

Oregon Department of Transportation

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Portland State



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U.S. Department of Transportation Federal Highway Administration



TRIGMET

TREC Transportation Insight for Vennant Communitie

MULTIMODAL INTEGRATED CORRIDOR MANAGEMENT

FINAL REPORT AUGUST 2018

1-84

PREPARED BY:

DKS

Stantec

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- FHWA
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TABLE OF CONTENTS

(1)

EXECUTIVE SUMMARY
What Is Multimodal ICM? 1
Why Multimodal ICM for I-84 Corridor? 2
What Are the Travel Shed Extents? 4
What Are the Goals of the Project? 5
How Did the Project Team Determine the Recommended Operations Alternatives? 5
What Are the Project Recommendations?
How Do the Operations Alternatives Work Together?
How Can Current Activities and Programs Be Used to Promote the Recommended
Operations Alternatives?
What Are the Next Steps to Work Toward Implementation?
What's Next?



PROJECT OVERVIEW AND BACKGROUND	. 20
Background	. 20
What Is Multimodal ICM?	. 22
Why Implement Multimodal ICM in the I-84 Corridor	. 23
Project Process	. 24



EXISTING ASSETS	27
Functional Classification Map	
Transit Routes	30
Signals and Communications	
ITS Devices and Operations Centers	
Bike Network	
Shared Mobility Network	
Incident Response Support	
Transportation Demand Management Programs	
Transit ITS Components	41

TABLE OF CONTENTS



VISION, GOALS, OBJECTIVES, AND NEEDS	. 42
Goals	. 43
Summary of Needs	. 45



IDENTIFICATION AND SCREENING/ SELECTION OF OPERATIONS ALTERNATIVES	46
Preliminary Screening	46
Advanced Screening	48



RECOMMENDED MULTIMODAL ICM OPERATIONS ALTERNATIVES	52
Current Agency Activities and Programs	53
Infrastructure Assessment	55
1) Establish a Multimodal Detour Policy Across Agencies	56
2) Create a Data Sharing Policy	62
3) Form Agreements with Third Party Traveler Information Providers	69
4) Share Construction Schedules Across Agencies	73
5) Implement Dynamic Multimodal Demand Management Solutions	79
6) Implement a Decision Support System (DSS)	85



CONCLUSION	92
Developing a Memorandum of Understanding (MOU)	93
Future Funding Opportunities	. 93
Expanding the System	93



APPENDICES	A-1
Appendix A: Memorandum of Understanding	A-1
Appendix B: Advanced Screening Summary	A-2

TABLE OF FIGURES

Figure 1.	Study Area
Figure 2.	Project Process
Figure 3.	Operations Alternatives Working Together9
Figure 4.	Current Agency Activities and Programs Related to the Operations Alternatives
Figure 5.	Study Area
Figure 6.	Project Process
Figure 7.	Functional Classification
Figure 8.	Transit Routes
Figure 9.	Signals and Communications
Figure 10.	ITS Devices and Operations Centers
Figure 11.	Bike Network
Figure 12.	Shared Mobility Network
Figure 13.	Current Agency Activities and Programs Related to Multimodal ICM54
Figure 14.	Examples of Data Sharing Elements from NACTO
Figure 15.	Example of a Construction Coordination Map from Get Portland Moving
Figure 16.	Example DSS Process from the Dallas Area Rapid Transit

EXECUTIVE SUMMARY

WHAT IS MULTIMODAL ICM?

Multimodal integrated corridor management (ICM) is an approach for maximizing efficiency and safety in a corridor by actively managing the corridor's various transportation networks and services. It works by proactively managing demand and capacity across all modes of travel. Multimodal ICM works in a coordinated and collaborative fashion across public agencies. It results in a holistic approach to managing typical congestion (recurring) and non-typical congestion (crashes, weather events, or other special events). "ICM is a promising tool... that seeks to optimize the use of existing infrastructure assets and leverage unused capacity along our nations urban corridors. With ICM, transportation professionals manage the transportation corridor as a multimodal system rather than taking a more traditional approach of managing assets." – FHWA, ICM: Implementation Guide and Lessons Learned, 2012

Multimodal ICM allows transportation system operators across different agencies to work cooperatively addressing both recurring and non-recurring congestion. From a traveler perspective, travelers will be able to make more informed decisions and have a wider range of multimodal travel choices, enabling more reliable travel times.



WHY MULTIMODAL ICM FOR I-84 CORRIDOR?

The I-84 corridor from Portland to Troutdale is well-equipped with Intelligent Transportation System (ITS) devices, such as cameras, detection, network communications, and coordinated traffic signal systems. The corridor also includes an extensive bicycle network, transit routes, shared mobility services, and a robust sidewalk network, making it a prime platform to implement multimodal ICM strategies.

In addition to the corridor being well-equipped with ITS devices and accommodating several different travel modes, I-84 experiences congestion that continues to grow, which makes it a prime target for instituting multimodal ICM solutions. According to the 2016 Portland Region Traffic Performance Report, hours of congested travel increased between 2013 and 2015. By 2015 the eastbound direction experienced 12.0 hours of congestion a day and the westbound direction experienced 13.8 hours of congestion a day, a 48% and 4% increase respectively from 2013.



