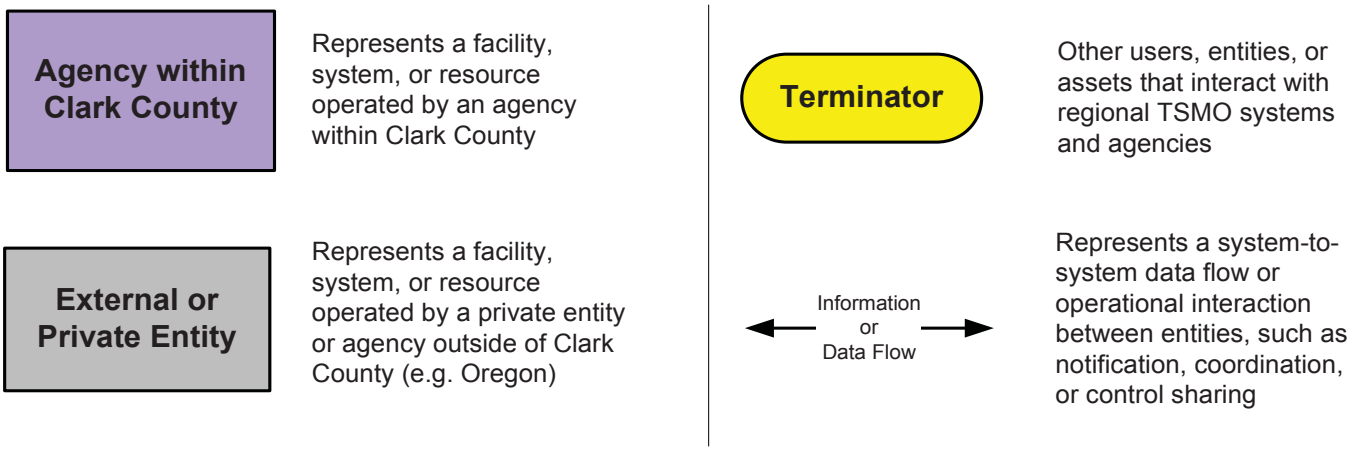
Regional Concept for Transportation Operations scenarios have been developed for each of the five categories of TSMO strategies introduced previously:

- Regional Management and Operations
- Roadway Management and Operations
- Transit Management and Operations
- Freight Management and Operations
- Traveler Information

Each Regional Concept for Transportation Operations includes:

- A description of the Transportation System Management and Operations strategy group;
- A list of the TSMO strategies included within the RCTO;
- An RCTO concept diagram indicating the high-level relationships among agencies and systems in the region associated with the implementation of the RCTO. This diagram provides a high-level overview of the system connections and information flows captured in greater detail in the Regional ITS Architecture; and
- A list of participating agencies and their current and future roles and responsibilities in supporting the RCTO.

Figure 9: RCTO Concept Diagram Legend to Figures 10-14



Agency Roles and Responsibilities in Support of TSMO Implementation

Many agencies in Clark County and on the Oregon side of the metropolitan area perform critical roles in supporting TSMO strategies. This is indicative of the underlying operational linkages among agencies and the multiple jurisdictions that comprise the region's complex, multimodal transportation network.

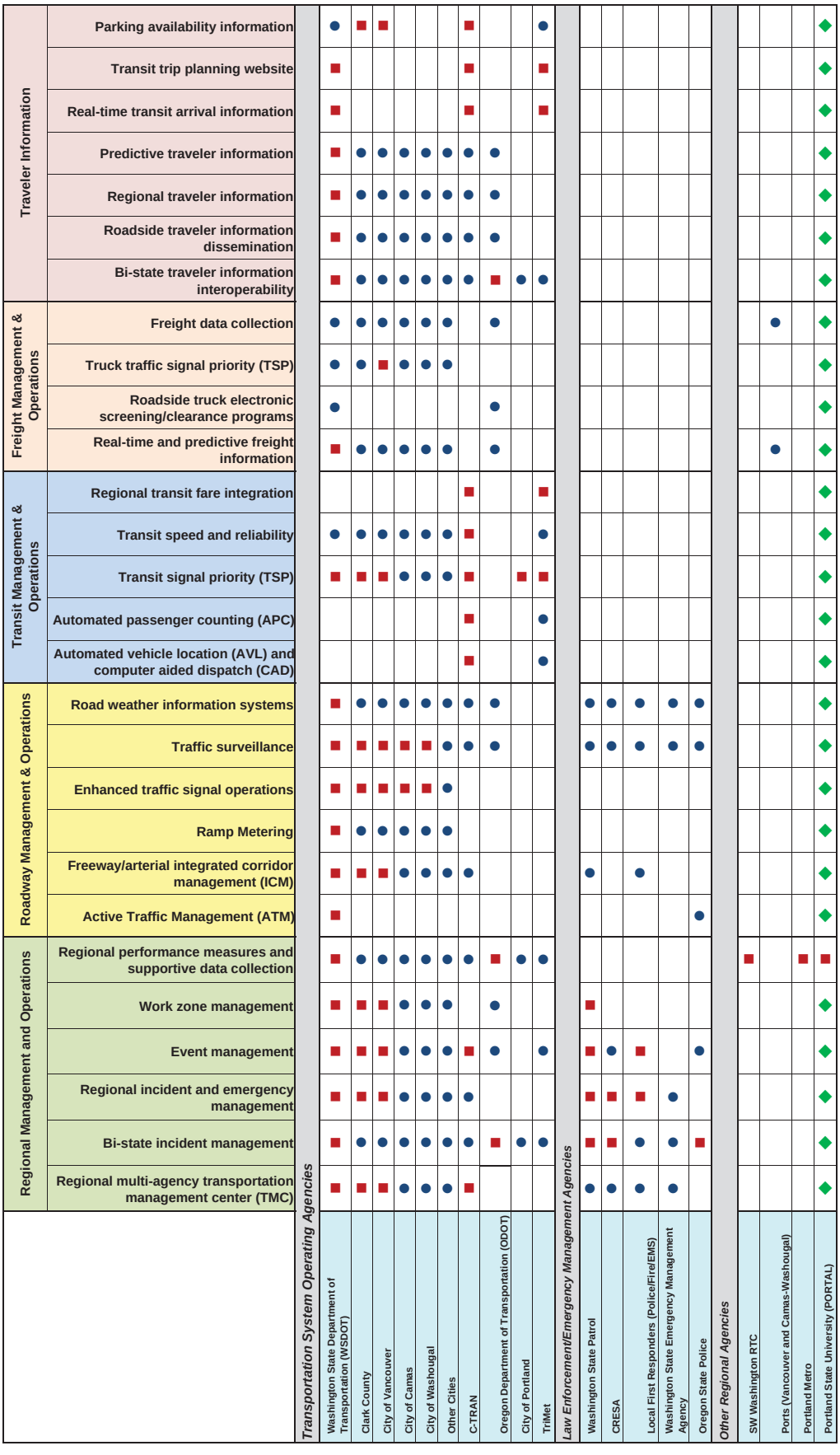
Table 13 on the following page summarizes the roles and responsibilities of regional agencies in supporting TSMO implementation. The diagram addresses implementation of TSMO strategies at the regional level; within a specific corridor, sub-area, or project the participation of agencies may vary.

Agencies are classified according to their function as follows:

- Agencies with a Lead Operations Role have a day-to-day, "hands on" role in implementing the TSMO strategy. Quite often, these agencies, or a subset of them, lead the planning, funding and implementation of ITS technologies that enable strategy implementation. Each TSMO strategy has at least one Lead Agency in the region.
- Agencies with a Supporting Operations Role are also critical to the success of a TSMO strategy, though their participation may be limited according to jurisdictional factors or the degree of responsibilities or participation as compared to Lead Agencies.
- Each TSMO strategy is also a potential Data Source of ITS or operational data to the PORTAL archive to support performance measurement, analysis, and planning. This is acknowledged in Table 13 by illustrating the role of Portland State University in collecting and archiving operations data in each strategy. This role is also indicted by PSU's Lead Operations Role in the Regional Performance Measures and Supporting Data Collection strategy.

For example, many agencies may take advantage of the County's Roadway Weather Information System (RWIS) data to support operations and emergency response, but only WSDOT (the Lead Agency) operates and maintains the single RWIS location. By contrast, a TSMO strategy like Regional Incident and Emergency Management requires substantial commitment of technology, resources and personnel by several traffic, law enforcement and emergency management agencies. Accordingly, a larger number of agencies are shown with a lead operational role. In both examples, data from the ITS devices supporting these TSMO strategies, such as event logs and pavement weather conditions, is exported to the PORTAL regional data archive at PSU.

Table 13: Agency Roles and Responsibilities in Support of Regional TSMO Strategies



TSMO STRATEGY GROUP	1. Regional Management & Operations
DESCRIPTION	The Operational Concept describes the cooperation among regional transportation and emergency management agencies to seamlessly operate the multi-modal transportation system of the region (Figure 10). This includes management of incidents and emergencies of a bi-state nature that necessitate a coordinated operational response with partner agencies in Oregon. A virtual traffic management center concept is envisioned to focus on center-to-center sharing of information, and in some cases, device control, among agency participants while minimizing the day-to-day operational staffing requirements. Sharing of data and information across centers enables each agency to make better operational decisions based upon a fuller picture of transportation system conditions. Coordination with emergency responders is achieved through similar data and information sharing that provides 'situational awareness' to emergency responders and aids in dispatch of the appropriate response tools. Transportation agencies can support the emergency response effort by managing regional traffic response through traveler information, diversions/ detours, or altered traffic signal timing for example. Real-time response among agencies is supported by pre-planned incident response plans, scenarios, and training that builds the tactical working relationships among agencies. As another regional service, agencies in southwest Washington will contribute transportation data to the PORTAL regional data archive, making these data accessible for performance measurement, planning, incident/event debriefing, and other uses.
TSMO STRATEGIES INCLUDED	• Regional Multi-Agency Traffic Management Center (TMC) • Regional Performance Measures and Supportive Data Collection • Traffic Surveillance • Bi-State Incident Management • Work Zone Management • Regional Incident and Emergency Management

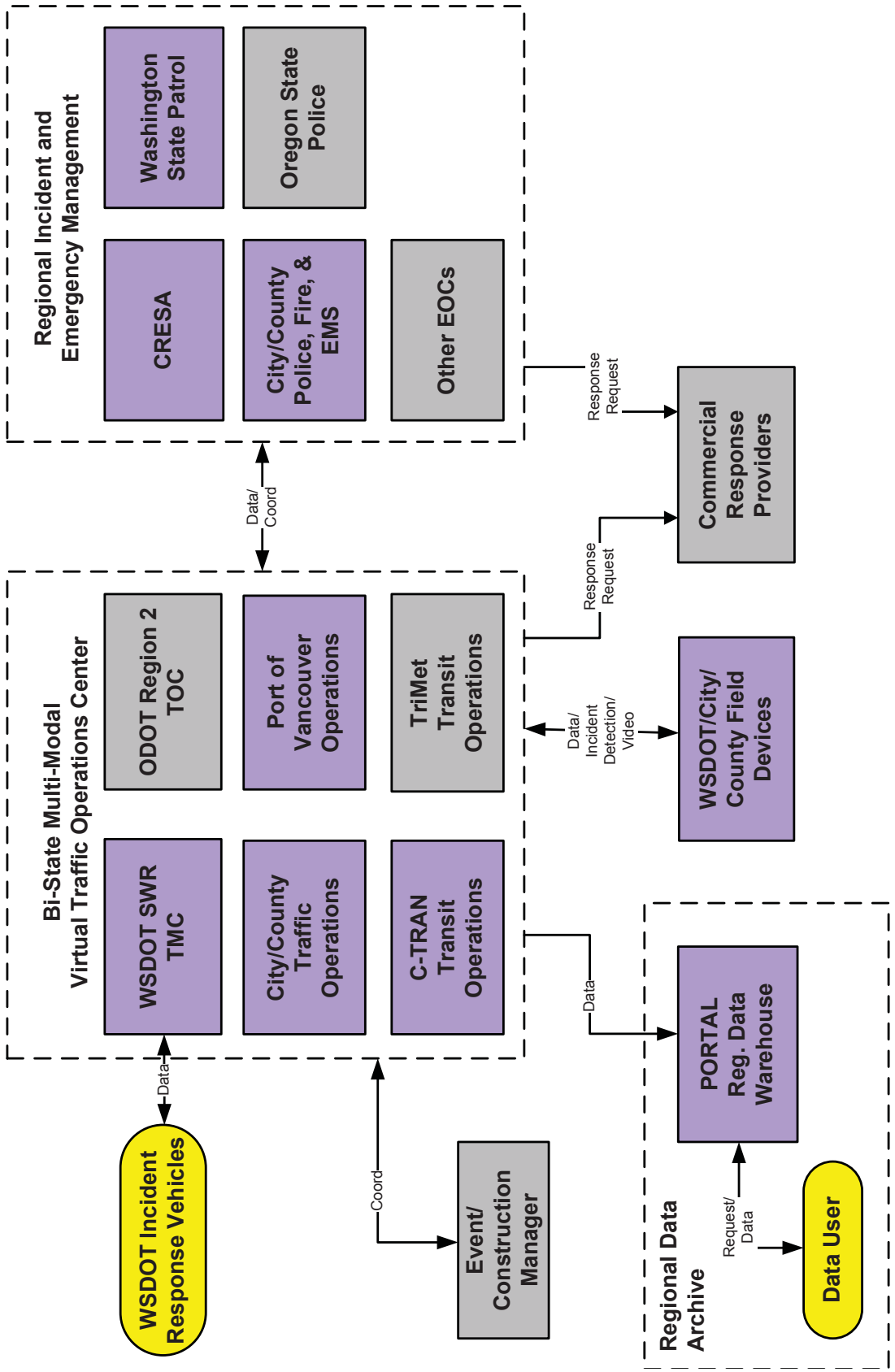


Figure 10: Regional Management and Operations RCTO

TSMO STRATEGY GROUP		
Agency	**Current Related Roles and Responsibilities**	**Additional Future Roles and Responsibilities**
Washington State Department of Transportation (WSDOT)	• Coordinates with other agencies in the Virtual Traffic Management Center environment through its Southwest Region Traffic Management Center (TMC) • Coordinates with other WSDOT regions and the state Emergency Operations Center for large-scale incident response	• Develops and implements updated bi-state traffic and incident management strategies • Enhanced information, data, and control sharing functions through the region's virtual Transportation Management Center • Participates in training exercises with state and local law enforcement and emergency responders to support incident management • Implements work zone management strategies on state highways
Cities (Vancouver, Battle Ground, Camas, Washougal, others) **Clark County**	• Operates arterial traffic management systems, including traffic signals, detection, and surveillance • Leads incident management and response on City/County roadways and arterials • Participant in regional traffic incident and event management for larger scale incidents	• Enhanced information, data, and control sharing functions through the region's virtual Transportation Management Center • Participates in training exercises with state and local law enforcement and emergency responders to support incident management • Participates in implementation of freeway detour plans through management of diversion routes and spill-over traffic • Implements work zone management strategies on local streets and arterials • Data provider to PORTAL Regional Data Archive n support of regional data archive and performance measurement programs
C-TRAN	• Coordinates with traffic agencies on incident-related service disruptions	• Recipient of real-time traffic data information through the virtual Traffic Management Center to support transit operations

TSMO STRATEGY GROUP

Agency	Current Related Roles and Responsibilities	Additional Future Roles and Responsibilities
TriMet	• Coordinates with C-TRAN on incident-related service disruptions	• Recipient of real-time traffic data information through the virtual Traffic Management Center to support transit operations
Clark Regional Emergency Services Agency (CRESA)	• 9-1-1 Public Safety Answering Points (PSAP) and regional emergency response dispatch center for Clark County • Coordinates with transportation agencies and first responders for incident and emergency response	• Recipient of real-time traffic data information through the virtual Traffic Management Center to support transit operations • Shares 911 incident and event data through Computer Aided Dispatch (CAD) integration with traffic management systems • Participates in training exercises with traffic management agencies to support incident and event management
Oregon Department of Transportation (ODOT)	• Provides traffic and incident management services for adjacent areas of ODOT region 2, including joint management of the I-5 and I-205 bridges • Coordinates with WSDOT Southwest Region TMC and WSP on bi-state response for major incidents and events	• Implements coordinated traffic and incident management plans for bi-state incidents in accordance with updated regional strategies
Oregon State Police (OSP) **Washington State Patrol (WSP)**	• Emergency responder for transportation incidents and emergencies • Coordinates with WSDOT Southwest Region TMC on tactical incident response	• Increased coordination with traffic management agencies for management of traffic incidents and events • Participates in training exercises with traffic management agencies to support incident and event management

TSMO STRATEGY GROUP

Agency	Current Related Roles and Responsibilities	Additional Future Roles and Responsibilities
Local First Responders (City/ County Police, Fire, & EMS)	• Respond to traffic incidents and other regional emergencies and events • Participants in traffic detour/ diversion schemes during transportation system disruptions	• Increased coordination with traffic management agencies for management of traffic incidents and events • Participates in training exercises with traffic management agencies to support incident and event management
Commercial Response Providers	• Contract response services to traffic incidents and emergencies (e.g., tow trucks, hazmat)	• Potential recipient of live incident information and video feeds to assist with emergency response
Regional Transportation Council (RTC)	• Manages regional traffic data collection program	• Key user of traffic and operations data for planning and performance measurement
PORTAL Regional Data Archive (Portland State University)		• Receives and archives traffic, incident, and event information in the PORTAL regional data archive