2016 Portland Region Traffic Performance Report





A multimodal ICM strategy can help mitigate congestion and improve safety during both planned and unplanned events optimizing the management of the system across all modes. ICM application areas include:

- **Demand Management.** Changing transportation use patterns through a variety of options that could include congestion pricing, incentivizing non-drive-alone trips, and promoting carpool and telecommute options.
- Load Balancing. Moving travelers in the network and between modes by using tools and techniques such as traffic signal timing, ramp metering, signal priority, and transit service adjustments.
- **Event Response.** Responding to events and incidents through coordination across response agencies, implementing a decision support system, and pre-planning signal timing plans for events.
- **Capital Improvement.** Enhancing corridor facilities to support and integrate the three previous components. Examples include installing data networks and additional ITS devices.

To understand how a multimodal ICM plan will improve safety and operations for the corridor, imagine a crash on I-84 that blocks a lane and creates significant congestion. With the current system drivers tend to use navigation apps or local roadway knowledge to exit the freeway and take an ad hoc detour to their destination. This approach often leads to traffic detouring through neighborhood streets or school zones, creating safety issues and undesired side effects.

With multimodal ICM, the response is coordinated across all involved agencies. If there is an event on I-84, ODOT coordinates with the local jurisdictions to mitigate the congestion and impacts to local streets. Special signal timing plans and activated signs to direct traffic along a specified route could be deployed and coordinated with third party traveler information services. The multimodal ICM response can coordinate with transit agencies to share available capacity on trains and buses. Response can also be coordinated with private shared mobility companies, and incentives offered to promote switching modes during specified times.





WHAT ARE THE TRAVEL SHED EXTENTS?

The I-84 Multimodal ICM is focused on both freeways and surface streets throughout the I-84 corridor. The I-84 corridor for the purposes of this project is defined as spanning from the Willamette River to Troutdale, and from Powell Boulevard to Sandy Boulevard, with the freight travel shed expanding further to the north and including Columbia Boulevard, Airport Way and Marine Drive, as shown in Figure 1.

NE Columbia Blvd NE Killingsworth St NE Airport Way NE Marine Dr Blvd NE Sandy Blvd NE WIK NESandy 84 NE Halsey St 84 E Burnside St SE Stark St NW Burnside Rd SW 257th SE Hawthorne Blvd Av (205) 82nd 5 SE Division St NW Division St SE Powell Blvd ell Blvd

Figure 1. Study Area

The corridor encompasses a broad swath of the some of the densest mixed-use neighborhoods in the Portland region. In addition to I-84, the corridor includes portions of I-5 and I-205, several heavy rail routes, four Multnomah County-operated bridges over the Willamette River, three MAX light rail transit routes, Portland Streetcar A and B Loop service, dozens of frequent service bus routes, numerous arterials in Portland, Gresham, and several other cities, and an expanding network of bike facilities.



WHAT ARE THE GOALS OF THE PROJECT?

The project steering committee (PSC) developed a vision and five key goals to guide the selection of recommended operations alternatives for this project:

- Improve Safety. Improve safety for all multimodal transportation users toward zero deaths.
- Improve Performance. Improve efficiency, mobility, and/or reliability of the transportation system.

VISION: Operate the I-84 travel shed in a safe, multimodal, integrated, reliable and efficient fashion where the focus is on the transportation user, and equitably sharing the economic and quality of life benefits.

- Integrate Transportation Choices. Provide improved connections among transportation choices to support traveler decisions and multimodal options.
- **Deepen Partnerships.** Build on and formalize current partnerships, and form new partnerships.
- **Promote Environmental Stewardship.** Promote transportation projects that address both the climate and human health.

HOW DID THE PROJECT TEAM DETERMINE THE RECOMMENDED OPERATIONS ALTERNATIVES?

The project process was collaborative with a core project management team, a broader project steering committee, and then a larger group of stakeholders. The Project Steering Committee (PSC) consisted of representatives from nine agencies, who played an integral role throughout the project, providing feedback and input for each step of the process. At the onset of the project a larger group of stakeholders across the region, representing all different travel modes, convened at a workshop to provide input about key corridor needs.

Project Steering Committee Representation:

- ODOT
- Metro
- TriMe
- City of Portland
- City of Gresham
- Portland State University
- FHWA
- Multnomah County
- Port of Portland



The project team then identified strategies to address those needs and put the strategies through a screening process to arrive at the top six recommended operations alternatives. The criteria for the screening process was unique for this project and developed by PSC members. The project process is illustrated in Figure 2.

Figure 2. Project Process





WHAT ARE THE PROJECT RECOMMENDATIONS?

Through a collaborative process with the project steering committee, the team recommended six operations alternatives that support implementation of an automated Decision Support System (DSS). Each operations alternative provides individual benefits, as well as contributing to the overall success of a DSS.

Establish a Multimodal Detour Policy Across Agencies



Create an agreement between agencies that establishes protocols to manage detouring traffic safely from I-84 and I-205 onto non-freeway facilities and then back on to I-84 and I-205. Policy should prioritize transit and other

High Occupancy Vehicles (HOVs), address equity issues, and target routes for potential detours to minimize use of neighborhood streets, bicycle boulevards, or other roadways not designed, nor intended for high vehicle volumes. Freight detours will need special considerations.

The agreements reached in this Multimodal Detour Policy will contain shared rules among operators for use by the DSS.

Create a Data-Sharing Policy



Create a common policy amongst public agencies to improve transportation-related data sharing capabilities across the region. The intent is to provide an open data platform that will improve information flow and

availability to both agencies and transporatation system operators, as well as travelers.

Implement Dynamic Multimodal Travel Demand Management Solutions



Create a common policy amongst public agencies to improve transportation-related data sharing capabilities across the region. The intent is to provide an open data platform that will improve information flow and

availability to both agencies and transporatation system operators, as well as travelers.

Examples of combining active demand management with ICM to respond to a planned or unplanned event include: sharing transit and park&ride capacities, dynamically changing parking pricing, incentivizing non-drive alone trips in real-time, partnering with employers, and congestion pricing.

Form Agreements with Third-Party Traveler Information Providers



Coordinate and form agreements with third party information providers and mobility app providers. Collaborating beyond the Portland region may provide additional leverage and opportunity to engage with third party

traveler information providers and improve outcomes. Intended purposes include:

- Encouraging routing away from school zones, high bicycle and pedestrian zones such as neighborhood-serving business districts
- Discouraging or preventing additional vehicle traffic on neighborhood greenways
- Encouraging two-way data sharing and partner on safety for high-crash corridors

Share Construction Schedules Across Agencies



Establish a policy and method (such as a website) for all agencies to identify, coordinate, and mitigate safety and multimodal impacts from construction activities and detours. The information will

prevent the DSS from recommending travelers detour through construction zones that are already creating congestion.

Implement a Decision Support System (DSS)



Develop a DSS to support organizational decision making in real-time in response to both planned and unplanned events. A DSS can range from a manual decision matrix to an automated system that runs pre-

dictive algorithms and optimizes system operations. This operations alternative requires collaboration and agreement among all participating agencies, agreening upon a set of business rules that address predefined inter-agency permissions and criteria.



HOW DO THE OPERATIONS ALTERNATIVES WORK TOGETHER?

Each of the first five operations alternatives can be developed individually, but all feed into developing the Decision Support System (DSS), as shown in Figure 3. Additional elements could be added in the future to further advance the capabilities of the DSS.







The operations alternatives work similarly whether responding to recurring congestion or non-recurring congestion such as a crash, weather event, or planned sporting event. The table below helps to explain how each of the operations alternatives helps alleviate congestion under both recurring and non-recurring congestion.

DETOUR	Establish a Multimodal Detour Policy Across Agencies	Traffic is detoured along a predefined route equipped with ITS devices and optimized signal timing to promote traffic flow. The route avoids sensitive areas such as school zones or high pedestrian areas.
	Create a Data-Sharing Policy	Operators share data so they can operate the transportation network as efficiently as possible, understanding real-time capacity optimizing the network.
	Form Agreements with Third-Party Traveler Information Providers	Agreements will be in place with third party traveler information providers so that travelers using those apps are routed as intended by agencies, and not through school zones or other sensitive areas.
	Share Construction Schedules Across Agencies	Agencies share construction information so that when a detour is necessary, it can be routed to avoid a work zone. The information also helps agencies coordinate construction when feasible to minimize impacts to travelers.
Ô	Implement Dynamic Multimodal Travel Demand Management Solutions	Travelers may be encouraged to use non-drive alone modes by use of an array of solutions. Options include incentivizing non-drive along modes during peak congestion such as vouchers or reduced trip pricing. Another option is dynamic parking pricing or congestion pricing.
	Implement a Decision Support System (DSS)	With a decision support system, the process of making and implementing traffic management decisions is simplified. A DSS can be a manual process, fully automated, or a hybrid of both. An automated DSS will provide a system simulation and offer optimal solutions for the operator to implement. At the other end of the spectrum, a manual DSS provides a preplanned framework to guide operators and lead them through the process.



HOW CAN CURRENT ACTIVITIES AND PROGRAMS BE USED TO PROMOTE THE **RECOMMENDED OPERATIONS ALTERNATIVES?**

Partner agencies already participate in several programs and activities that can be used as launching points for the recommended operations alternatives. The list of current activities and programs as they relate to the six recommended operations alternatives intended as a starting point, to help understand which programs and activities can be used to help propel the next steps. This list is show in Figure 4 below.

Figure 4. Current Agency Activities and Programs Related to the Operations Alternatives

Proposed Operations Alternatives

1 Establish a Multimodal Detour Policy Across Agencies

Create a Data Sharing Policy

😢 Form Agreements with Third Party Traveler Information Providers 🛛 🌀 Implement a Decision Support System (DSS)

- A Share Construction Schedules Across Agencies
- Implement Dynamic Multimodal Demand Management Solutions

Current Agency Activities and Programs and How Each Relates to the Six Proposed Operations Alternatives

ODOT

- Operates TripCheck, TTIP, and real-time ACM and VMS 200
- Maintains TripCheck Local Entry (TLE)
- Operates the TMOC and Incident Response (24/7) 2 🜀
- Provides data to PORTAL
 P
- Operates Flash Alert System 2 🜀
- Integrated WAZE into TripCheck 28
- · Formed past agreements with Inrix for traffic data and Strava for bike data 🕗 🖸 🗗
- Investigating congestion pricing on I-5 and I-205
- Operates field devices
- Communicates with other agencies via phone or email
- Participates in TransPort
- Co-leads Traffic Incident Management (TIM) Coalition G