TSMO STRATEGY GROUP	2. Roadway Management & Operations
DESCRIPTION	Roadway Management & Operations involves the coordinated response to changing traffic conditions, weather events and all other localized or widespread disruptions to the regional transportation system. These activities are the bedrock of day-to-day management of the region's roadway network. The linkages between transportation agencies is vital to maximizing system performance and event management, and is supported through pre-defined operational management plans, systems integration, and training exercises. As traffic conditions change over time, operating agencies monitor field conditions and can centrally implement response measures (such as traffic signal timing changes) from agency traffic operations centers. Through technology, real-time information exchange, and coordinated response and communications plans, agencies at the state, regional and local levels will have an improved ability to manage multiple facilities in a given corridor, to ensure that the efficiency of the transportation system is maximized. Event management applies coordinated operations strategies to the region's large-scale special events, such as Fourth of July fireworks, concerts, and parades. By using ITS infrastructure to inform motorists and monitor changing roadway conditions, agencies are better equipped to manage demand surges or unusual traffic patterns in a coordinated manner. Winter operations decision-making, including the dispatch of plows and application of treatment materials, is informed by WSDOT's regional network Road Weather Information Systems (RWIS) that monitor critical atmospheric conditions and pavement temperatures. By sharing RWIS network data with other regional agencies, this system increases safety while improving the effectiveness and efficiency of agency response efforts.
TSMO STRATEGIES INCLUDED	• Integrated Corridor Management (ICM) • Enhanced Traffic Signal Operations • Road Weather Information Systems (RWIS) • Computer Aided Dispatch (CAD) integration • Special Event Management • Traffic Surveillance • Future Ramp Metering

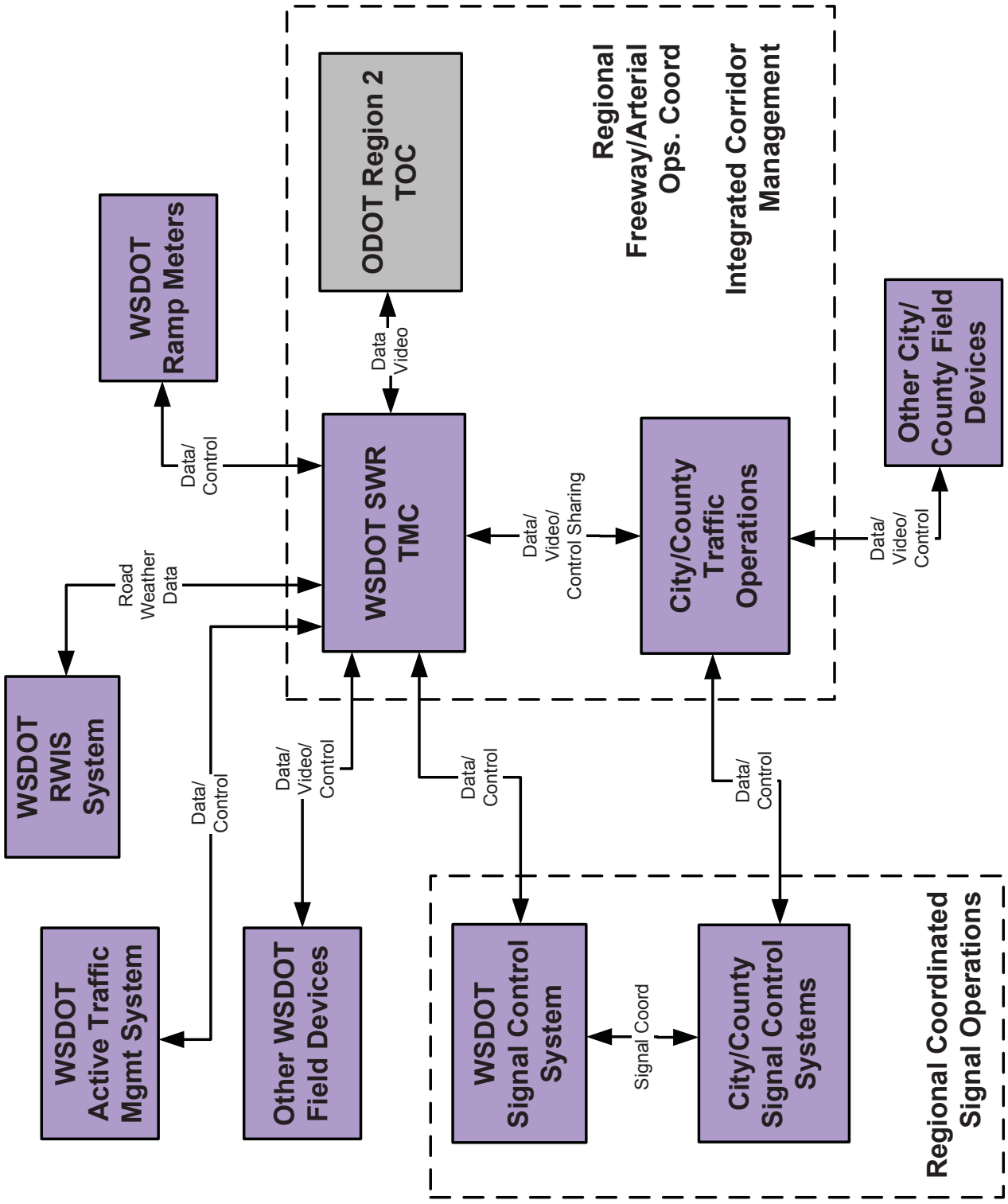


Figure 11: Roadway Management and Operations

TSMO STRATEGY GROUP

Agency	Current Related Roles and Responsibilities	Additional Future Roles and Responsibilities
Washington State Department of Transportation (WSDOT)	• Operates and maintains state freeways and highways in Clark County and the Southwest Region, including associated ITS field devices • Coordinates incident management and response on freeways and state highways • Operates freeway ramp meter at one location (SR-14 @ southbound I-5) • Operates Roadway Weather Information Systems (RWIS)	• Implements Integrated Corridor Management (ICM) and freeway diversion strategies in concert local agencies • Increased coordination of arterial traffic management strategies with adjacent jurisdictions • Potential application of Active Traffic Management (ATM) strategies on a trial basis on one or more freeway corridors • Support traffic management and incident detection/verification through expanded traffic surveillance and interagency video sharing • Limited expansion of ramp metering systems where warranted and feasible
Cities (Vancouver, Battle Ground, Camas, Washougal, others) **Clark County**	• Operate local streets and arterials, including traffic signal systems, detection, and other ITS devices	• Implements enhanced arterial traffic signal coordination and operational strategies • Increased coordination of arterial traffic management strategies with WSDOT and other local jurisdictions
PORTAL Regional Data Archive (Portland State University)		• Receives and archives traffic, incident, and event information in the PORTAL regional data archive

TSMO STRATEGY GROUP	3. Transit Management and Operations
DESCRIPTION	The application of operational strategies and advanced technologies to public transportation improves the quality and reliability of transit service. This increases the attractiveness of the mode for existing and potential customers of C-TRAN, and increases the efficiency and cost-effectiveness of transit operations for the agency. The operational impacts of regional traffic congestion and intersection delay are minimized through the use of advanced technology such as Computer Aided Dispatch/Automatic Vehicle Location (CAD/AVL) These systems allow C-TRAN operations dispatch personnel to mitigate and recover from operational disruptions due to internal or external factors. ITS devices and TSMO transit strategies also support the enhanced service quality and passenger experience envisioned in the implementation of High Capacity Transit in the region. C-TRAN collaborates with local traffic agencies to implement and operate Transit Signal Priority (TSP) at key intersection delay points, improving service reliability under congested conditions. Coordination between C-TRAN and TriMet is important to provide quality transit service across the entire bi-state region. This includes interoperability of ITS devices like TSP and fare collection as well as real-time enhance of operations data among the region's transit and traffic operations agencies through a virtual transit management center concept.
TSMO STRATEGIES INCLUDED	• Computer Aided Dispatch/ Automatic Vehicle Location (CAD/AVL) • Transit Signal Priority (TSP) • Regional Transit Fare Integration • Automated Passenger Counting (APC) • Transit Speed and Reliability

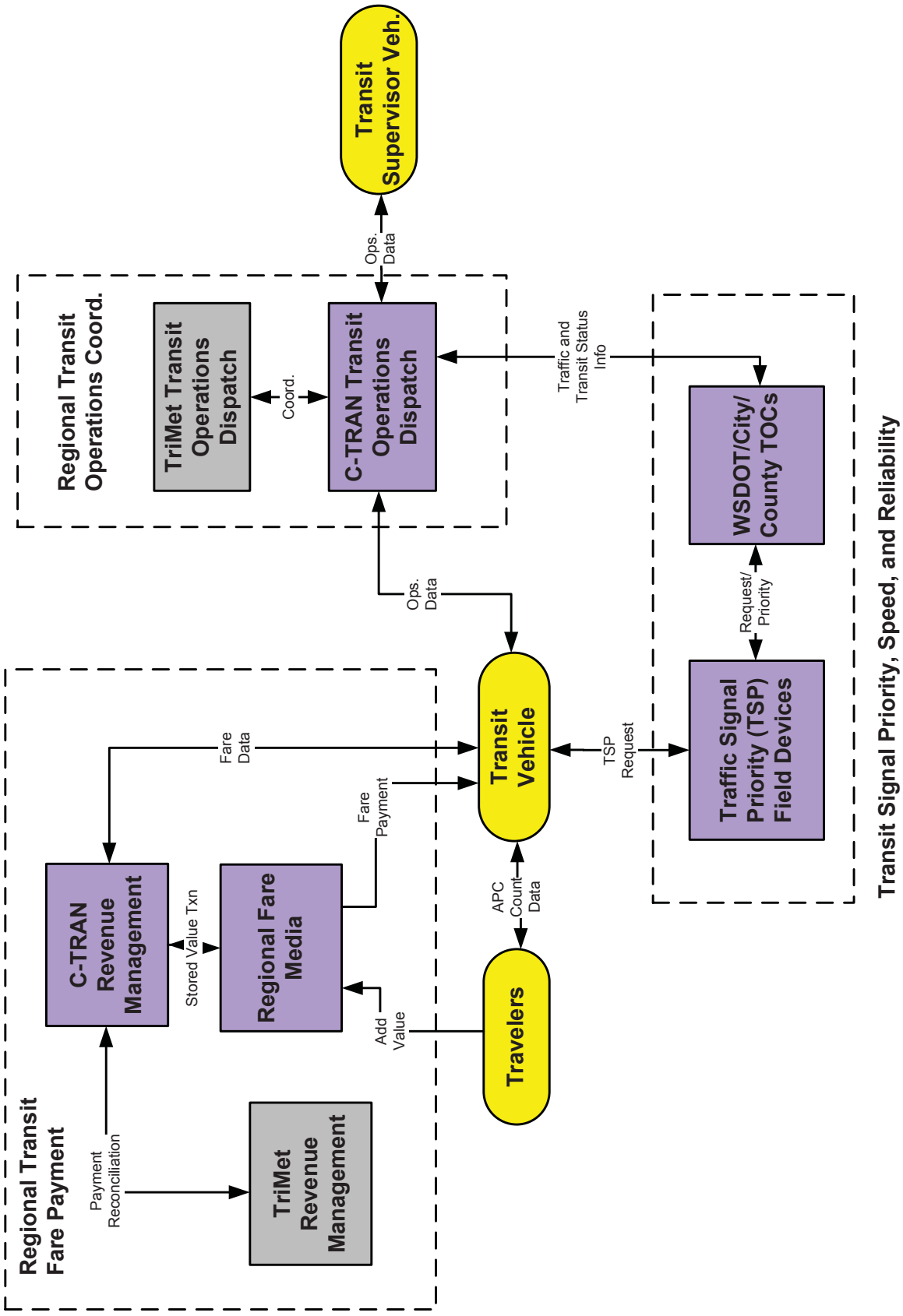


Figure 12: Transit Management and Operations

TSMO STRATEGY GROUP		
Agency	**Current Related Roles and Responsibilities**	**Additional Future Roles and Responsibilities**
C-TRAN	• Operates public transportation services in Clark County • Coordinates with TriMet on bi-state transit operational issues	• Operates Advanced Transit Management System (ATPS) infrastructure including CAD/AVL • Coordinates with local traffic signal operators to operate Transit Signal Priority • Supports fare coordination and interoperability with TriMet
TriMet	• Operates Advanced Transit Management System (ATPS) infrastructure for TriMet services • Coordinates with C-TRAN on bi-state transit operational issues	• Coordinates with C-TRAN and shares data with C-TRAN APTS systems to support real-time transit operations and service coordination • Supports fare coordination and interoperability with C-TRAN
Washington State Department of Transportation (WSDOT)	• Coordinates with C-TRAN operations during incident and event management and response	• Support Transit Signal Priority System through regional traffic signal operations infrastructure • Shares traffic data and video through virtual Traffic Management Center concept to support transit operations
Cities (Vancouver, Battle Ground, Camas, Washougal, others) **Clark County**	• Coordinates with C-TRAN operations during incident and event management and response	• Support Transit Signal Priority System through regional traffic signal operations infrastructure • Shares traffic data and video through virtual Traffic Management Center concept to support transit operations

TSMO STRATEGY GROUP	4. Freight Management & Operations
DESCRIPTION	Freight mobility in Clark County will be enhanced through the development and delivery of services targeted at commercial vehicles and access to the region's ports and industrial corridors. Development of real-time and predictive information services on regional freight corridors strategies will enable port users and commercial shippers to plan delivery routes and schedules in ways that minimize the impacts of traffic congestion incidents, bridge lifts, construction, and other operational causes of delay. The use of truck-to-roadside communications at weigh stations allows regulatory data to be received while in-motion, reducing delay of inspections while increasing the effectiveness of enforcement programs. The application of truck signal priority on regional freight corridors will allow green phase extension to reduce truck delay, account for the slower acceleration and braking characteristics of trucks, and improve safety by reducing sudden stops and collisions with other vehicles. Regional freight data collected by WSDOT and other agencies, such as classified traffic counts, will be archived in the PORTAL data archive to support analysis of and performance measurement of freight mobility in the region.
TSMO STRATEGIES INCLUDED	• Real-time and Predictive Freight Information • Truck Traffic Signal Priority • Roadside Electronic Truck Screening/Clearance Programs • Regional Performance Measures and Supportive Data Collection

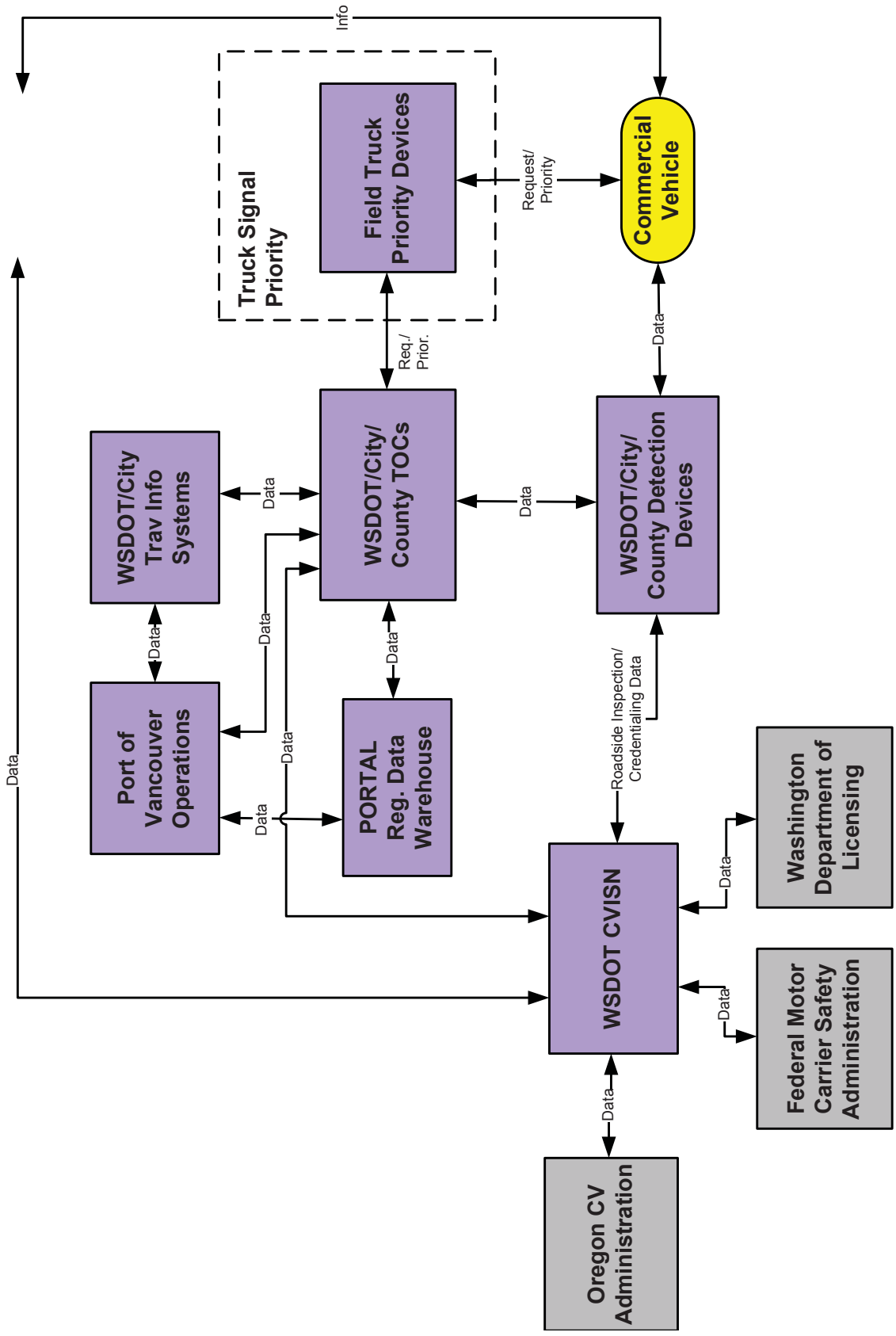


Figure 13: Freight Management and Operations RCTO

TSMO STRATEGY GROUP

Agency	Current Related Roles and Responsibilities	Additional Future Roles and Responsibilities
Washington State Department of Transportation (WSDOT)	• Manages statewide Commercial Vehicle Information Systems Network (CVISN) programs • Implements and leads roadside commercial vehicle inspection equipment (e.g. weigh stations) • Performs freeway and arterial traffic management on regional freight corridors • Operates traffic count stations (including vehicle classification)	• Provide commercial vehicle operation data to PORTAL regional data archive • Implement and operate truck signal priority on state highway corridors
Ports (Vancouver, Ridgefield and Camas-Washougal)	• Operates port facilities and coordinates with commercial shippers and on-port industries on freight movement into and out of the ports	• Provide port operations data to PORTAL regional data archive
Cities (Vancouver, Battle Ground, Camas, Washougal, others) **Clark County**	• Operate traffic signals and provide traffic management in select regional freight corridors.	• Implement and operate truck signal priority on city/county corridors
Regional Transportation Council (RTC)	• Support regional traffic data collection program	• Key user of freight for planning and performance measurement
Oregon Department of Transportation (ODOT)	• Manages commercial vehicle programs and related ITS infrastructure in Oregon • Provides freight data to PORTAL regional data archive	• Coordinate with WSDOT and other agencies on bi-state freight operations initiatives • Share traffic data sets for bi-state freight management analysis through PORTAL