PBOT

- Maintains and operates shared regional traffic signal system server. Remote communications to TransSuite is supported by Multnomah Co, Gresham, ODOT, and other regional operators outside the corridor 2 3 6
- Maintains "Get Portland Moving" (construction projects)
- Manages the Regional Construction Coordination Committee
- Partner in PUDL (Portland Urban Data Lake) and manages the Traffic Safety
- Sensor Pilot project to monitor bike, ped, vehicle, and parking data 2000 Reached out to WAZE requesting routing around school zones
- (no agreement in place yet) 😣
- Operates Parking Kitty (mobile app) and parking lots/garages
- Operates maintenance 24/7
- Provides data to PORTAL 2
- Operates field devices
- Shares video images with ODOT (TripCheck) 2
- Participates in TransPort
- Maintains a TDM program
- Maintains operating agreements with Biketown Developing a Smart Automated Vehicle Initiative (SAVI)

Multnomah County

- Provides bridge lift info provided to mobile app and other media 2 😣
- Participates in TransPort

Shared Mobility

• Operates bikeshare, carshare, and transportation network companies (TNCs) 🕞

TriMet

- Developing a Mobility on Demand app 285
- Provides data in Open API format 28
- Operates the TriMet Operations Command Center 24/7 20 Maintains TriMet website, mobile apps, and transit tracker 205
- Operates mobile payment
- Operates In-house app "Alerts" to notify PIOs of incidents 🕗
- Provides data to PORTAL 2
- Operates field devices
- Operates transit services
- Participates in TransPort
- Manages park & rides and bike & rides

Port of Portland

- Provides data to PORTAL (planned) 🕗
- Manages parking system at PDX 56
- Operates field devices (parking and VMS) 6
- Participates in TransPort
- Metro
- Operates the RTO Program 🕒
- Participates in TransPort Planning for operations and emerging technology 2000

PSU

- Maintains PORTAL 283
- Participates in TransPort
- Partner in PUDL 283
- Piloting DSRC with Portland Streetcar
- Developing a Smart Cities Action Plan 2 G

Gresham

- Provides data to PORTAL
 P
- Operates field devices
- Participates in TransPort
- Partner in data sharing with TTS 🕗

Emergency Management Center

Operates the emergency management center G



WHAT ARE THE NEXT STEPS TO WORK TOWARD IMPLEMENTATION?

For each of the Operational Alternatives, lead agencies and recommended actions are identified. This information can be used to scope the next phases for each of the operations alternatives and work toward implementation. The next six pages include a one-page summary of the lead agencies and recommended actions to move each of the operations alternatives forward.



ESTABLISH A MULTIMODAL DETOUR POLICY ACROSS AGENCIES



CREATE A DATA-SHARING POLICY



FORM AGREEMENTS WITH THIRD PARTY TRAVELER INFORMATION PROVIDERS



SHARE CONSTRUCTION SCHEDULES ACROSS AGENCIES



IMPLEMENT DYNAMIC MULTIMODAL DEMAND MANAGEMENT SOLUTIONS



IMPLEMENT A DECISION SUPPORT SYSTEM (DSS)



ESTABLISH A MULTIMODAL DETOUR POLICY ACROSS AGENCIES

Lead Agencies

Metro, ODOT, and PBOT

Recommended Actions

Identify detour routes:

- Evaluate the following elements when developing detour routes:
 - » High crash locations¹
 - » Sensitive land uses such as hospitals and schools
 - » Rail crossing locations
 - » Areas with vulnerable roadway users (bike facilities, high pedestrian areas, senior living facilities, etc.)
 - » Current construction activity
 - » Transit routes
 - » Identify freight detour routes/freight issues
 - » Understand where buses are capable of operating
 - » Understanding roadway grades
- Develop maps showing possible detours.
- Develop signal timing plans for detour routes.
- Determine if additional field devices are necessary to safely and effectively activate and operate detours.
- Evaluate advancing installation of TSP on non-transit routes for detour purposes.

Define the operations of a detour:

- Determine level of automation to activate detours.
- Document device control agreements.
- Develop business rules.
- Determine hours of operation.
- Identify how the detour information will be relayed to travelers (en-route and pre-trip).

Evaluate before and after implementation:

- Identify performance measures to evaluate.
- Structure a report.

Engage the public:

- Coordinate public outreach to inform the public and businesses and property owners along potential detour routes.
- Help residents and business owners understand the intended operations and characteristics of the roadway network.
- Explain how this effort will mitigate the ad hoc rerouting currently in place due to navigation apps.

1 Metro's 2017 report on High Injury Corridors provides an important reference point: https://www.oregon metro.gov/ sites/default/files/2018/05/25/high-injury-corridors-report-April-2017.pdf



CREATE A DATA-SHARING POLICY

Lead Agencies

TriMet, ODOT, PSU, PBOT, and Metro

Recommended Actions

Organize a consortium representing all agencies to form a working group that meets regularly to address the data needs for the region:

• Determine who will be members of this group and how often the group will meet.

Options to consider:

- » PUDL group currently meets monthly and could be expanded to encapsulate this broader data policy.
- » Develop a TransPort subcommittee
- Document the by-laws of the consortium that outlines how the consortium makes decisions (examples: unanimous agreement, majority vote, lead agency decision, etc.)
- Document the intended use of shared data and show how it will be used to ensure it promotes the six regional goals.
- Review existing data privacy policies across the region and develop a data privacy policy for the ICM project.
- Create a policy that outlines expectations for sharing data between agencies for purposes of transportation operations, planning, and/or maintenance.
- Document how data sharing equity issues will be addressed.
- Address liability issues.

Determine what decisions the data will be used for, and then identify the necessary data to support those decisions:

- Determine how data will be used. Examples: detour purposes, performance metrics, construction impacts, before and after studies, etc.
- Review existing available data and databases (Ex: PORTAL, TripCheck, PUDL).
- Identify gaps in the existing data and determine if agencies can provide the additional data.
- Investigate the use of data from the private sector to fill gaps (see Operations Alternative #3)

Determine how the data will be disseminated and shared, between public agencies, private sector companies, and the traveling public:

- Advance the work already completed by PSU and PBOT investigating different cloud database
 options and define the data sharing platform.
- Establish consistent data format and fields for all users.
- Determine appropriate dissemination for the data flows (ex: what stays between agencies, what data goes to third party providers, and what data goes to the public.)
- Establish how data liability issues will be addressed.
- Publish performance reports on a regular basis.



FORM AGREEMENTS WITH THIRD PARTY TRAVELER INFORMATION PROVIDERS

Lead Agencies

PBOT, ODOT, Metro

Recommended Actions

Coordinate route preferences:

- Form a working group to develop common goals for the region to work with third party traveler information services to encourage routing around specific areas. Elements to consider:
 - » School zones
 - » Bicycle boulevards
 - » Steep grades during inclement weather or for bike and pedestrian travel
- Pursue routing agreements with third party traveler information providers based on developed goals.

Share data:

- Evaluate existing agreements.
- Review intent of data (Operations Alternative #2) and determine what data is needed from third party vendors to fill the gaps (especially on arterials).
- Leverage opportunities for two-way data sharing.
- Determine what data is available from third party vendors, as well as associated costs or whether data can be exchanged or provided for free.
- Schedule presentations by the private sectors to demonstrate their products.
- Pursue new agreements or leverage existing agreements to meet the data needs determined through this evaluation.





SHARE CONSTRUCTION SCHEDULES ACROSS AGENCIES

Lead Agencies

PBOT and ODOT

Recommended Actions

Evaluate Platforms to Share Construction Information:

- Evaluate existing platforms in use for sharing construction information (including: TripCheck TLE, Get Portland Moving, and Regional Construction Coordination Committee).
- Consider streamlining the services of PUDL, Get Portland Moving, and TLE through open APIs. Allow one data stream to be consumable by others.
- Determine future platform for sharing the construction information using systems engineering:
- Document system requirements.
- Determine criteria and data fields for entering construction information.

Establish Procedures:

- Establish procedures and operations and maintenance agreements to address coordination for using the tool.
- Identify a process to include utility construction and maintenance activity.
- Develop roles and responsibilities for participating agencies.
- Provide a process for the information to feed into the Decision Support System.
- Develop impact identification, prevention, and mitigation assessment policy and tool.

Evaluate Mitigation Strategies:

- Determine performance measures to evaluation.
- Review before and after data to determine the effectiveness of the program and how to improve it.





IMPLEMENT DYNAMIC MULTIMODAL DEMAND MANAGEMENT SOLUTIONS

Lead Agencies

Metro, ODOT, TriMet, and PBOT

Recommended Actions

Determine overarching components:

- Identify participating agencies and partners, and establish roles and responsibilities in developing the demand management solutions.
- Establish a corridor-wide demand management team and partners.
- Investigate equity impacts for all proposed options.

Explore concepts:

- Study congestion and value pricing concepts for I-84.
- Evaluate parking opportunities (Ex: dynamic parking pricing, removal and/or ease of parking restrictions, or removal of occupancy).
- Evaluate dynamic incentives for bikeshare and transit (offer incentives when congestion or events arise).
- Evaluate opportunities to increase capacity on transit and high occupancy rideshare during events.
- Explore funding opportunities and logistics.

Coordinate and expand programs:

- Develop scopes to expand demand management programs.
- Coordinate with bikeshare and transit for incentive programs.
- Expand the existing RTO program and explore new incentives.
- Develop/expand partnerships with corridor employers, exploring options to reduce drive alone trips during peak demand periods.

Evaluate demand management solutions:

- Determine performance measures to evaluate.
- Publish reports documenting the effectiveness of the programs.



IMPLEMENT A DECISION SUPPORT SYSTEM (DSS)

Lead Agencies

Metro and ODOT (supported by all partner agencies)

Recommended Actions

Organize participating agencies and information exchange network:

- Identify participating agencies and data users (public and private).
- Define desired outcomes. This may include environmental benefits from implementation of the strategy.
- Establish an Information Exchange Network (see Operations Alternative #2 Data Sharing Policy)
- Identify sources of data and communication protocols for sharing information between agencies and third party vendors (see Operations Alternatives #2 and #3).
- Apply systems engineering to define the requirements and capabilities of the system (manual vs automated, simulation models, etc.).
- Evaluate available DSS software options (off the shelf).
- Establish how travelers will be informed of actions that result from the DSS.