TSMO STRATEGY GROUP	5. Traveler Information
DESCRIPTION	Agencies in Clark County provide real-time traveler information on traffic conditions, transit services, and incident/emergency information through shared and integrated ITS devices. Traveler information TSMO strategies are an important means of influencing traveler behavior in conjunction with traffic, incident, and event management strategies. With the availability of up-to-date and reliable information available, travelers are able to make more informed decisions, reduce travel delays, and make more effective use of the multimodal regional transportation system. The highest degree of benefit from traveler information strategies is achieved when accurate, quality information is disseminated through a variety of convenient media. Regional agencies leverage statewide assets such as the 511 telephone traveler information system and WSDOT website, as well as agency-owned systems and field devices. Coordination with ODOT and mutual exchange of traveler information with Oregon traveler information systems (such as ODOT's TripCheck) provides seamless and consistent information across the metropolitan area for both local and long-distance commuters. Opportunities to leverage private or third-party traveler information applications, delivered through handheld devices, broadcast media, and/or in-vehicle devices is supported through public agency data portals to Information Service Providers (ISPs) which extend the reach of traveler information strategies to the greatest number of users using the most up-to-date technologies.
TSMO STRATEGIES INCLUDED	• Roadside Traveler Information Dissemination • Regional Travel Information (travel-time, congestion information, incidents) • Predictive Traveler Information • Transit Trip Planning Website • Parking Availability

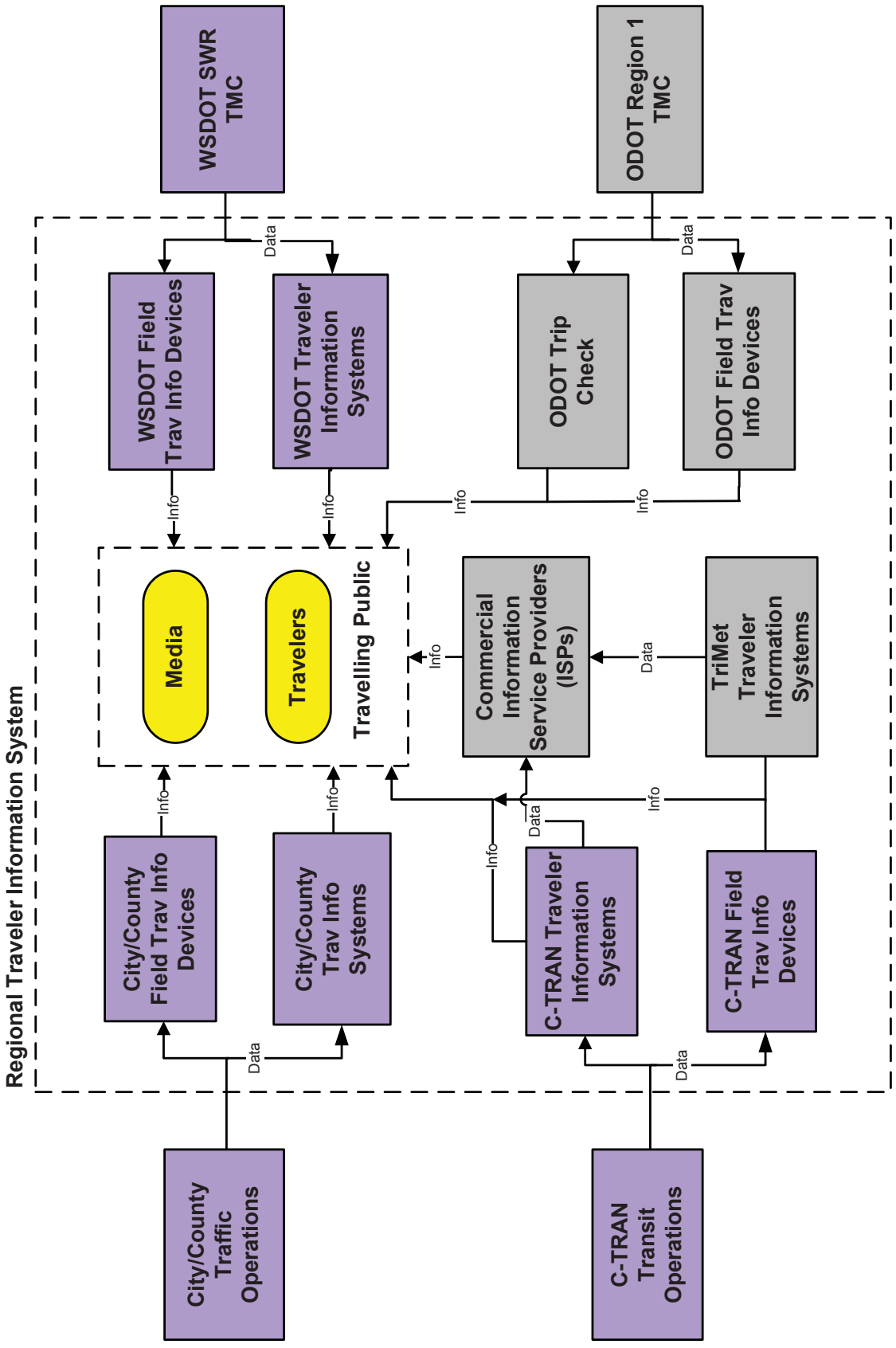


Figure 14: Traveler Information RCTO

TSMO STRATEGY GROUP

Agency	Current Related Roles and Responsibilities	Additional Future Roles and Responsibilities
Washington State Department of Transportation (WSDOT)	• Operates Statewide Traveler Information Systems (511 telephone traveler information, website, and mobile/ subscription applications) • Operates field traveler information ITS devices (e.g. variable message signs, highway advisory radio, PTZ cameras, vehicle detection) • Coordinates with local media and regional agencies on traffic and emergency management issues • Coordinates with other WSDOT regions and the state Emergency Operations Center for large-scale incident response	• Develops and implements updated bi-state traffic and incident management strategies • Enhanced information, data, and control sharing functions through the region's virtual Transportation Management Center • Participates in training exercises with state and local law enforcement and emergency responders to support incident management • Implements work zone management strategies on state highways
Cities (Vancouver, Battle Ground, Camas, Washougal, others) **Clark County**	• Limited degree of operation of field ITS devices • Coordinates with local media on traffic management issues	• Enhanced information, data, and control sharing functions through the region's virtual Transportation Management Center • Participates in training exercises with state and local law enforcement and emergency responders to support incident management • Participates in implementation of freeway detour plans through management of diversion routes and spill-over traffic • Implements work zone management strategies on local streets and arterials • Data provider to PORTAL Regional Data Archive n support of regional data archive and performance measurement programs

TSMO STRATEGY GROUP

Agency	Current Related Roles and Responsibilities	Additional Future Roles and Responsibilities
C-TRAN	• Operates agency website with static information and special announcements • Operates customer information hotline • Coordinates with media on transit service disruptions and event information	• Operation of enhanced real-time traveler information and trip planning services • Integration of automated transit with WSDOT ATIS services • Operates field ATIS devices at select locations (e.g. Park and Rides)
TriMet	• Operates Transit Tracker automated transit traveler information system • Operates customer information hotline • Coordinates with media on transit service disruptions and event information	• Integration of TriMet and C-Tran traveler information systems, including end-to-end trip planning and real-time information across systems
Media	• Coordinates with traffic and transit agencies for traffic reporting and special events	• Recipient of third-part traffic data and information feeds from traffic and transit agencies
Information Service Providers (ISPS)		• Recipient of third-part traffic data and information feeds from traffic and transit agencies • Dissemination of regional traveler information through third-party services, including, web, mobile and in-vehicle devices

Chapter 6
TSMO in the Regional Planning Process

Key Concepts

- As an integral part of the regional transportation strategy, TSMO opportunities, policies, and projects must be engrained in regional transportation planning and project development processes.
- TSMO concepts and objectives should be integrated into the region's long range Metropolitan Transportation Plan.
- More formalized evaluation of TSMO opportunities is recommended in the project development and funding process.
- TSMO can provide both performance data and candidate solutions to the region's Congestion Management Process
- Interagency TSMO coordination and outreach are key ongoing functions of RTC and the Vancouver Area Smart Trek program to support regional operations.

Introduction

As emphasis shifts towards more efficiently operating the multi-modal transportation system and away from large-scale capacity improvements, TSMO will assume a more visible role in regional transportation investment.

To realize the potential of TSMO and to address the underlying operational roots of many of the region's transportation needs, it is critical that it is fully integrated into the regional transportation planning process.

RTC and its planning partners support the continued integration of TSMO activities within the regional transportation planning and project development process. This indicates the growing recognition that system operation is a vital strategy to meeting the transportation needs of the region in the coming years. TSMO strategies and ITS investments will need to be coordinated, prioritized and evaluated along with other proposed transportation improvements. The development of this regional TSMO Plan is an important step in achieving this future vision.

The primary objectives of linking planning and operations are to ensure that:

- On the whole, the existing transportation system is better managed through cost-effective planning practices and using the currently limited funds as efficiently as possible;
- TSMO solutions are considered alongside traditional capacity and safety enhancements, as well as mutually-supportive strategies including - but not limited to - access management, transportation demand management, and smart growth, in meeting the transportation needs of the region; and

- Southwest Washington builds upon its past successes in planning for operations as it extends its efforts that began with the establishment and implementation of the Vancouver Area Smart Trek (VAST) program.

Ultimately, this suggests that TSMO should assume a more formalized role in regional transportation planning policies, processes and project programming. This chapter describes specific opportunities to integrate TSMO into the regional transportation planning process.

TSMO and Regional Transportation Goals

At a policy level, it is important that regional decision-makers and technical staff understand the potential contributions of TSMO to meeting the region's transportation goals.

As has been emphasized throughout this Plan, the ability of TSMO to provide cost-effective and near-term strategies for meeting regional transportation needs is the basis for incorporating TSMO into traditional transportation planning.

Recognizing the contribution TSMO can make in meeting regional transportation goals is the basis for further discussion of the role of TSMO and planning. In addition, TSMO should be part of an ongoing regional dialogue from project development, project funding, through project implementation and performance measurement. Further recognition of these contributions will illustrate that the goals of TSMO emanate from the same notion as other strategies, which are more familiar to decision-makers and the general public.

TSMO can contribute to each of the eight regional transportation goals in the Metropolitan Transportation Plan (MTP) as shown in Table 14 on the next page. This contribution is a basis for regional conversations about integrating TSMO into regional transportation planning project development processes and projects.

Planning for Operations in Southwest Washington

Just as operations can contribute to meeting regional planning goals, operations in and of itself will benefit from regional coordination among agencies. This concept is often referred to as "planning for operations," and encompasses the interagency cooperation to plan, fund, implement, operate and evaluate TSMO programs in the region.

There are many advantages to a coordinated, regional approach to TSMO:

- Operations-oriented solutions to transportation problems are evaluated alongside other potential solutions such as capacity expansion, access management, transportation demand management, and/or smart growth strategies. TSMO and other near-term, lower-cost strategies may allow the region to avoid or defer more costly capacity expansion projects.
- By involving a broad set of stakeholders in operations planning discussions, such as transit, freeway, freight, arterial and emergency management, a regional approach to TSMO can more successfully address the complex, multimodal needs of the region.
- Cooperative deployment and shared operations of Intelligent Transportation Systems Infrastructure allows agencies to address multiple needs simultaneously and reduce implementation costs.
- More cost-effective investment through sharing of infrastructure and systems by multiple agencies.

The transportation agencies in southwest Washington have made important strides towards regional cooperation through the successful Vancouver Area Smart Trek (VAST) initiative. VAST has promoted ongoing coordination among operating agencies for over ten years, and has been an important contributor to the success and innovation of many of the region's existing and planned operations and ITS initiatives. By extending this model to TSMO, agency collaboration will support improved performance of the transportation system.

Table 14: How TSMO Contributes to Meeting MTP Goals

METROPOLITAN TRANSPORTATION PLAN (MTP) REGINAL TRANSPORTATION GOALS	TSMO CONTRIBUTES TO MEETING THE GOALS…
Maintain, preserve and improve the existing regional transportation system.	…by managing congestion and improving incident response to improve the efficiency and reliability of regional roadways as an alternative to capacity expansion.
Provide a safe and secure transportation system that allows for the movement of people and freight.	…by providing transportation surveillance to monitor and protect the region's transportation infrastructure, and also to improve response to natural and man-made emergencies.
Support economic development and community vitality.	…by managing congestion and improving incident response to improve the efficiency and reliability of regional roadways. This in turn supports the efficiency, productivity, and economic vitality of the region.
Provide an efficient, balanced, multimodal regional transportation system including highway, bus transit, high-capacity transit, rail, aviation, marine, bicycle and pedestrian modes as well as transportation demand management and transportation system management strategies.	…by increasing the quality and efficiency of public transportation options and supporting the dissemination of traveler information to the general public – leading to greater mobility options for travelers.
Provide an acceptable level of mobility for personal travel and freight movement throughout the regional transportation network and adequate access to locations throughout the region.	…by supporting a multimodal approach to corridor operations that considers the impacts of congestion and delay on personal and freight mobility.
Provide a transportation system that is sensitive to the quality of the environment and natural resources.	…by enhancing the effective capacity of regional transportation networks and reducing the need for traditional transportation expansion, thereby helping to preserve the natural environment.
Provide for the development of a financially viable and sustainable transportation system.	…by providing cost-effective alternatives to capacity expansion that can be implemented at lower cost and in a shorter timeframe.
Provide a transportation system that reflects the community vision and values.	…by supporting the region's growth concepts and quality of life through a reliable multimodal transportation system.

Integrating TSMO into Regional Planning

TSMO, and the ITS technologies that enable many of the TSMO strategies presented in this document, can have direct and cost-effective benefits in addressing particular transportation needs in the region. Specifically, in the case of recurring and non-recurring congestion on corridors that are constrained by physical or other factors, TSMO offers alternatives or complements to conventional transportation investments. Therefore, it should be incorporated consistently within the transportation planning process and the allocation of funding.

By linking potential ITS deployments with planning outcomes and goals, it is anticipated that funding for TSMO can more often come from the traditional planning process. The aspiration of TSMO is that it will become more likely now that technology investments can be compared to "conventional" projects on a more equal basis.

The scarcity of funding sources means that technology and other system management initiatives need to compete with conventional infrastructure projects, which draw from the same source of funds. The linkage of TSMO projects with regional planning needs, therefore, is increasingly essential to demonstrating that they do in fact contribute towards widely understood planning goals such as safety and mobility (and therefore are equally worthy of funding).

In many cases, TSMO projects (e.g. enhanced signal coordination) may be able to address certain needs far more cost-effectively than infrastructure projects that add capacity. This can potentially increase the appeal of system management techniques, provided that the linkage to regional goals is clearly articulated, and the results of TSMO investments are demonstrated through quantitative system performance measures.

Opportunities for Integrating Planning and Operations in Southwest Washington

Regional transportation planning is a complex and multi-faceted topic with myriad inter-related processes, policies, and objectives. It also involves a wide range of participants and stakeholders ranging from technical analysts to committees to elected officials and the general public.

Similarly, successful integration of operations into regional planning will occur through the cumulative efforts of many individuals and agencies' efforts. The following Table 15 summarizes the key opportunities to integrate planning and operations in southwest Washington. These topics are discussed at greater length through the remainder of this chapter.

Table 15: Opportunities to Integrate TSMO into Regional Planning

REGIONAL PLANNING ACTIVITY	"PLANNING FOR OPERATIONS" STRATEGIES
Long-Range Transportation Planning	As long-range regional transportation planning expands from primarily capacity expansion and capital intensive strategies, TSMO will play an increasingly important role in making the most effective use of the region's existing transportation capacity in light of growing future need. Furthermore, TSMO supports a regional management and operations approach to transportation that requires cooperative, multimodal approaches to complex issues and opportunities identified in the region's transportation goals.
Project Development Process and Funding	While southwest Washington has been highly effective in developing, funding, and implementing multi-agency ITS and operations projects in the past, there is a growing imperative to better coordinate operations investments with traditional project development in the future. The project development and evaluation process of the future will factor in operational benefits and TSMO alternatives to capital investment. Additionally, incremental deployment of ITS infrastructure as part of conventional transportation improvement projects will help the region advance towards its build-out ITS and TSMO vision.
Congestion Management Process (CMP)	The objective of the CMP is to systematically evaluate and address the root causes and locations of congestion in the region, due either to physical constraints, high traffic volumes or non-recurring events such as traffic collisions or weather. TSMO strategies can be highly effective as solutions for the operational needs identified through the CMP. Furthermore, there is significant potential to use data generated by ITS devices to more accurately and cost-effectively measure the performance impacts of both recurring and non-recurring delay.
Operations Planning and Coordination	For over ten years theVAST coalition, chaired by RTC and involving operations stakeholders from across Clark County and beyond, has been an effective forum for the transportation operations community to coordinate, envision, and implement regional ITS and communications projects for over a decade. The future success of this group will be strengthened further by engaging operations, engineering, and planning representatives of the respective agencies, continuing the momentum and relationships nurtured through the development of the TSMO Plan.
Data Collection and Performance Measurement	With the implementation of the PORTAL interface for southwest Washington, planning agencies in the region will have unprecedented access to archived operational data to support planning analysis and performance measurement, and the CMP. This opportunity must be harnessed to more effectively evaluate transportation needs related to operational phenomena like non-recurring congestion. Furthermore, this data can help agencies make the case for funding of TSMO investment and evaluate the resulting impacts of these operational strategies.
Awareness and Outreach	At all levels, from the general public through senior elected officials, there is a recognized need to build greater awareness of regional TSMO needs, strategies, and benefits. This awareness will lead to greater support for implementation of cost-effective solutions and recognition of its contribution to project, corridor, and regional transportation goals.