Develop business rules:

- Develop agreements between agencies to operate traffic signals and ITS devices during hours when agency staff is not available.
- Determine whether to establish a virtual 24/7 TMOC for all partner agencies.
- Determine how to prioritize non-drive alone trips.
- Determine transit system capacity (transit vehicle capacity and park and ride capacity) along with other high-occupancy vehicles (e.g., ridesharing, TNCs with multiple passengers (Lyft Line/ Uber Pool).
- Determine modifications to transit operations and availability of related one-way services (e.g., bike-sharing, car-sharing, TNCs and micro transit).
- Establish control capabilities for ITS devices owned and operated by various stakeholders.
- Define the desired level of automation (from manual decision trees to advanced predictive algorithms).



WHAT'S NEXT?

The I-84 corridor is prime for developing a multimodal ICM system. Already equipped with ITS devices, network communications, transit routes, bike facilities, and shared mobility resources, the existing corridor infrastructure lays the groundwork for a multimodal ICM system. As the recommendations from this project are implemented, they can be scaled to incorporate additional stakeholders and expand capabilities.

As transportation continues to evolve with emerging technologies, adapting a multimodal ICM will help to coordinate operations between agencies and maximize efficiencies. Once these strategies are implemented, travelers will experience safer trips and more reliable travel times, for a more enjoyable travel experience.



PROJECT BACKGROUND AND OVERVIEW



BACKGROUND

The I-84 Multimodal ICM is focused on both freeways and surface streets throughout the I-84 corridor. The I-84 corridor for the purposes of this project is defined as spanning from the Willamette River to Troutdale, and from Powell Boulevard to Sandy Boulevard, with the freight travel shed expanding further to the north and including Columbia Boulevard, Airport Way and Marine Drive, as shown in Figure 5.

The corridor encompasses a broad swath of the some of the densest mixed-use neighborhoods in the Portland region. In addition to I-84, the corridor includes portions of I-5 and I-205, several heavy rail routes, four Multnomah County-operated bridges over the Willamette River, three MAX light rail transit routes, Portland Streetcar A and B Loop service, dozens of frequent service bus routes, numerous arterials in Portland, Gresham, and several other cities, and an expanding network of bike facilities.



Figure 5. Study Area



The Portland metro region faces significant transportation challenges. The region's population is growing quickly. The region's current population stands at 2.35 million and is expected to increase by over one million residents by 2040. The Portland region is known for managing growth through strong land use and transportation policies. This corridor includes several urban centers and extends to the outer edge of the region's urban growth boundary, protecting rural and recreation areas in the Columbia River Gorge. The Portland region is also an important trade center, functioning as both an international gateway and domestic hub for commerce. The regional economy is highly dependent on manufacturing, warehousing, trade, transportation, and utility sectors. The region's trade is supported by two major rivers, Portland International Airport, heavy rail corridors operated by Union Pacific, BNSF and other regional railroads, and the region's three interstate freeways (I-84, I-5, and I-205).



WHAT IS MULTIMODAL ICM?

Multimodal integrated corridor management (ICM) is an approach for maximizing throughput efficiency and safety for people and goods in a corridor by actively managing the corridor's various transportation networks and services. It works by proactively managing demand and capacity across all modes of travel. Traditionally public agencies as well as private companies such as TNC's and other shared mobility companies operate independently. Multimodal ICM works in a coordinated and collaborative fashion. It results in a holistic approach to managing typical and non-typical travel day events.

"ICM is a promising tool... that seeks to optimize the use of existing infrastructure assets and leverage unused capacity along our nations urban corridors. With ICM, transportation professionals manage the transportation corridor as a multimodal system rather than taking a more traditional approach of managing assets."

> - FHWA, ICM: Implementation Guide and Lessons Learned, 2012

Integrated corridor management strategies encompass four main project categories:

- **Demand Management.** Changing transportation use patterns through a variety of options that could include congestion pricing, incentivizing non-drive-alone trips, and promoting carpool and telecommute options.
- Load Balancing. Moving travelers in the network and between modes by using tools and techniques such as traffic signal timing, ramp metering, signal priority, and transit service adjustments.
- **Event Response.** Responding to events and incidents through coordination across response agencies, implementing a decision support system, and pre-planning signal timing plans for events.
- **Capital Improvement.** Enhancing corridor facilities to support and integrate the three previous components. Examples include installing data networks and additional ITS devices.



To demonstrate how multimodal ICM works, imagine a lane blocking crash that occurs on I-84 during the PM peak commute hours. Under the current system drivers tend to use navigation apps or local roadway knowledge to exit the freeway and take an ad hoc detour to their destination. This approach often leads to traffic detouring through neighborhood streets or school zones, creating safety issues and undesired side effects. With multimodal ICM, the intent is to coordinate response across all involved agencies. If there is an event on I-84, ODOT coordinates with the local operating agencies to activate special signal timing plans and safely direct traffic along dedicated detour routes using signs or coordination with third party traveler information services. This coordinate with transit agencies or other shared mobility companies to incentivize use of those services during specific times.

Integrated corridor management achieves coordination on three levels: institutional (cultural change), operational (maximizing efficiencies of the system), and technical (means by which it occurs).

Multimodal ICM is a natural progression for operations. Typically, agencies begin by operating their own ITS devices and separate modal systems. Then agencies can evolve to integrate across agency and modal boundaries to dynamically manage and optimize the system.

WHY IMPLEMENT MULTIMODAL ICM IN THE I-84 CORRIDOR?

Congestion along the I-84 corridor continues to worsen, with several safety and performance needs identified (see Vision, Goals, and Objectives section). While the corridor experiences high congestion, especially during peak periods, it is also well equipped with data communications, Intelligent

Multimodal ICM supports Vision Zero, recently adopted by the City of Portland, by improving management of traffic along high crash corridors.