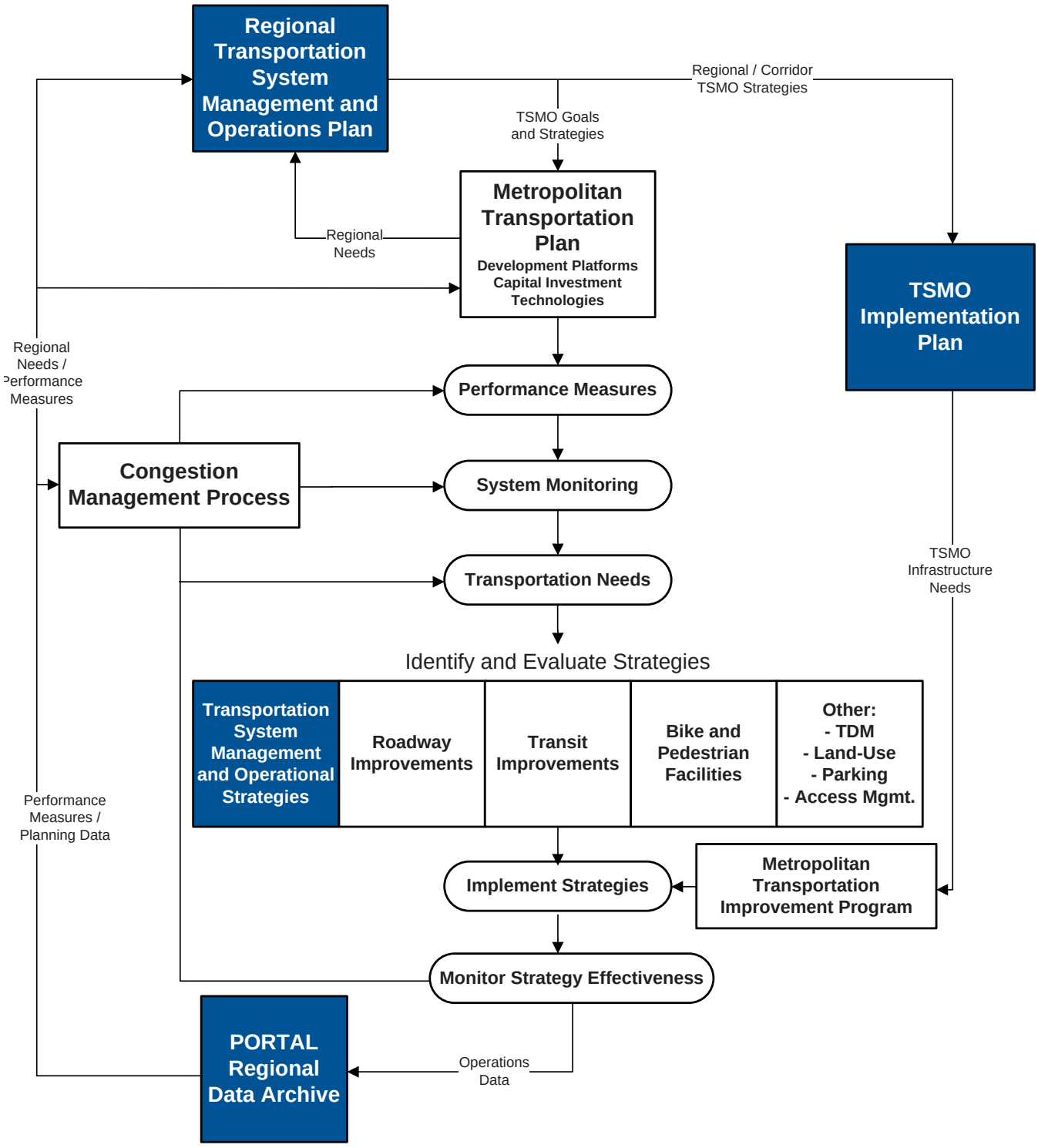
Integrating TSMO into Regional Transportation Processes

Figure 15 on the following page illustrates key opportunities to integrate TSMO, and this TSMO plan, into existing elements of the transportation planning process in southwest Washington, including the metropolitan transportation plan (MTP), the metropolitan transportation improvement plan (MTIP), and the congestion management process (CMP):

- **Defining Goals and Priorities:** The Regional TSMO Plan has a two-way relationship with the MTP: First, the Regional TSMO Plan builds upon the regional transportation goals and priorities defined in the MTP, so that operations programs ultimately contribute to meeting the region's transportation needs and policy objectives. Secondly, the TSMO plan describes specific operational needs and TSMO strategies that should be reflected in the MTP, recognizing that TSMO is an important part of the region's overall transportation strategy.
- **Identifying and Evaluating Strategies:** TSMO strategies are part of the regional transportation toolkit, and therefore should be evaluated alongside other candidate strategies such as roadway improvements, transit improvements, bicycle and pedestrian facilities and other strategies (e.g. land-use, transportation demand management (TDM), parking and access management). In a given situation, the most appropriate solution may be a combination of one or more of these strategies, so it is important that TSMO is evaluated as part of the solution alongside other measures.
- **Formulating and Implementing Projects:** The Regional TSMO Implementation Plan describes investment needs in ITS, communications and supporting infrastructure to implement the region's TSMO strategies. This plan supports the development of the Metropolitan Transportation Improvement Plan by identifying investment needs to suit a particular corridor or transportation objective. As with the identification and evaluation of strategies, it is important that TSMO investment needs are considered alongside other potential transportation investments. In the case of capital projects with large costs and long project development timelines, TSMO strategies may provide interim solutions that can defer or reduce the need for the major capital investment.
- **Monitoring and Measuring:** The PORTAL Regional Data Archive will play an important role in the region moving forward in supporting the region's congestion management process and performance measurement programs. One of the most important advantages of PORTAL over existing data sampling methods is PORTAL's ability to collect real-time transportation data from field sensors and ITS systems on a continuous basis, which allows for more robust project before-after measurement, operations performance monitoring and monitoring of non-recurring phenomena. The results of this data analysis support the data element of the region's CMP, as well as performance data to support updates of the MTP and the Regional TSMO Plan in the future.

Figure 15: Integrating TSMO into Regional Planning Processes:

Integrating TSMO into the regional planning process provides new options for meeting transportation needs, while PORTAL operations data allows for more sophisticated performance measurement and planning evaluation.



Long Range Transportation Planning

As TSMO strategies become more conventional and better recognized in the future, the options to respond to future transportation needs will become more diverse in terms of long-range planning. A key component in this is being able to support the linkage between TSMO and regional transportation goals when making the case for TSMO investments. It is likely that TSMO program investments will become more significant in a fiscally-constrained environment where the region has to get more efficiency out of the existing transportation system.

Demonstrating the successes of TSMO investments through performance measures (e.g., reduction in hours of delay due to congestion) will help to build the case for sustained technology investment for both capital and operating expenditures.

Recommendation: Incorporate the concepts, objectives and strategies of the Regional TSMO plan into the upcoming revision of the Long Range Metropolitan Transportation Plan, and furthermore that this planning exercise be leveraged as an opportunity to further raise awareness of TSMO within the broader audience of transportation policy makers and the general public.

Project Development Process and Funding

Historically, ITS projects within southwest Washington have relied upon ITS earmarked-funds and collaboration among operations-minded project proponents to secure funding (e.g., annual VAST CMAQ application). The VAST partners identify operational projects to compete for funding, but do not have a formal role in the project review or selection process (however, many of the participating agencies within VAST are participants in transportation planning and funding).

Additionally, there is growing recognition that deployment of TSMO infrastructure as part of mainstream capital projects is an effective way to achieve the build out vision of the Regional TSMO network and the ITS Implementation Plan. However, there are currently no formalized mechanisms within the region that support coordination of operations/ITS investments with other capital projects.

Most ITS project investments and ongoing operational needs in the region are not funded with dedicated revenue streams. As such, revenue streams for new TSMO investments and ongoing operational costs such as staffing, facilities and materials are uncertain from year to year. This creates distinct complications for regional transportation operations, which is more reliant on ongoing operational funding than most other project investments. Creating a system operations line-item or ongoing funding stream within the regional process is critical to the ongoing sustainability of operations in the region.

The Federal transportation authorization that replaces SAFETEA-LU may include dedicated programs for systems operations or those with an emphasis on total transportation system performance and associated measurement. While speculative at this time, such developments would further strengthen the position of ITS and TSMO within the overall transportation investment scheme, with positive implications for these activities in the Vancouver region. To achieve the best project outcomes based on local corridor conditions and needs, it is important to engage key stakeholders during the project development process in order to balance operational, safety, and other improvement strategies.

Recommendation: Incorporate more formalized evaluation of system management opportunities and benefits within the regional project development process, to promote consideration of TSMO and other operational strategies by project proponents. Include attention to resources needed for ongoing maintenance and operations of TSMO deployment.

Congestion Management Process (CMP)

By Federal mandate, RTC maintains a congestion management process (CMP) to inform the transportation planning and investment decision-making process.

The monitoring element of the CMP is designed as an informational tool to be used within the decision-making process. It is also intended to provide an understanding of the transportation system's operating conditions and deficiencies and to assess the impacts of alternative improvement strategies.

The corridor performance measures considered within the CMP include vehicle volumes, corridor capacity ratio, corridor travel speed, speed as percent of speed limit, intersection delay, automobile occupancy, truck percentage, transit seat capacity used, and other transportation measures. In addition, using individual corridor segment data, areas of concerns are identified. Areas of concern are defined as segments within an individual corridor that have a volume to capacity ratio greater than 0.9 or a travel speed 60% or less of the posted speed limit.

CMP congestion locations are subsequently considered in the regional transportation project development process and in identifying candidates for more in-depth study. Through the CMP, the RTC has developed a program and a myriad of solutions to reduce the prevalence and severity of congestion in the region.

The Congestion Management Process is relevant to regional TSMO/ITS planning in several ways:

- TSMO strategies and ITS technologies are powerful tools that can address sources of congestion in a cost-effective manner.
- TSMO and ITS technologies may offer the only viable strategies in transportation corridors that are physically or environmentally constrained, or where more conventional treatments like capacity expansion are cost prohibitive or would bring unintended or undesirable consequences.
- ITS systems in the field can collect transportation system data that allows for more efficient and effective quantification of regional CMP needs.
- Similarly, ITS technologies can be used to support CMP performance measurement (e.g., before-and-after studies) to demonstrate the efficacy of TSMO solutions on the problems they are intended to address.
- The formal linkages between the federally mandated CMP process and the regional transportation planning and project development cycles are an important avenue for formalizing TSMO into the regional transportation dialogue.
- The CMP has been incorporated into the RTC policy, planning, and investment decision-making processes via its inclusion in the current MTP.

Recommendation: Leverage the Regional TSMO Plan as a tool for addressing the needs identified in the Congestion Management Process and the Regional TSMO Plan. Furthermore, leverage the data generated by field ITS systems and the analytical capabilities of PORTAL to enrich the analysis performed under the CMP program.

Data Collection and Performance Measurement

As noted previously in this report, measuring the benefits of TSMO investments has typically been challenging due to limited data availability. However, performance measurement is important from an accountability perspective and in response to the need to demonstrate the effectiveness of TSMO and ITS programs against broadly recognized regional transportation needs.

Most ITS systems generate a considerable amount of data over the course of operations. However, it is only when this data is collected, stored and analyzed that it reveals useful information for before-and-after studies. The implementation of the PORTAL regional data archive in southwest Washington is greatly increasing the potential for performance measurement of TSMO activities using data generated by ITS systems.

Measures of travel reliability are emerging as one of the more direct, yet simple measures of the effectiveness of transportation system management and operations. These measures provide a point of reference for TSMO and ITS initiatives and investments against project expectations and regional mobility goals.

The current PORTAL system archives a wide variety of transportation-related data including freeway loop-detector data, weather data and incident data. However, as described below, the system has the capacity to do much more.

As part of RTC's TSMO planning efforts, the capabilities of the PORTAL system will be expanded from its current freeway data focus to include new data sources, such as transit data from C-TRAN, plus arterial data from the Clark County region. In addition, PORTAL will be enhanced to improve customized reporting capabilities for the end-user.

Recommendation: RTC and other stakeholder agencies should leverage the capability of PORTAL to establish early performance measures for demonstrating the efficacy of TSMO investments, as well as supporting other traditionally labor intensive data collection efforts (e.g., CMP) using ITS field devices. In support of this objective, a proactive approach to field data sensor ment and quality will be required to ensure the suitability of collected data for planning and performance measurement purposes.

Operations Planning and Coordination

From a strategic perspective, the precedent set by Vancouver Area Smart Trek (VAST) has been a critical element in promoting interagency cooperation in planning for operations. The achievements of VAST over the past ten years were documented in earlier chapters of this Plan.

There are many advantages, operationally and financially, to a coordinated approach to TSMO planning, deployment and operations. Specific benefits include, but are not limited to:

- More integrated TSMO projects and systems that address the complex, multimodal transportation needs faced by the region and its total transportation system;
- Increased functionality of TSMO systems that provide value in response to multiple needs simultaneously;
- Increased opportunities for cost sharing among participating agencies;
- Improved competitiveness for discretionary and emerging funding opportunities that require interagency or multimodal coordination; and
- Improved coordination and integration of TSMO investments into the multimodal regional transportation planning process.

Moving forward, there is a distinct opportunity to strengthen this existing interagency coordination through sustained collaboration of operations, engineering and planning representatives of the VAST stakeholder agencies. The development of this TSMO plan, involving each of the above stakeholder types, provides a model for ongoing coordination and illustrates its capacity for awareness-building and discussion of critical operations issues within a planning context.

Recommendation: TSMO operations and planning stakeholders should coordinate on an ongoing basis, at least quarterly, to address regional 'planning for operations' issues including Regional TSMO Plan implementation.

Building TSMO Awareness Through Outreach

In a complex transportation environment and an increasingly competitive funding arena for transportation investment, it is more important than ever for transportation policy-makers, transportation professionals, elected officials and the general public to understand and see evidence of the value of public investment in TSMO programs.

Even within agencies that participate in transportation operations on a daily basis, other departments or decision-makers may not be fully aware of TSMO initiatives and their regional benefits.

The future success of TSMO requires sustained awareness among non-operations stakeholders. In order to ensure a sustainable and adequate funding level for TSMO in Clark County, it is imperative that audiences beyond the transportation operations community understand the following points:

The relationship of TSMO programs to broadly-recognized regional transportation needs, policies, and goals:

- That TSMO can provide cost-effective alternatives to other proposed transportation investments;
- That there are successful examples of ITS and TSMO at work today in the region;
- That the region has a long history of successful and progressively more integrated transportation operations through the participation of multimodal stakeholder agencies at every level of government;
- That the region has increasing capabilities to analyze quantifiable benefits and performance measures to establish the benefits of TSMO;

In other words, regional policy makers must be aware of the potential contribution of TSMO to meeting the region's transportation needs to be considered alongside other proposed strategies in planning, project development, and funding decisions.

Recommendation: Implement a program of proactive outreach to policy makers, stakeholder agencies, and the public, to raise awareness of the contributions of TSMO to meeting regional transportation needs.

Chapter 7
Corridor Operation Improvement Plan

Key Concepts:

- A network of Regional TSMO Corridors and Critical Operations Sub-Corridors have been identified for urbanized Clark County.
- Specific TSMO strategies can be applied to each corridor depending on their operational characteristics and needs.
- Implementation of TSMO strategies guides the operational agreements and ITS infrastructure investments required in a given corridor.
- There are mutually-supportive transportation strategies that may be applied in combination with TSMO to address the complete needs of the corridors.

Introduction

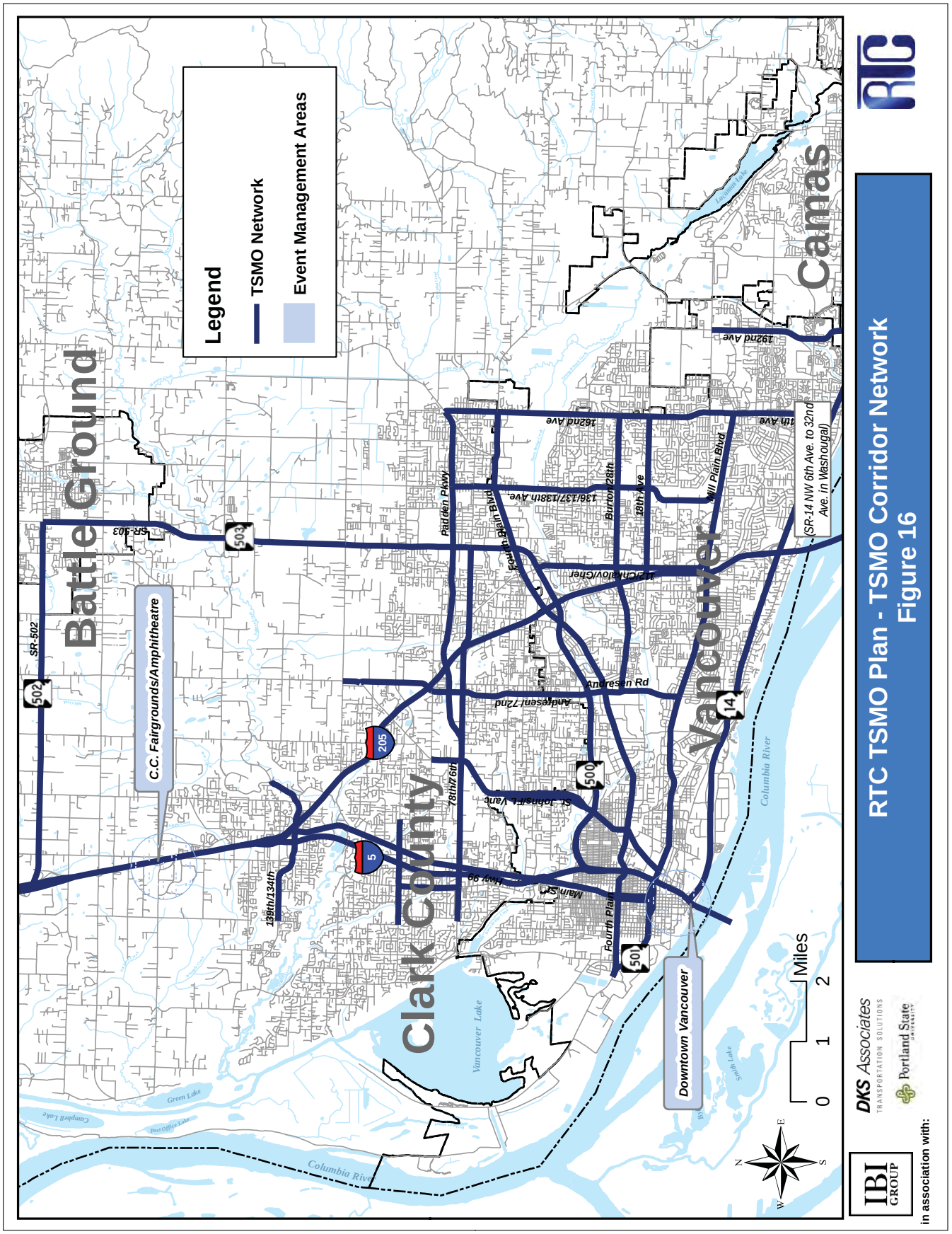
The previous chapters of this Plan have discussed opportunities for TSMO and particular strategies at the regional level. This chapter describes the TSMO network in Clark County and the process by which the network was developed. It also discusses the applicability of TSMO strategies identified at the regional level to specific corridors within the TSMO network.

For example, varying levels of congestion on these corridors, either by time of day or due to non-recurring events such as traffic accidents, weather, or special events, suggests that an active TSMO approach to managed operations is necessary to minimize impacts to the traveler and commercial freight.

The Regional TSMO Network in Clark County

The Regional TSMO Network consists of limited-access roadways, principal and major arterials throughout urbanized Clark County where TSMO strategies are likely to be effective, given the operational characteristics of these facilities. These corridors should be reviewed periodically and updated to reflect changes in conditions or character based on the criteria in Table 16.

Figure 16 illustrates the full TSMO Network, including limited-access highway and arterial corridors. The process of selecting the TSMO Network from the regional transportation network is described in section 7.2.


RTC TSMO Plan - TSMO Corridor Network
Figure 16
Legend
TSMO Network
Event Management Areas
Battle Ground
Clark County
Vancouver
Camas
C.C. Fairgrounds/Amphitheatre
Downtown Vancouver
SR-502
SR-503
Padden Pkwy
Fourth Plain Blvd
Andresen Rd
Andresen/72nd
78th/76th
139th/134th
St Johns/Ft. Vanc
Main St
Hwy 99
Mill Plain Blvd
162nd Ave
192nd Ave
18th Ave
136/137/138th Ave
Burton/28th
18th Ave
SR-14/Chkalov/Ger
(SR-14 NW 6th Ave. to 32nd Ave. in Washougal)
Columbia River
Vancouver Lake
Green Lake
Post Office Lake
Campbell Lake
Lacamas Lake
Miles
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IBI GROUP
DKS Associates
TRANSPORTATION SOLUTIONS
Portland State
UNIVERSITY
in association with:

Regional TSMO Corridor Screening Process

RTC's congestion management process (CMP) was used as the basis for identifying the Regional TSMO Network. The CMP is a federally-mandated program for evaluating the transportation system to reduce congestion and achieve regional transportation goals. Using the CMP as a starting point for TSMO corridor identification has several benefits:

- There is a strong linkage between congestion and the operations needs that TSMO seeks to address; this footprint of corridors represents where there is an operational need or where the implementation of TSMO strategies may improve corridor performance.
- It creates a linkage between TSMO and existing traditional regional planning processes;
- It establishes TSMO strategies as viable, low-cost, near-term solutions to address the transportation needs identified through the CMP; and
- It allows the TSMO evaluation to take advantage of the significant data collection and analytical work that is performed by RTC in preparing of the CMP.

TSMO Corridor Screening Process

The regional CMP network was reviewed by the project Steering Committee, which made additions and deletions based upon known operational conditions in the corridors. Steering Committee members were provided with a set of criteria, which was developed to capture transportation characteristics that suggest a need for active management of the transportation system network.

Table 16 lists the criteria that were used to identify the regional TSMO Corridors.

Table 16: Criteria for TSMO Corridor Evaluation and Network Development

1. VOLUME TO CAPACITY RATIO	
Description:	**Highest volume to capacity (V/C) ratio within the corridor**
Scoring:	10 point if V/C > 0.9; 0 for otherwise 5 points if 0.9 > V/C > 0.8 0 points if V/C < 0.8
2. FUNCTIONAL CLASSIFICATION	
Description:	**Hierarchical designation of road function based on FHWA Functional Classification System, as designated by WSDOT**
Scoring:	10 points for Principal Arterial (Expressway/Interstate) 5 points for Principal Arterial Major 0 points for Minor Arterial

Table 16 - Continued

3. TRAFFIC VOLUME	
Description:	**PM Peak Hour Traffic Volumes**
Scoring:	10 points for > 4,000; 5 points for 1,000 – 3,999; 0 points for 0 – 999;
4. HIGH INCIDENT LOCATIONS	
Description:	**Corridor contains high incident locations prone to non-recurring congestion events and safety hazards, as identified by stakeholders**
Scoring:	10 points if corridor contains a high incident location 0 points if does not contain a high incident location
5. INTERSTATE RELIEVER/DETOUR ROUTE	
Description:	**Corridor has the potential to serve as a reliever route to an existing interstate facility, as identified by stakeholders. A reliever route is considered to be an alternate facility (typically running parallel to the facility for a long-distance) to the interstate(s).**
Scoring:	10 points if a primary detour route 5 points if a secondary detour route 0 points if not a significant detour route
6. EXISTING TRANSIT CORRIDOR	
Description:	**Presence of existing and planned C-TRAN fixed-route transit operating in the corridor**
Scoring:	10 points if principal and/or future High Capacity Transit corridor 5 point if existing C-Tran services 0 if no transit services
7. FREIGHT CORRIDOR OF REGIONAL SIGNIFICANCE (FCRS)	
Description:	**Corridor is identified as a FCRS in the RTC Freight Mobility Study because of existing truck volumes, plus it provides a connection between key distribution centers, major employment areas and/or the Port of Vancouver.**
Scoring:	10 points if a regionally significant corridor 5 points if a locally significant corridor 0 points if not a designated corridor

Table 16 - Continued

8. EXISTING OR PLANNED ITS IMPLEMENTATION	
Description:	**Corridor and/or some portion of the corridor has existing or planned ITS investments which can be used as a basis for implementation of TSMO strategies**
Scoring:	10 points for existing ITS infrastructure 5 points if planned ITS infrastructure 0 points for no ITS implementation
9. VITAL EMERGENCY SERVICES CORRIDOR	
Description:	**Corridor is in close proximity to emergency service providers and/or special importance in emergency situations (e.g. evacuation routes)**
Scoring:	10 points if a principal emergency corridor (stakeholder designated) 5 points of a secondary emergency corridor (stakeholder designated) 0 points if no distinguished regional significance
10. MULTI-JURISDICTIONAL CORRIDOR	
Description:	**Corridor is under the jurisdiction and/or operation of multiple agencies; multi-jurisdictional status may also bring more resources for improvements**
Scoring:	10 points if three or more agencies 5 points if two agencies 0 points if one agency
11. TRAVEL SPEED VS. POSTED SPEED (CMP MEASURE)	
Description:	**A travel speed lower than 60% of the posted speed limit is an indicator of delay/congestion.**
Scoring:	10 points if 60% or less of posted speed 0 points if greater than 60%

Regional TSMO Network Description

The regional TSMO network developed by the Steering Committee describes a footprint of regional freeways, highways, and arterials that meet a minimum threshold of operational needs in accordance with the previous evaluation criteria.

The regional TSMO corridors network provides a guideline for future regional and operation planning; these strategies should be considered a viable approach to meeting at least some of the transportation needs of these corridors, based upon the analysis and feedback from transportation agencies participating in the development of this network.

It is recommended that the Regional TSMO Network and associated TSMO strategies be referenced in the course of corridor studies or area plans, traffic impact evaluations of development and land-use changes, and project development, planning, and engineering, and regional transportation system performance measurement.

The TSMO network is one of the most fluid aspects of the TSMO Plan, because it is sensitive to external changes in the transportation network and the impacts of other initiatives and projects. As both transportation conditions and TSMO strategies evolve, the TSMO corridors network should be re-evaluated every two to five years to identify additions or deletions to the network, emerging critical operations sub-corridors and other changes precipitated over time by regional growth and modifications to the network.

Critical Operations Sub-Corridors

A subset of the Regional TSMO Network with the highest degree of operational need and opportunity has been identified as "Critical Operations Sub-Corridors."

Critical Operations Sub-Corridors were identified both from the list of high-scoring corridors against the criteria described previously, as well as suggestions by members of the Steering Committee who are familiar with these facilities, their operational characteristics and their physical constraints.

The Committee notes that while all corridors within the Regional TSMO Network are operationally significant, there were specific critical segments within each of the corridors that would stand to benefit the most from TSMO strategies. This guidance reflects the notion that a corridor has many elements and that, although on the whole a corridor may be operating within acceptable limits, certain segments and/or intersection combinations may be in need of attention.

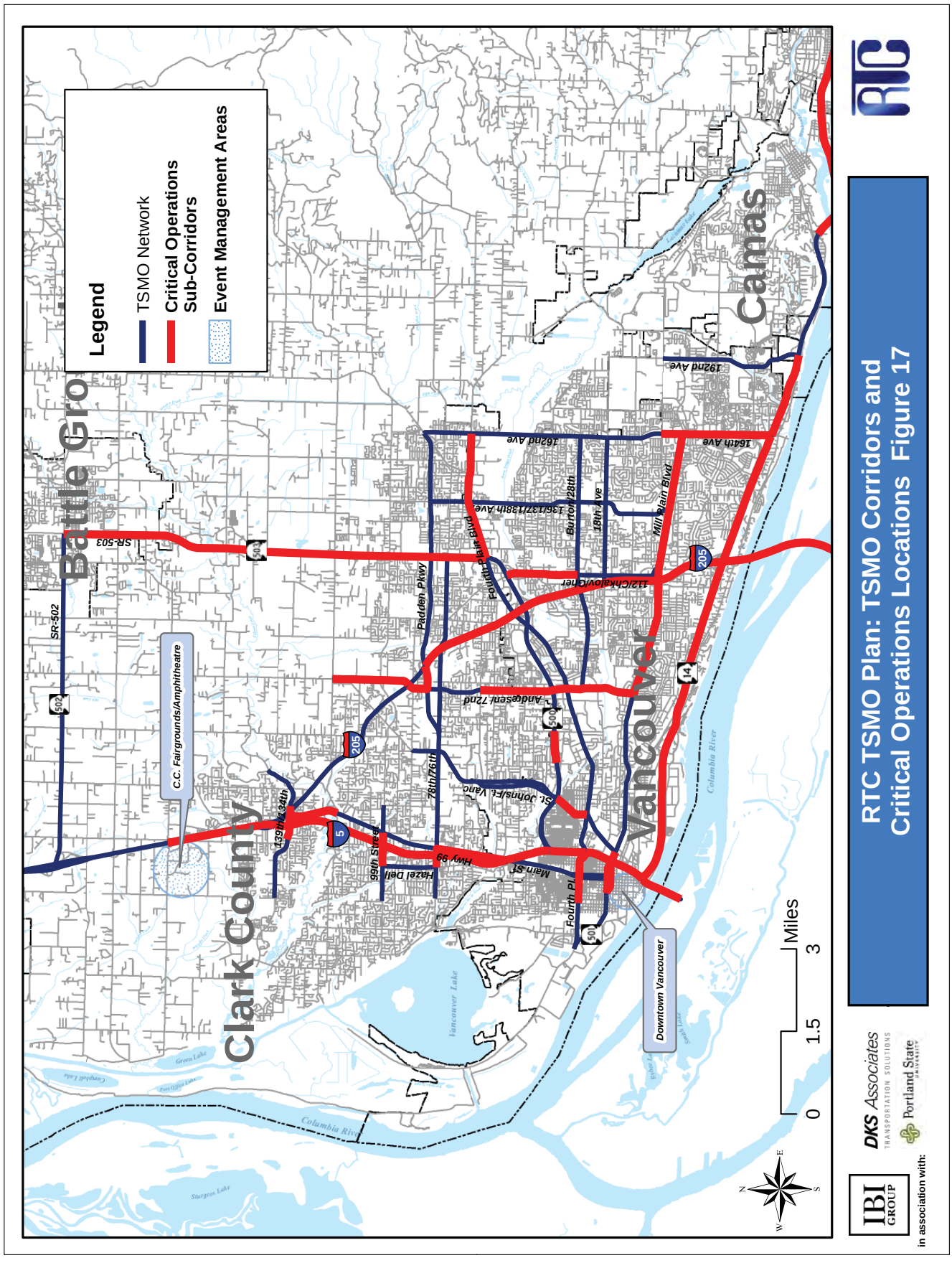
Figure 17 shows the limited-access and arterial corridors and the respective segments that met the above criteria.

Special-Event Management Area

A limitation of the corridor-based approach to planning for TSMO corridors is capturing other specific geographic areas that are sub-regional, but not actually corridor-based. Opportunities for sub-regional operations management identified by the Steering Committee pertain to special-events management: the downtown Vancouver area, and in the vicinity of the Clark County Fairgrounds.

Management of special-events through traveler information, dynamic traffic control, parking management, transit management and other operational strategies is an ideal application for TSMO strategies, because the temporal nature of these events does not warrant substantial capacity investments. However, they can have significant regional, even bi-state, impacts on transportation system operations.

These special event areas acknowledged in the Regional TSMO Network maps are also shown on Figure 17.


Legend
TSMO Network
Critical Operations Sub-Corridors
Event Management Areas
Clark County
Vancouver
Camas
Battle Gro
SR-502
C.C. Fairgrounds/Amphitheatre
Downtown Vancouver
Padden Pkwy
Fourth Plain Blvd
112/Chkalov/Ogden
Andresen/72nd
78th/76th
St. Johns/Fe. Vanc
Main St
Hwy 99
Hazel Dell
99th Street
139th/134th
Burton/28th
18th Ave
Mill Plain Blvd
136/137/138th Ave
162nd Ave
164th Ave
192nd Ave
Columbia River
Vancouver Lake
Green Lake
Sturgeon Lake
0
1.5
3
Miles
RTC TSMO Plan: TSMO Corridors and Critical Operations Locations Figure 17
RTC
IBI GROUP
DKS Associates
TRANSPORTATION SOLUTIONS
Portland State
UNIVERSITY
in association with:

TSMO Strategies Applied to the Corridors

After determining the Regional TSMO Network, specific TSMO strategies identified in the regional plan were applied to individual TSMO corridors. The result of this process is shown in Table 17.

In general, TSMO strategies in the regional plan fall into two categories: those that are implemented on a regional basis (e.g., Regional Incident/Emergency Management) and those that are implemented on a localized or corridor-by-corridor basis (e.g., Transit Signal Priority). Those that are implemented regionally are not mapped against specific corridors, because these are more overarching initiatives that are not directly relevant to any specific corridor.

As Table 17 shows, the broadest array of TSMO strategies are applicable to the region's limited access corridors, including Bi-State Incident Management and emerging concepts such as Active Traffic Management.

Most regional arterials offer similar opportunities, with the differences among them attributable to the presence (or absence) of transit service, regional freight corridor designation, or proximity to a limited access corridor (diversion and incident effects). Corricors scoring lowest in the screening process are not listed individually, but they are blended as "Other Regional Corridors" (Table 22). However, all arterial corridors in the Regional TSMO Network can benefit from Enhanced Traffic Signal Operations and Traffic Surveillance as core strategies for arterial operations management.