Transportation System (ITS) devices, transit routes, neighborhood bike/walk greenways, and shared mobility providers, making the corridor prime for multimodal ICM strategies.



PROJECT PROCESS

Developing the I-84 Multimodal ICM Deployment Plan was a collaborative effort among the project management team, a core group of steering committee members and a broader group of stakeholders. The sections below describe the project approach and how the stakeholders contributed to the process, which is illustrated in Figure 6.

Figure 6. Project Process





Project Approach

The project began by developing an atlas of the existing assets along the study corridor, to understand existing infrastructure as well as gaps. Then the project steering committee developed a project vision with supporting goals and objectives.

A workshop was held in September of 2017, where stakeholders helped identify key needs along the corridor. After the workshop the project team developed a toolbox of 53 operations alternatives² to address the identified needs. Then the project team evaluated the alternatives based on how well they achieved each of the five goals (improve safety, improve performance, integrate transportation choices, deepen partnerships, and promote environmental stewardship). By discussing and referencing the evaluation, the PSC narrowed the extensive list of 53 down to 18 potential operations alternatives.

Then the project team applied a second level of screening to select the top six operations alternatives for the I-84 corridor, which the project team then refined. The general process is shown in Figure 1.

Stakeholder Contributions

The project was a collaborative effort, engaging a core group to serve as the project steering committee, as well as a broader group to participate in a workshop.

Project Steering Committee: The project steering committee consisted of representatives from seven agencies. These representatives provided continued feedback and support throughout the project, meeting regularly and reviewing all deliverables.

Agency	Description and Role
Metro	Metro serves as the lead agency for the I-84 Multimodal Integrated Corridor Management project. Metro is the metropolitan planning organization (MPO) for the Portland metropolitan region. As a result, Metro is well-positioned to oversee a project that crosses jurisdictional boundaries, fosters existing relationships with all involved parties, understands regional transportation and operations planning, and is a recipient and distributor of federal funds. Metro manages programs related to transportation demand management and transportation system management and operations.
Oregon Department of Transportation (ODOT)	ODOT serves as the contract manager for the FHWA grant. ODOT is the state transportation agency that maintains I-84, I-5, and I-205, along with several state highways inside the I-84 Multimodal ICM boundary that are part of the National Highway System. ODOT's Region 1 oversees all operations inside the Portland Metro region, and the Transportation Management Operations Center (TMOC) manages Incident Response vehicles and freeway operations in the region. ODOT employs traffic engineers to design, build and maintain freeway signals, ramp meters, variable message signs, advisory speed signs and its operators maintain freeway ITS devices, alert local officials of incidents, and post messages to TripCheck.org.

² Operations Alternatives Draft Toolbox. Oct 31, 2017. Prepared by DKS Associates.



TriMet	TriMet is the transit agency for the Portland metropolitan region, serving riders in Multnomah, Clackamas and Washington Counties. TriMet manages five light rail Metropolitan Area Express (MAX) lines, 80 bus lines, and the Westside Express Service (WES) commuter rail line. TriMet has a strong record of commitment to utilizing advanced technologies to enhance its service and is a natural partner to absorb more trips when incidents happen along the I-84 corridor. TriMet's Operations Command Center supports service reliability of buses and trains during incidents and events.
City of Portland	The City of Portland , the largest city in the state of Oregon, is one of the jurisdictions in the I-84 corridor. The Portland Bureau of Transportation (PBOT) operates arterial roads throughout the corridor. PBOT maintains these roads and signals, monitors travel times and CCTV cameras, and has the power to modify signal timing on arterials for changing conditions. PBOT's Traffic Operations Center (TOC) allows the agency to address detailed traffic signal and operations maintenance issues including expediting towing for incident management.
City of Gresham	The City of Gresham , the fourth largest city in the state of Oregon, is east of Portland and is in the I-84 corridor. Gresham's Transportation Division operates, modifies, and installs adaptive traffic signals as needed along arterials inside its boundaries.
Multnomah County	Multnomah County , the most populous county in the state of Oregon, is home to all jurisdictions that are impacted by the I-84 Multimodal ICM. The County operates the road infrastructure for all communities in the county, excluding Portland and Gresham, several of which are located along I-84 and I-205. The County also operates four drawbridges over the Willamette River inside the I-84 Multimodal ICM travel shed.
Portland State University (PSU)	Portland State University (PSU) , the largest university in the state of Oregon, was named one of the USDOT's five national University Transportation Centers (UTC) in 2006 (around the USDOT's livable communities initiative), and PSU was reconfirmed a national UTC in 2016. PSU's transportation research assets and facilities include five research labs in Civil and Environmental Engineering as well as PORTAL, a transportation data service and archive with over 10 years of ITS data from Portland area highways, as well as transit, signal and bicycle- and pedestrian-count records.