TSMO Strategy Categories			Regional Management & Operations						Roadway Management & Operations						Transit Management & Operations					Freight Management & Operations				Traveler Information						
			Transportation Management Center	Bi-State Incident Management	Regional Incident/Emergency Management	Event Management (Vancouver CBD; Clark County Fairgrounds)	Work Zone Management	Regional Performance Measures	Active Traffic Management	Integrated Corridor Management	Ramp Metering	Enhanced Traffic Signal Ops	Traffic Surveillance	Road Weather Information Systems	Automatic Vehicle Locator & Computer Aided Dispatch	Automatic Passenger Counters	Transit Signal Priority (in applicable transit corridors)	Transit Speed & Reliability	Regional Transit Fare Media	Real-time/predictive Freight Info.	Roadside Truck Screening	Truck Traffic Signal Priority	Freight Data Collection	Bi-State Traveler Info.	Roadside Traveler Info.	Regional Traveler Information	Predictive Traveler Information	Real-time Transit Arrival Info.	Transit Trip Planning Website	Parking Availability Info.
Strategy Implemented Regionally			●		●		●	●			●			●	●	●			●				●			●	●	●	●	●
Strategy Implemented by Corridor				●		●			●	●		●	●				●	●		●	●	●		●	●					
Strategy Implementation: Limited Access Regional TSMO Corridors																														
Facility	**Terminus**	**Terminus**																												
I-205	Columbia River	Mill Plain		●					●	●			●					●		●	●	●		●	●					
I-205	Mill Plain	Padden Parkway		●					●	●			●					●		●	●	●		●	●					
I-205	Padden Parkway	I-5		●					●	●			●					●		●	●	●		●	●					
I-5	Columbia River	SR-500		●		●			●	●			●					●		●	●	●		●	●					
I-5	SR-500	134th St.		●					●	●			●					●		●	●	●		●	●					
I-5	134th St.	179th St.		●		●			●	●			●					●		●	●	●		●	●					
I-5	179th St.	219th St.		●					●	●			●					●		●	●	●		●	●					
SR-14	I-5	I-205		●					●	●			●					●		●	●	●		●	●					
SR-14	I-205	192nd Av.		●					●	●			●					●		●	●	●		●	●					
SR-14	192nd Av.	NW 6th Av.		●					●	●			●					●		●	●	●		●	●					
SR-14	NW 6th Av.	32nd St.		●					●	●			●					●		●	●	●		●	●					
SR-500	I-5	Falk							●	●			●							●	●	●		●	●					
SR-500	Falk	54th							●	●		●	●							●	●	●		●	●					
SR-500	54th	Fourth Plain/SR-503							●	●			●							●	●	●		●	●					
Strategy Implementation: Arterial Regional TSMO Corridors																														
Facility	***Terminus***	***Terminus***																												
112th Av.	Mill Plain	28th St.								●		●	●				●	●												
112th Av.	28th St.	SR-500								●		●	●				●	●												
134th St.	Fred Meyer	I-205 NB Off-Ramp								●		●	●				●	●												
164th Av.	SR-14	SE 1st St.										●	●				●	●		●	●	●			●					
78th St.	Hazel Dell	Hwy 99										●	●				●	●		●	●	●								
Andresen	18th St.	63rd St.										●	●				●	●							●					
Andresen	63rd	Padden Parkway										●	●				●	●							●					
Andresen	Padden Parkway	I-205										●	●				●	●							●					
72nd Ave	I-205	St. John's										●	●				●	●							●					
72nd Ave	St. John's	119th										●	●				●	●							●					
Fourth Plain	NW 26th Av.	Columbia								●		●	●				●	●		●	●	●								
Fourth Plain	Columbia	I-5								●		●	●				●	●		●	●	●								
Fourth Plain	I-5	Falk								●		●	●				●	●												
Fourth Plain	Falk	Andresen								●		●	●				●	●												
Fourth Plain	Andresen	SR-503								●		●	●				●	●												
Fourth Plain	SR-503	164th Av.								●		●	●				●	●		●	●	●			●					
Highway 99	I-5	78th St.								●		●	●				●	●							●					
Highway 99	78th St.	99th St.								●		●	●				●	●												
Highway 99	99th St.	117th St.								●		●	●				●	●												
Highway 99	117th St.	134th St.								●		●	●				●	●							●					
Main	Mill Plain	Fourth Plain								●		●	●				●	●												
Main	Fourth Plain	I-5								●		●	●				●	●												
Mill Plain	Fourth Plain	Columbia								●		●	●				●	●							●					
Mill Plain	Columbia	Ft. Vancouver								●		●	●				●	●							●					
Mill Plain	Ft. Vancouver	Lieser								●		●	●				●	●							●					
Mill Plain	Lieser	Chkalov								●		●	●				●	●		●	●	●			●					
Mill Plain	Chkalov	136th Av.								●		●	●				●	●		●	●	●			●					
Mill Plain	136th Av.	164th Av.								●		●	●				●	●		●	●	●			●					
Padden Parkway	78th St.	I-205										●	●							●	●	●								
Padden Parkway	I-205	SR-503/SR-500										●	●							●	●	●								
SR-502	I-5	SR-503										●	●				●	●		●	●	●								
SR-503	Fourth Plain	99th St.										●	●				●	●		●	●	●			●					
SR-503	99th St.	199th St.										●	●				●	●		●	●	●			●					
SR-503	199th St.	219th St.										●	●				●	●		●	●	●			●					
St. Johns	Fourth Plain	SR-500										●	●				●	●		●	●	●								
99th Street	Hazel Dell	Hwy 99										●	●				●	●		●	●	●								
Other Regional TSMO Arterial Corridors												●	●				●*	●*												

LEGEND:

O Critical Operations Sub-Corridor (red)
O Other Regional TSMO Corridors (blue)

Table 17: TSMO Strategies as Applied to Network Corridors

Chapter 8
Regional TSMO Implementation Plan

Key Concepts:

- The Regional TSMO Implementation Plan guides the deployment of Intelligent Transportation Systems Infrastructure necessary to support the region's TSMO vision.
- Future Investments build upon existing ITS infrastructure
- ITS should be deployed in accordance with Regional ITS Guidelines to obtain the maximum functionality and cost-effectiveness envisioned in the plan.

Introduction

This TSMO Implementation Plan describes a regional strategy for deployment of ITS in Clark County over the next ten years. The Plan was developed in consultation with members of the Steering Committee to identify future deployment corridors, and is a resource that supports both project development and grant applications.

Implementation of the TSMO strategies defined in this Plan relies on the availability of enabling ITS and communications infrastructure in the field that will allow agencies to monitor and actively manage traffic operations. Southwest Washington has the benefit of over ten years of coordinated ITS deployment by transportation agencies, which provides a solid foundation for supporting the TSMO vision.

To fulfill the TSMO vision for the region, this Implementation Plan provides the necessary guidance to agencies on the enabling ITS infrastructure that is required to support each of the TSMO strategies in the corridors defined in the regional network.

The future deployment need is based on three factors:

1. The existing or 'baseline' level of ITS deployment in the region presently;
2. The ITS technologies needed to support the TSMO strategies identifies in each corridor; and
3. A Regional ITS Deployment Guideline that defines a target level of instrumentation and functionality to fully instrumented ITS corridors, and that supports the desired TSMO functionality.

By comparing the 'baseline' ITS deployment in the region today to the ITS implementation standard, it is possible to estimate the level of future ITS deployment needed in the region to support the TSMO vision.

A Flexible Guide for Achieving Regional ITS Implementation

In developing this chapter of the Plan, stakeholder agencies emphasized the need for flexibility in project development due to varying priorities and funding opportunities. The ITS Implementation Plan echoes this need for flexibility and can be used as a resource in distinct ways depending on the circumstances and objectives of the participating agencies in a given corridor or project.

As noted earlier in this document, ITS projects are incremental and often opportunistic, with infrastructure deployment occurring as funding and other opportunities (e.g., corridor construction projects) permit. Therefore it is important that the Implementation Plan supports incremental deployment while presenting a vision that recognizes overall regional 'build-out' objectives.

Additionally, because the TSMO strategies that are identified as regional encompass multiple agencies and multiple modes, the plan provides guidance on the total multimodal infrastructure need within a given corridor, so that implementing agencies can consider the needs of other agencies as well as potential partnership opportunities with those agencies when implementing ITS infrastructure or seeking funding to do so.

Aggregate Regional ITS Deployment Cost Estimate

This Implementation Plan provides order-of-magnitude costs and guidance on the infrastructure required in each corridor (as of June 2011) to achieve the regional TSMO vision. Much of the information needed to determine specific ITS implementation costs is developed at the project engineering level. However, based on the 'gap analysis' performed to examine the ITS infrastructure readiness to support the region's TSMO vision, an aggregate planning level estimate of future ITS investment has been determined.

Based on a planning-level capital cost estimate, the regional ITS infrastructure needs for Clark County that will support the regional TSMO vision is approximately $12.4 million over the next ten years.

Additional information on planning-level cost assumptions for regional and corridor-level ITS implementation is provided in the appendix.

Using the ITS Implementation Plan

Figure 18 illustrates the elements of the TSMO Plan, and how they provide many 'entry points' into ITS project deployment planning and project development, depending on agency needs, objectives and conditions.

The key feature is the connection between field ITS components and the TSMO strategies they support. Those TSMO strategies, in turn, reflect transportation needs of the corridors and the region that have been identified by stakeholder agencies. In this way, fulfillment of the ITS Implementation Plan is a logical strategy towards addressing regional transportation needs.

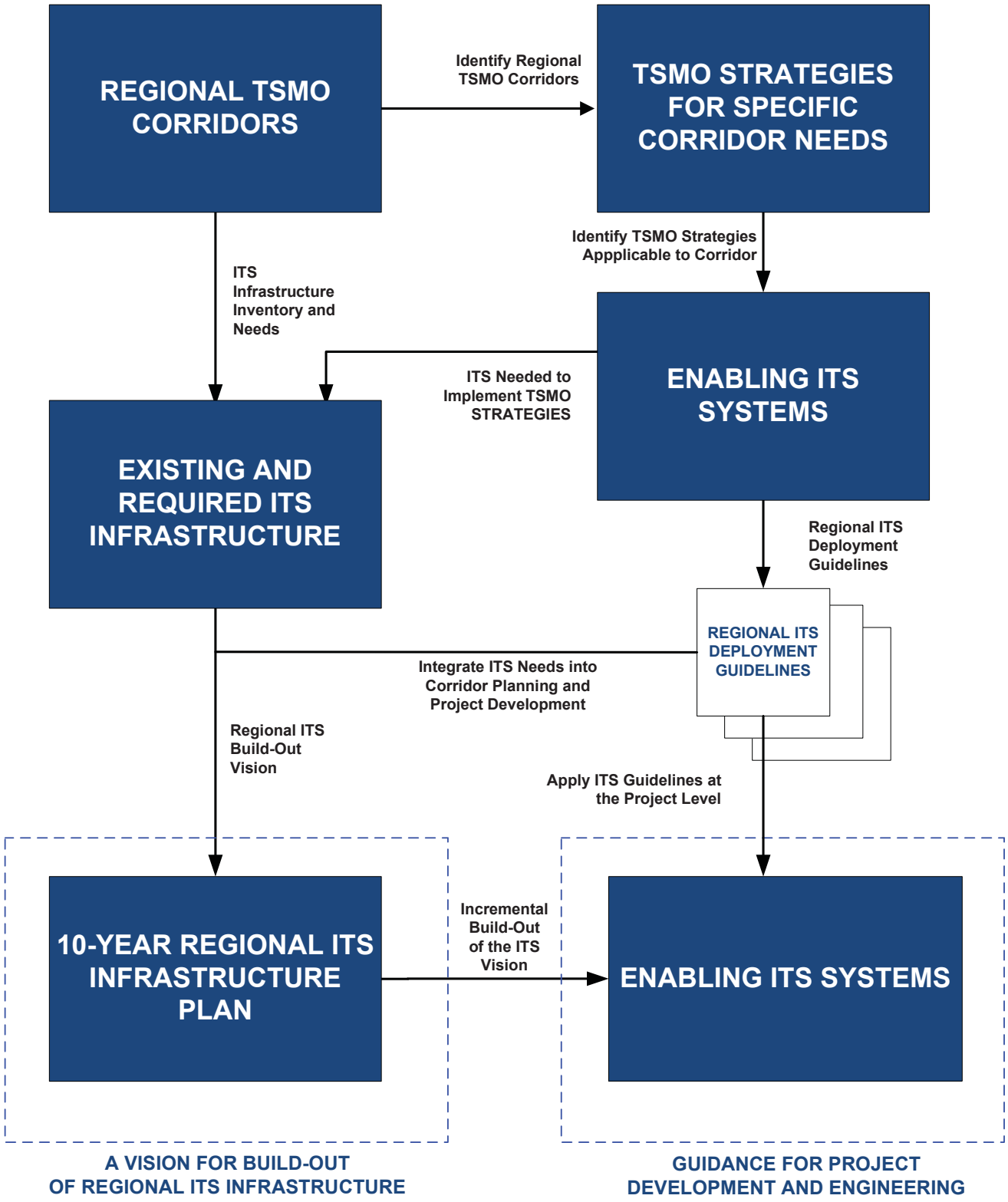


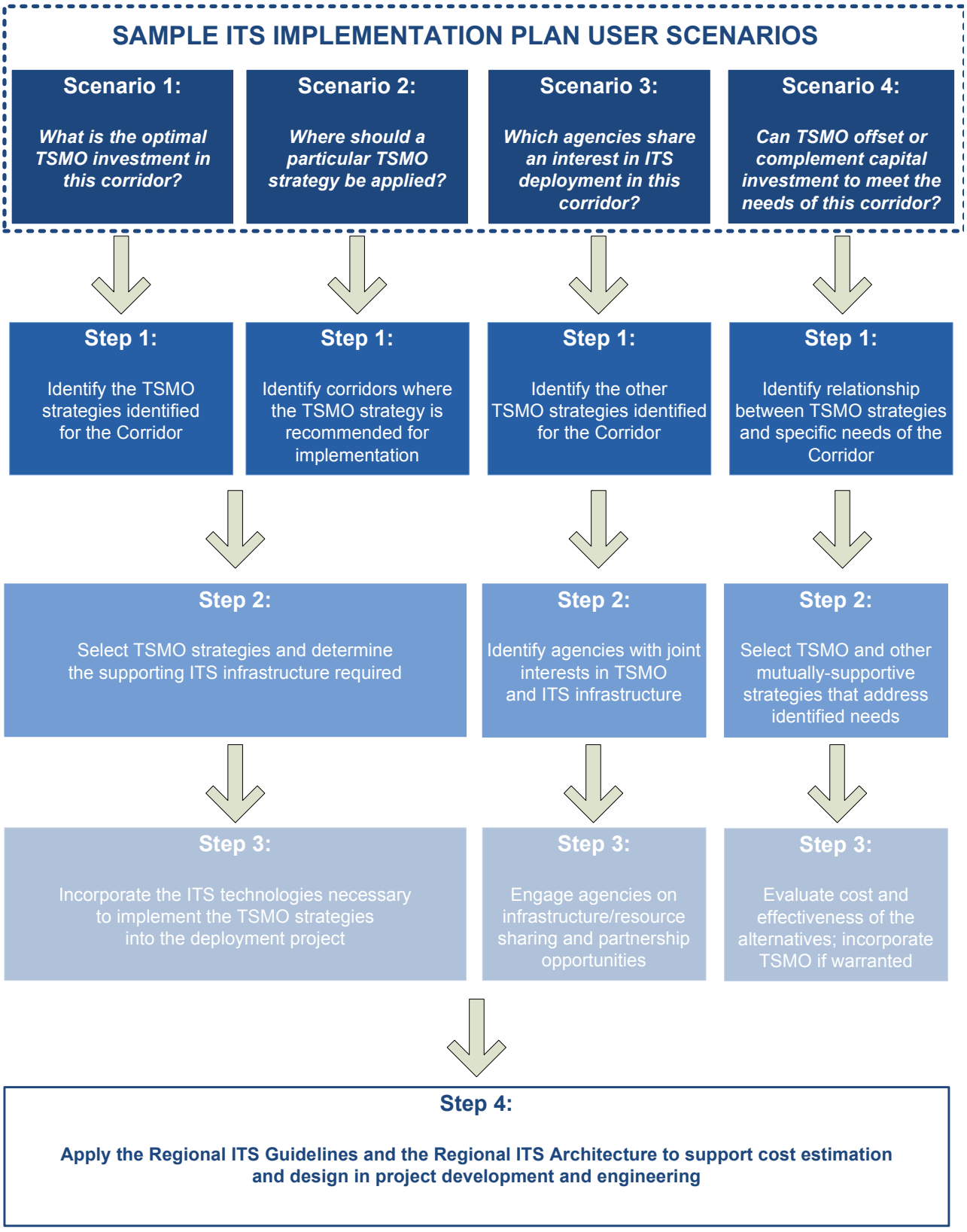
Figure 18: Relationships Among Key Elements of the Regional TSMO Plan and ITS Implementation Plan

Using the ITS Implementation Plan: Practical Examples

Table 18 describes the several ways to 'engage' the ITS Implementation Plan in several common ITS Implementation scenarios.

Table 18: Using the ITS Implementation Plan in Practical Situations

ITS IMPLEMENTATION SCENARIO	HOW TO USE THE ITS IMPLEMENTATION PLAN
Scenario 1: An agency is looking to identify the best ITS investments in a particular corridor. *Example: A reconstruction project generates the opportunity for an agency to incorporate ITS and communications infrastructure as part of the larger capital project.*	**Step 1.** Identify the TSMO strategies identified in the Corridor Implementation Plan (Chapter 7) for the corridor in question. **Step 2**. Select TSMO strategies to be implemented and determine the supporting ITS technologies required. **Step 3.** Incorporate the required ITS technologies into the proposed deployment project. **Step 4.** Use the Regional ITS Guidelines to estimate deployment requirements and guide project-level ITS engineering design.
Scenario 2: An agency is looking to implement a specific TSMO strategy and is seeking the most advantageous locations for deployment *Example: An agency wants to expand its successful Integrated Corridor Management program and is seeking the most beneficial locations for the next investment based on the TSMO network and critical operations sub-corridors.*	**Step 1.** Identify the corridors where the proposed TSMO strategy was specified as meeting corridor transportation needs in the Corridor Implementation Plan (Chapter 7). **Step 2.** Select TSMO strategies to be implemented, and determine the supporting ITS technologies required. **Step 3.** Incorporate the required ITS technologies into the proposed deployment project. **Step 4.** Use the Regional ITS Guidelines to estimate deployment requirements and guide project-level ITS engineering design.
Scenario 3: An agency is looking for partnership opportunities with other agencies who share an interest in ITS deployment in a given corridor *Example: An agency wants to implement traffic signal upgrades, but is looking for ways to share communications costs with other agencies and strengthen the funding application by addressing more regional needs.*	**Step 1.** Identify the other TSMO strategies identified in the Corridor Implementation Plan (Chapter 7) for the corridor in question. **Step 2.** Identify the stakeholder agencies with jurisdiction for implementing those strategies. **Step 3.** Enter a discussion with those agencies to identify specific infrastructure-sharing and/or joint funding, maintenance, and/ or operational partnerships. **Step 4.** Use the Regional ITS Guidelines to estimate deployment requirements and guide project-level ITS engineering design.
Scenario 4: An agency is in the process of developing a project and is comparing TSMO strategies with higher-cost capital projects. *Example: An agency wants to implement a particular project and there are several mutually-supportive strategies to consider; potential application of TSMO strategies should be the first step in project development.*	**Step 1.** Identify the ways that TSMO can address transportation needs for the corridor in question. **Step 2.** Select TSMO strategies to be implemented, and determine the mutually-supportive strategies that will achieve the desired outcome. **Step 3.** Evalualte cost and effectiveness of TSMO against other alternatives. **Step 4.** Incorporate the identified mutually-supportive strategies into the proposed deployment project.


SAMPLE ITS IMPLEMENTATION PLAN USER SCENARIOS
Scenario 1:
What is the optimal TSMO investment in this corridor?
Scenario 2:
Where should a particular TSMO strategy be applied?
Scenario 3:
Which agencies share an interest in ITS deployment in this corridor?
Scenario 4:
Can TSMO offset or complement capital investment to meet the needs of this corridor?
Step 1:
Identify the TSMO strategies identified for the Corridor
Step 1:
Identify corridors where the TSMO strategy is recommended for implementation
Step 1:
Identify the other TSMO strategies identified for the Corridor
Step 1:
Identify relationship between TSMO strategies and specific needs of the Corridor
Step 2:
Select TSMO strategies and determine the supporting ITS infrastructure required
Step 2:
Identify agencies with joint interests in TSMO and ITS infrastructure
Step 2:
Select TSMO and other mutually-supportive strategies that address identified needs
Step 3:
Incorporate the ITS technologies necessary to implement the TSMO strategies into the deployment project
Step 3:
Engage agencies on infrastructure/resource sharing and partnership opportunities
Step 3:
Evaluate cost and effectiveness of the alternatives; incorporate TSMO if warranted
Step 4:
Apply the Regional ITS Guidelines and the Regional ITS Architecture to support cost estimation and design in project development and engineering

ITS Technologies Required to Support TSMO Strategies

Most of the strategies identified in the Regional TSMO Plan require some level of field ITS and communications deployment. Conversely, it is also true that ITS technologies, once deployed, can support more than one TSMO strategy. For example, communications infrastructure, such as fiber optic cable, can support many transportation and non-transportation data communications needs.

Table 19 on the next page shows the relationship between TSMO strategies identified in the plan and the specific ITS components that support those strategies. This table provides a reference for agencies to determine the infrastructure needs required to support TSMO, or that are seeking opportunities to leverage existing infrastructure.

Note that certain TSMO strategies that are typically deployed at the regional level and that do not have a corresponding field ITS application (e.g. many traveler information systems do not involve roadside devices, such as 511 telephone) are not included in the table on the next page.

Table 19: ITS Infrastructure Required to Support TSMO Strategies

	ENABLING FIELD ITS INFRASTRUCTURE	VIDEO SURVEILLANCE	TRAFFIC SIGNAL SYSTEMS	TRANSIT SIGNAL PRIORITY	TRUCK SIGNAL PRIORITY	TRAFFIC FLOW MONITORING	ROADSIDE TRAVELER INFORMATION
Regional Management & Operations	Regional Performance Measures		✓			✓	
	Work Zone Management	✓	✓			✓	✓
	Event Management	✓	✓			✓	✓
	Regional Incident/Emergency Management	✓	✓			✓	✓
	Bi-State Incident Management	✓				✓	✓
	Transportation Management Center	✓	✓	✓	✓	✓	✓
Roadway Management & Operations	Road Weather Information Systems						
	Traffic Surveillance	✓					
	Enhanced Traffic Signal Ops	✓				✓	
	Ramp Metering	✓	✓			✓	
	Integrated Corridor Management	✓				✓	✓
	Active Traffic Management	✓				✓	✓
Transit Management & Operations	Regional Transit Fare						
	Transit Speed & Reliability			✓		✓	
	Transit Signal Priority		✓	✓		✓	
	Automatic Passenger Counters						
	Automatic Vehicle Locator & Computer Aided Dispatch	✓		✓		✓	
Freight Managment & Operations	Freight Data Collection						
	Truck Signal Priority		✓		✓	✓	
	Roadside Truck Screening						
	Real-time/predictive Freight Info.	✓				✓	✓
Traveler Information	Parking Availability Info.	✓					
	Transit Trip Planning Website						
	Real-time Transit Arrival Info.					✓	
	Predictive Traveler Information					✓	
	Regional Traveler Information	✓				✓	
	Roadside Traveler Info.					✓	✓
	Bi-State Traveler Info.	✓				✓	

	ENABLING FIELD ITS INFRASTRUCTURE	DYNAMIC TRAFFIC MANAGEMENT DEVICES	RAMP METERING	ROADWAY WEATHER INFORMATION SYSTEMS	PARKING MANAGEMENT SYSTEM	FIELD COMMUNICATIONS
Regional Management & Operations	Regional Performance Measures					✓
	Work Zone Management					✓
	Event Management	✓			✓	✓
	Regional Incident/Emergency Management	✓				✓
	Bi-State Incident Management	✓				✓
	Transportation Management Center	✓	✓	✓	✓	✓
Roadway Management & Operations	Road Weather Information Systems			✓		✓
	Traffic Surveillance					✓
	Enhanced Traffic Signal Ops	✓	✓			✓
	Ramp Metering		✓			✓
	Integrated Corridor Management	✓				✓
	Active Traffic Management	✓	✓			✓
Transit Management & Operations	Regional Transit Fare					✓
	Transit Speed & Reliability					✓
	Transit Signal Priority					✓
	Automatic Passenger Counters					✓
	Automatic Vehicle Locator & Computer Aided Dispatch					✓
Freight Managment & Operations	Freight Data Collection					✓
	Truck Signal Priority					✓
	Roadside Truck Screening					✓
	Real-time/predictive Freight Info.					✓
Traveler Information	Parking Availability Info.				✓	✓
	Transit Trip Planning Website					✓
	Real-time Transit Arrival Info.					✓
	Predictive Traveler Information					✓
	Regional Traveler Information				✓	✓
	Roadside Traveler Info.				✓	✓
	Bi-State Traveler Info.					✓

ITS Implementation Needs by Corridor

The following exhibits illustrate the build-out ITS deployment need and corridor 'readiness' to implement the ten-year TSMO vision set out in this Plan. In this case, readiness refers to the level of existing ITS infrastructure in the field as compared to the ITS infrastructure needed to fully support all of the TSMO strategies envisioned for the corridors.

The ITS Implementation Guidelines (discussed later in the chapter) was used as the basis for estimating the future ITS deployment need. By comparing that future build out scenario to existing ITS infrastructure, it is possible to determine the 'gap' that has yet to be implemented.

For each ITS equipment type, as well as for each corridor as a whole, that future ITS deployment need gap was classified as low, medium, or high. Note that the readiness of a corridor is discrete from the TSMO implementation priority identified in Chapter 7. However, these two concepts work hand-in-hand to identify the ITS investment needs and the investment priorities, respectively.

Facility:	Start segment	End segment	OVERALL CORRIDOR ITS INFRASTRUCTURE READINESS	Communications Backbone (Fiber Optic/High Bandwidth)	Transit Signal Priority	Truck Signal Priority	Video Surveillance (CCTV)	Data Collection - Travel Time Measurement and Classification Counts	Signal Technology Upgrades (systems, controllers and integration)	Variable Message Signs (VMS)	Segment Length (miles)	# Signalized Intersections
I-205	Columbia River	Mill Plain		N/A	N/A	N/A	N/A	●	N/A	N/A	1.65	
I-205	Mill Plain	Padden Parkway		N/A	N/A	N/A	N/A	●	N/A	N/A	4.71	
I-205	Padden Parkway	I-5		N/A	N/A	N/A	●	●	N/A	N/A	4.07	
I-5	Columbia River	SR-500		N/A	N/A	N/A	N/A	●	N/A	N/A	2.00	
I-5	SR-500	134th St.		N/A	N/A	N/A	N/A	●	N/A	N/A	5.00	
I-5	134th St.	179th St.		N/A	N/A	N/A	N/A	●	N/A	N/A	2.28	
I-5	179th St.	219th St.		N/A	N/A	N/A	N/A	●	N/A	N/A	2.05	
I-5	219th St.	SR-501/Pioneer St.		N/A	N/A	N/A	N/A	●	N/A	●	2.59	
SR-14	I-5	I-205		N/A	N/A	N/A	●	●	N/A	N/A	6.05	
SR-14	I-205	192nd Av.		●	N/A	N/A	●	●	●	N/A	4.08	
SR-14	192nd Av.	NW 6th Av.		●	N/A	N/A	N/A	N/A	●	N/A	2.22	
SR-14	NW 6th Av.	32nd St.		●	N/A	N/A	●	●	●	N/A	4.72	2
SR-500	I-5	Falk		N/A	N/A	N/A	●	N/A	N/A	●	1.73	2
SR-500	Falk	54th		N/A	N/A	N/A	●	N/A	N/A	●	0.58	1
SR-500	54th	Fourth Plain/SR-503		N/A	N/A	N/A	●	●	N/A	●	2.05	0
112th Av.	Mill Plain	28th St.		N/A	●	N/A	●	●	N/A	N/A	1.57	4
112th Av.	28th St.	SR-500		N/A	●	N/A	●	●	N/A	N/A	1.32	5
134th St.	Fred Meyer	I-205 NB Off-Ramp		●	N/A	N/A	●	●	N/A	N/A	0.89	6
164th Av.	SR-14	SE 1st St.		N/A		N/A	●	●	●	N/A	2.04	10
192nd Ave	SR-14	18th St.		N/A	N/A	N/A	●	●	●	N/A	3.60	10
78th St.	Hazel Dell	Hwy 99		N/A	N/A	N/A	●	●	N/A	N/A	0.34	3
Andresen	Mill Plain	18th St.		N/A	●	N/A	N/A	●	N/A	N/A	0.68	3
Andresen	18th St.	63rd St.		N/A	●	N/A	●	●	N/A	N/A	2.17	7
Andresen	63rd	Padden Parkway		N/A	N/A	N/A	●	●	N/A	N/A	0.99	2
Andresen	Padden Parkway	I-205		N/A	N/A	N/A	●	●	N/A	N/A	0.37	4
72nd Ave	I-205	St. John's		●	N/A	N/A	●	●	N/A	N/A	1.15	0
72nd Ave	St. John's	119th		●	N/A	N/A	●	●	●	N/A	0.29	2
Fourth Plain	NW 26th Av.	Columbia		●	●	●	●	●	●	N/A	1.24	3
Fourth Plain	Columbia	I-5		N/A	●	N/A	●	●	●	N/A	0.60	5
Fourth Plain	I-5	Falk		N/A	●	N/A	●	●	●	N/A	1.79	5
Fourth Plain	Falk	Andresen		N/A	●	N/A	●	●	●	N/A	1.30	7
Fourth Plain	Andresen	SR-503		N/A	●	N/A	●	●	●	N/A	2.86	10
Fourth Plain	SR-503	162nd Ave.		N/A	●	N/A	●	●	●	N/A	2.32	5
Highway 99	I-5	78th St.		N/A	●	N/A	N/A	●	N/A	N/A	1.31	4
Highway 99	78th St.	99th St.		N/A	●	N/A	●	●	N/A	N/A	1.04	1
Highway 99	99th St.	117th St.		N/A	●	N/A	●	●	N/A	N/A	0.92	3
Highway 99	117th St.	134th St.		N/A	●	N/A	N/A	●	●	N/A	0.90	4
Main	Mill Plain	Fourth Plain		●	●	N/A	●	●	●	N/A	0.58	4
Main	Fourth Plain	I-5		●	●	N/A	●	●	●	N/A	1.30	8
Mill Plain	Fourth Plain	Columbia		N/A	N/A	●	●	●	●	N/A	1.40	5
Mill Plain	Columbia	I-5		N/A	●	N/A	N/A	●	●	N/A	0.44	5
Mill Plain	I-5	Lieser		N/A	●	N/A	●	●	●	N/A	3.96	8
Mill Plain	Lieser	Chkalov		N/A	N/A	N/A	●	●	●	N/A	1.51	8
Mill Plain	Chkalov	136th Av.		N/A	N/A	N/A	●	●	N/A	N/A	1.09	6
Mill Plain	136th Av.	164th Av.		N/A	N/A	N/A	●	●	N/A	N/A	1.39	5
Padden Parkway	78th St.	I-205		●	N/A	N/A	●	●	N/A	N/A	1.28	3
Padden Parkway	I-205	SR-503/SR-500		●	N/A	N/A	●	●	N/A	N/A	2.01	3
SR-502	I-5	SR-503		N/A	N/A	N/A	●	●	N/A	N/A	6.02	6
SR-503	Fourth Plain	119th St.		N/A	●	N/A	N/A	●	N/A	N/A	1.80	7
SR-503	119th St.	199th St.		N/A	N/A	N/A	N/A	●	N/A	N/A	5.07	5
SR-503	199th St.	219th St.		N/A	N/A	N/A	N/A	●	N/A	N/A	1.00	1
SR-503	219th St.	244th St.		●	N/A	N/A	●	●	N/A	N/A	1.25	2
St. Johns	Fourth Plain	SR-500		●	N/A	N/A	N/A	●	●	N/A	0.81	3
99th Street	Hazel Dell	Hwy 99		N/A	●	N/A	N/A	●	N/A	N/A	0.60	4

Table 20: ITS Infrastructure Readiness to Support TSMO Strategies (as of June 2011)

Legend:

- ● Low level of field infrastructure readiness
- ● Moderate level of field infrastructure readiness
- ● High level of field infrastructure readiness

			**Fiber Optic - communications backbone (per mile costs)	Transit Signal Priority (per intersection)	Truck Signal Priority - *possible locations* (per installation)	Video Surveillance/Active Traffic Management CCTV (per camera)	Video Surveillance/Active Traffic Management CCTV (per camera)	Ramp meters (assumes ~10 ramp meters with the CRC project)	Data Collection: counts, classification, travel-time measurement (per installation costs)	Signal technology upgrades including systems, controllers and integration (per intersection costs)	Variable Message Sign (each)	Regional Totals
		Captial Costs (each):	$75,000	$20,000	$125,000	$35,000	$65,000	$130,000	$25,000	$35,000	$150,000	
Facility:	**Start Segment**	**End Segment**										
I-205	Columbia River	Mill Plain	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
I-205	Mill Plain	Padden Parkway	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
I-205	Padden Parkway	I-5	N/A	N/A	N/A	N/A	$65,000	N/A	N/A	N/A	N/A	$65,000
I-5	Columbia River	SR-500	N/A	N/A	N/A	N/A	N/A	$1,300,000	N/A	N/A	N/A	$1,300,000
I-5	SR-500	134th St.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
I-5	134th St.	179th St.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
I-5	179th St.	219th St.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
I-5	219th St.	SR-501/Pioneer St.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$150,000	$150,000
SR-14	I-5	I-205	N/A	N/A	N/A	N/A	$65,000	N/A	N/A	N/A	$150,000	$215,000
SR-14	I-205	192nd Av.	$306,000	N/A	N/A	N/A	$65,000	N/A	$25,000	N/A	$150,000	$546,000
SR-14	192nd Av.	NW 6th Av.	$166,500	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$166,500
SR-14	NW 6th Av.	32nd St.	$90,000	N/A	N/A	N/A	$65,000	N/A	$25,000	$35,000	N/A	$215,000
SR-500	I-5	Falk	N/A	N/A	N/A	N/A	$65,000	N/A	$25,000	N/A	$150,000	$240,000
SR-500	Falk	54th	N/A	N/A	N/A	N/A	$65,000	N/A	N/A	N/A	$150,000	$215,000
SR-500	54th	Fourth Plain/SR-503	N/A	N/A	N/A	N/A	$130,000	N/A	$50,000	N/A	N/A	$180,000
112th Av.	Mill Plain	28th St.	N/A	$80,000	N/A	$35,000	N/A	N/A	$25,000	N/A	N/A	$140,000
112th Av.	28th St.	SR-500	N/A	$80,000	N/A	$35,000	N/A	N/A	$25,000	N/A	N/A	$140,000
134th St.	Fred Meyer	I-205 NB Off-Ramp	$66,750	N/A	N/A	$35,000	N/A	N/A	$25,000	N/A	N/A	$126,750
164th Av.	SR-14	SE 1st St.	N/A	$200,000	N/A	$70,000	N/A	N/A	$25,000	$280,000	N/A	$575,000
192nd Ave	SR-14	18th St.	$75,750	N/A	N/A	$105,000	N/A	N/A	$25,000	$280,000	N/A	$485,750
78th St.	Hazel Dell	Hwy 99	N/A	N/A	N/A	$35,000	N/A	N/A	$25,000	N/A	N/A	$60,000
Andresen	Mill Plain	18th St.	N/A	$60,000	N/A	N/A	N/A	N/A	$25,000	N/A	N/A	$85,000
Andresen	18th St.	63rd St.	N/A	$80,000	N/A	$35,000	N/A	N/A	$25,000	N/A	N/A	$140,000
Andresen	63rd	Padden Parkway	N/A	N/A	N/A	$35,000	N/A	N/A	$25,000	N/A	N/A	$60,000
Andresen	Padden Parkway	I-205	N/A	N/A	N/A	$35,000	N/A	N/A	$25,000	N/A	N/A	$60,000
72nd Ave	I-205	St. John's	$86,250	N/A	N/A	$35,000	N/A	N/A	$25,000	N/A	N/A	$146,250
72nd Ave	St. John's	119th	$21,750	N/A	N/A	$35,000	N/A	N/A	$25,000	$70,000	N/A	$151,750
Fourth Plain	NW 26th Av.	Columbia	$93,000	$60,000	$125,000	$35,000	N/A	N/A	$25,000	$105,000	N/A	$443,000
Fourth Plain	Columbia	I-5	N/A	$100,000	N/A	$35,000	N/A	N/A	$25,000	$175,000	N/A	$335,000
Fourth Plain	I-5	Falk	N/A	$100,000	N/A	$70,000	N/A	N/A	$25,000	$175,000	N/A	$370,000
Fourth Plain	Falk	Andresen	N/A	$140,000	N/A	$35,000	N/A	N/A	$25,000	$245,000	N/A	$445,000
Fourth Plain	Andresen	SR-503	N/A	$200,000	N/A	$105,000	N/A	N/A	$25,000	$280,000	N/A	$610,000
Fourth Plain	SR-503	162nd Ave.	N/A	$100,000	N/A	$35,000	N/A	N/A	$25,000	$175,000	N/A	$335,000
Highway 99	I-5	78th St.	N/A	$80,000	N/A	N/A	N/A	N/A	$25,000	N/A	N/A	$105,000
Highway 99	78th St.	99th St.	N/A	$20,000	N/A	$35,000	N/A	N/A	$25,000	N/A	N/A	$80,000
Highway 99	99th St.	117th St.	N/A	$60,000	N/A	$35,000	N/A	N/A	$25,000	N/A	N/A	$120,000
Highway 99	117th St.	134th St.	N/A	$80,000	N/A	N/A	N/A	N/A	$25,000	$140,000	N/A	$245,000
Main	Mill Plain	Fourth Plain	$43,500	$80,000	N/A	$70,000	N/A	N/A	$25,000	$140,000	N/A	$358,500
Main	Fourth Plain	I-5	$37,500	$160,000	N/A	$70,000	N/A	N/A	$25,000	$210,000	N/A	$502,500
Mill Plain	Fourth Plain	Columbia	N/A	N/A	$125,000	$35,000	N/A	N/A	$25,000	$175,000	N/A	$360,000
Mill Plain	Columbia	I-5	N/A	$100,000	N/A	N/A	N/A	N/A	$25,000	$175,000	N/A	$300,000
Mill Plain	I-5	Lieser	N/A	$160,000	N/A	$140,000	N/A	N/A	$25,000	$210,000	N/A	$535,000
Mill Plain	Lieser	Chkalov	N/A	N/A	N/A	$70,000	N/A	N/A	$25,000	$210,000	N/A	$305,000
Mill Plain	Chkalov	136th Av.	N/A	N/A	N/A	$35,000	N/A	N/A	$25,000	N/A	N/A	$60,000
Mill Plain	136th Av.	164th Av.	N/A	N/A	N/A	$105,000	N/A	N/A	$25,000	N/A	N/A	$130,000
Padden Parkway	78th St.	I-205	$96,000	N/A	N/A	$70,000	N/A	N/A	$25,000	N/A	N/A	$191,000
Padden Parkway	I-205	SR-503/SR-500	$150,750	N/A	N/A	$35,000	N/A	N/A	$25,000	N/A	N/A	$210,750
SR-502	I-5	SR-503	N/A	N/A	N/A	$70,000	N/A	N/A	$150,000	N/A	N/A	$220,000
SR-503	Fourth Plain	119th St.	N/A	$40,000	N/A	N/A	N/A	N/A	$100,000	N/A	N/A	$140,000
SR-503	119th St.	199th St.	N/A	N/A	N/A	N/A	N/A	N/A	$100,000	N/A	N/A	$100,000
SR-503	199th St.	219th St.	N/A	N/A	N/A	N/A	N/A	N/A	$25,000	N/A	N/A	$25,000
SR-503	219th St.	244th St.	$93,750	N/A	N/A	$35,000	N/A	N/A	$25,000	N/A	N/A	$153,750
St. Johns	Fourth Plain	SR-500	$60,750	N/A	N/A	N/A	N/A	N/A	$25,000	$105,000	N/A	$190,750
99th Street	Hazel Dell	Hwy 99	N/A	$40,000	N/A	N/A	N/A	N/A	$25,000	N/A	N/A	$65,000
		Quantities:	18.51	101	2	46	8	10	55	91	5	
		***Other Regional TSMO Corridors (separate table)*										
			$1,388,250	$2,020,000	$250,000	$1,610,000	$520,000	$1,300,000	$1,375,000	$3,185,000	$750,000	$12,483,250

Table 21: Estimated 10-yr Implementation Plan Costs Summary (as of June 2011)

***Programmed projects are not included**

IBI GROUP with: DKS Associates, Portland State University

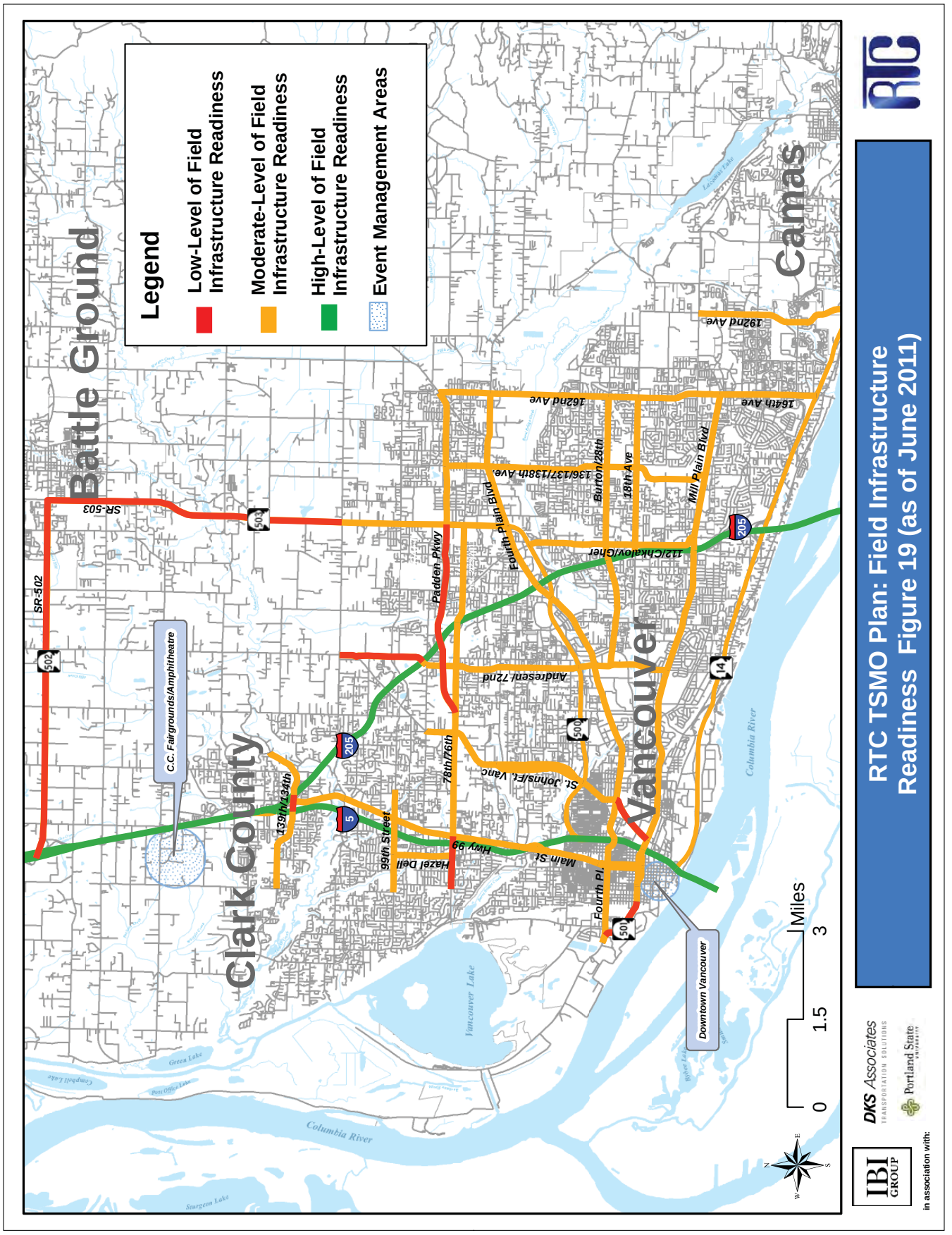
RTC

			**Fiber Optic - communications backbone (per mile costs)	Transit Signal Priority (per intersection)	Truck Signal Priority (per installation)	Video Surveillance/Active Traffic Management CCTV (per camera)	Data Collection: counts, classification, travel-time measurement (per installation costs)	Signal technology upgrades including systems, controllers and integration (per intersection costs)	Variable Message Sign (each)	Regional Totals
		Capital Costs (each)	$75,000	$20,000	$125,000	$35,000	$25,000	$35,000	$150,000	
Facility:	**Start segment**	**End segment**								
18th Ave	112th Ave	162nd Ave	$195,000	N/A	N/A	N/A	$25,000	$70,000	N/A	$290,000
SR-500/Padden Pkwy	SR-503	Ward Rd	$170,250	N/A	N/A	$105,000	$25,000	$70,000	N/A	$370,250
78th/76th	NW 10th Ave	Hazel Dell	$42,000	N/A	N/A	$35,000	$25,000	$70,000	N/A	$172,000
78th/76th	Hwy 99	SR-503	N/A	N/A	N/A	$35,000	$25,000	N/A	N/A	$60,000
99th Street	NW 11th Ave	Hazel Dell	$48,000	N/A	N/A	N/A	$25,000	N/A	N/A	$73,000
99th Street	Hwy 99	25th Ave	N/A	N/A	N/A	N/A	$25,000	N/A	N/A	$25,000
136/137/138th Ave.	Mill Plain	Padden Parkway	N/A	$60,000	N/A	$35,000	$25,000	$140,000	N/A	$260,000
Burton/28th	Andresen Rd	162nd/164th Ave	N/A	N/A	N/A	N/A	$25,000	$175,000	N/A	$200,000
162nd Ave	SE 1st	Padden Parkway	N/A	$100,000	N/A	$105,000	$25,000	$175,000	N/A	$405,000
139th/134th	NW 11th Ave	NE 10th Ave	$87,000	N/A	N/A	N/A	$25,000	$140,000	N/A	$252,000
139th/134th	I-205	WSU Entrance	$73,500	N/A	N/A	N/A	$25,000	$105,000	N/A	$203,500
Ft Vancouver Way	Mill Plain	Fourth Plain	$47,250	N/A	N/A	N/A	$25,000	$70,000	N/A	$142,250
St. Johns	SR-500	NE 88th Street	$227,250	N/A	N/A	$35,000	$25,000	$245,000	N/A	$532,250
Hazel Dell	78th/76th	99th Street	$74,250	$60,000	N/A	N/A	$25,000	$210,000	N/A	$369,250
		Quantities:	12.86	11	0	10	14	42		
		Total Costs:	$964,500	$220,000	$0	$350,000	$350,000	$1,470,000	$0	$3,354,500

Table 22: Estimated 10-yr Implementation Plan Costs Summary - 'Low Scoring TSMO Corridors' (as of June 2011)

***Programmed projects are not included**

IBI GROUP with: DKS Associates TRANSPORTATION SOLUTIONS, Portland State UNIVERSITY


Legend
Low-Level of Field Infrastructure Readiness
Moderate-Level of Field Infrastructure Readiness
High-Level of Field Infrastructure Readiness
Event Management Areas
Battle Ground
Camas
Clark County
Vancouver
SR-503
SR-502
C.C. Fairgrounds/Amphitheatre
Downtown Vancouver
Padden Pkwy
Fourth Plain Blvd
Andresen/72nd
78th/76th
St. Johns/Ft. Vanc
Hwy 99
Main St
Fourth Pl.
99th Street
Hazel Dell
139th/134th
Burton/28th
18th Ave
Mill Plain Blvd
192nd Ave
164th Ave
162nd Ave
136/137/138th Ave
112/Chkalov/Gher
Columbia River
Vancouver Lake
Green Lake
Post Office Lake
Campbell Lake
Sturgeon Lake
Miles
0
1.5
3
RTC TSMO Plan: Field Infrastructure Readiness Figure 19 (as of June 2011)
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TRANSPORTATION SOLUTIONS
Portland State
UNIVERSITY
in association with:

Regional ITS Deployment Guidelines for TSMO Corridors

The Regional ITS Deployment Guidelines provide planning-level, pre-engineering functional guidance to support the development of ITS infrastructure project concepts and funding estimates. These guidelines reflect the level of field ITS instrumentation required to 'build out' TSMO corridors in the region. These standards are described functionally, with specific implementation considerations for a given project or corridor left to the appropriate project engineering phase.

These guidelines will assist project planners and engineers in selecting the appropriate ITS elements for a given project that fulfill the collective vision for ITS functionality, considering the needs of all impacted agencies, the desired level of data collection to support operations performance monitoring and planning, and the functionality of all future TSMO strategies. By building to this regional standard, agencies are supporting the incremental fulfillment of the region's TSMO vision and field infrastructure needs.

ITS deployment guidelines are subject to the verification of field conditions, project-level engineering, evaluation and design, and also the governing codes and standards of the implementing agencies. Actual deployment standards may vary by corridor in response to specific conditions or needs.

The ITS implementation guidelines are organized by ITS field element and include the following:

- **Communications Backbone;**
- **Traffic Signals;**
- **Traffic Detection;**
- **Corridor Video Surveillance;**
- **Traveler Information;**
- **Emergency Vehicle Pre-Emption;**
- **Transit Signal Priority;**
- **Truck Signal Priority; and**
- **Other Guidelines.**

Table 23: Regional ITS Deployment Guidelines

ITS FIELD ELEMENT	REGIONAL ITS DEPLOYMENT GUIDELINES
Communications Backbone	To the extent practical, all field devices shall be connected by a redundant fiber optic communications backbone and linked to central control locations. Provisions for future communications network in designated TSMO corridors, such as installation of conduit and pull boxes, shall be incorporated as part of road reconstruction/upgrade projects. Field devices shall be connected (directly or through the appropriate central system) to host agency data archives and the PORTAL regional data archive to support performance measurement and data analysis.
Traffic Signals	All traffic signals shall be connected to the appropriate State, County, or City central traffic signal control system for remote monitoring, operations and maintenance. Where appropriate, traffic signals shall operate in a coordinated fashion using demand responsive or adaptive traffic control algorithms to respond to variability in traffic flow conditions by time of day, day of week, and due to planned and non-recurring events.
Traffic Detection	Traffic detection shall provide situational awareness to support operational objectives of the corridor, including but not limited to: traffic signal operations, detour implementation, incident management, transit management, and/or integrated corridor management. Traffic signal detection shall support collection of data needed to support transportation performance metrics defined in the Regional TSMO Plan (e.g., speed, volume, travel-time). Traffic detection devices shall, to the extent practical, support lane-level data collection. At a minimum, classified traffic counts shall be collected at major intersections. Traffic detection shall be implemented to support regional traveler information systems, such as travel-time measurement.
Traffic Video Surveillance	Traffic video surveillance shall provide situational awareness to support operational objectives of the corridor, including but not limited to: traffic signal operations, detour implementation, incident management, transit management, and/or integrated corridor management. Traffic video surveillance shall be provided at each intersection in the designated TSMO corridors. Additional traffic video surveillance shall be implemented to achieve a maximum camera spacing of ½ mile. Where practical, cameras shall be of pan-tilt-zoom (PTZ) functionality for maximum device flexibility. Where possible, inter-agency video sharing capabilities shall be implemented to support multimodal transportation system management such as transit operations, integrated corridor management, etc.

ITS FIELD ELEMENT	REGIONAL ITS DEPLOYMENT GUIDELINES
Traveler Information	Field traveler information devices shall be implemented to support the operational objectives of the corridor, such as route choice decision making, implementation of detours, or incident and event management. Arterial variable message signs (VMS) and/or blank-out signs shall be located at key points of decision throughout the region, such as major intersections, freeway entrance ramps, park and rides, and approaches to major activity centers or high congestion locations. Arterial variable message signs (VMS) and/or blank-out signs shall be implemented along designated detour or alternative routes to provide wayfinding guidance to motorists. Transit traveler information systems shall be installed at key passenger stops, transfer facilities, and park and rides in accordance with C-TRAN standards. Capability to retrieve data from field devices and supply it to regional traveler information providers.
Emergency Vehicle Pre-Emption	Emergency vehicle pre-emption shall be implemented at all signalized intersections within the region. Emergency vehicle pre-emption systems shall be capable of encoding for secure operations Emergency vehicle pre-emption systems shall be inter-operable with systems in neighboring jurisdictions to the extent possible and practical. Traffic signals shall support the activation of emergency vehicle pre-emption centrally from regional traffic control centers.
Transit Signal Priority	Transit signal priority shall be implemented at intersections along C-TRAN transit service corridors that are designated for implementation, and where warranted by detailed engineering evaluation. Transit signal priority shall be operated per agreement between C-TRAN and the respective State, County, and/or City agencies with jurisdiction at each signal location.
Truck Signal Priority	Truck signal priority shall be implemented at intersections along designated regional freight corridors where warranted by detailed engineering evaluation.
Other Guidelines	Field ITS deployment shall take into account future standards in support of USDOT's Connected Vehicle Technology program (vehicle-to-roadside, vehicle-to-vehicle, and vehicle-to-center applications (e.g. crash avoidance). ITS systems shall be implemented in a manner that is mutually supportive of mutually-supportive operations and transportation management strategies such as towing/ roadside assistance, access management, transportation demand management (TDM), etc. Special treatments (e.g. flashing beacons) should be considered at transitions from rural arterial/highway to urbanized conditions.