In addition to the PSC, a broader group convened at the beginning of the project to help identify needs along the corridor. Those invited to the workshop included representatives from:

- City of Gresham (additional staff from core PSC)
- City of Portland (additional staff from core PSC) PBOT and BPS
- City of Troutdale
- City of Wood Village
- Columbia Corridor Association
- C-Tran
- FHWA
- Towing companies
- Metro (additional staff from core PSC)

- Multnomah County (additional staff from core PSC)
- ODOT (additional staff from core PSC)
- Port of Portland
- Portland Streetcar
- Portland State University (additional staff from core PSC)
- Providence Hospital
- Ride Connection
- The Street Trust
- TriMet (additional staff from core PSC)

EXISTING ASSETS



Implementing ICM solutions requires a network of ITS devices and modal systems to be in place before advancing to the integration component. To understand what the I-84 corridor is capable of advancing, the project management team documented existing and planned near-term operations assets along the corridor. Please note that this inventory was completed before the project study area expanded to Marine Dr., adding additional freight routes, transit routes and Portland International Airport. The inventory included a review of:

- Functional classification map (see Figure 7)
- Transit routes (see Figure 8)
- Signals and communications (see Figure 9)
- ITS devices and operations centers (see Figure 10)
- Bike network (see Figure 11)
- Shared mobility network (see Figure 12)
- Incident response support (see Pages 40-41)
- Transportation demand management programs (see Pages 40-41)
- Transit ITS components (see Pages 40-41)












INCIDENT RESPONSE

Within the study area, four programs perform incident response.

Agency	Response Types	Hours	Location	# of Employees	# of Vehicles	Service Area	Highway or Surface Streets?
ODOT Incident Response	 Disabled vehicle Disabled vehicle in travel lanes Hazard /debris removal Clearing lane blocking incidents Road kill Vehicle and roadside fires Abandoned vehicles Hazmat (low level initial response) Weather Coordination 	Typically, 5am-10pm Varies by day of week and can go later if there is an incident One responder is on call when Incident Response is off duty	 Baldock Maintenance– 9637 SW 35th Dr. East Portland Maintenance– 5315 NE 101st Ave. North Portland Maintenance– 1100 N Columbia Sylvan Maintenance– 6000 SE Raab Rd. 	9	11	Portland Region	Freeway only unless specifically requested by a partner agency for a fuel tank breach
City of Portland Police	 Disabled vehicles Disabled vehicle in travel lanes Moving accident vehicles from travel lanes Hazard / debris Vehicle and roadside fires 	24/7	 1111 SW 2nd Ave, Portland 2619 NW Industrial St, Portland 	N/A	N/A	Portland	Will respond if ODOT is unavailable
City of Gresham Police	 Disabled vehicles Disabled vehicle in travel lanes Moving accident vehicles from travel lanes Hazard / debris Vehicle and roadside fires 	24/7	• 1333 NW Eastman Pkwy, Gresham	N/A	N/A	Gresham	Will respond if ODOT is unavailable
Oregon State Police	 Disabled vehicles Disabled vehicle in travel lanes Moving accident vehicles from travel lanes Hazard / debris Vehicle and roadside fires 	24/7	• 8085 SE Deer Creek Ln, Portland	N/A	N/A	Outside Portland City Limits	I-205 and I-84 (mostly in the Columbia Gorge)

TRANSPORTATION DEMAND MANAGEMENT PROGRAMS

Program	Description	
SmartTrips Residential Outreach	SmartTrips encourages the use of active modes of transportation by offering residents information and resources to learn about their transportation options. These marketing campaigns supply information on transit, biking, carpooling and walking based on resident's requests. Both Portland and Gresham have conducted these campaigns that commonly achieve a neighborhood-wide 9% reduction in drive alone trips, and increases in trips using other options.	
Employer Program	TriMet and Go Lloyd help employers in the corridor to support employee commute options. Employers offer incentives to take transit, carppol, bike or walk to work. Many employers also offer flexible work schedules and telecommuting, taking more trips off the road. The federal government allows employers to pay employees \$20 a month as a fringe benefit. Many employers provide secure bike parking, lockers, showers, and changing rooms to remove a barrier to biking to work. Regionally, 803 employment sites have achieved a 31.8% non-drive alone commute rate (2015 ECO data; source: <u>http://www.oregonmetro.gov/travel-options-research</u>).	
Go Lloyd	For more than 20 years, Go Lloyd has operated as a non-profit transportation management association (TMA) serving the Lloyd District portion of the Portland central city. Supported by government agencies and employers, Go Lloyd offers services to commuters and residents to encourage sustainable transportation th fosters sustainable economic development Since 1997, commutes supported by Go Lloyd reduced their drive alone trips to by 30%.	
Gresham Wayfinding Signage	City of Gresham has installed wayfinding signage for bicyclists between the Ruby Junction MAX station and SE Main Street, along with sharrows to encourage easier connections within the city and to transit.	

TRANSIT ITS

Transit Intelligent Transportation Systems include a broad range of operations such as transit signal priority (TSP), global positioning system (GPS) devices, wireless communication, updated fare collection system (smart phone apps and Hop Fastpass), automatic passenger counting and various data collection capabilities. TriMet is in the process of updating the older ITS equipment and operations on MAX trains through the Rail Operations Optimization Technology (ROOT) project. One element of this project will enhance the real-time information available to travelers through Transit Tracker.

Transit Signal Priority (TSP) refers generally to signal priority treatments (extending the green phase or truncating the red phase) for street-running transit vehicles. TSP helps make transit travel time more reliable and thereby helps riders get to their destination on time. Currently, TSP for TriMet vehicles operates by communicating as the bus approaches a signalized intersection, on a first-come first-served basis. For the Division Transit Project, TriMet plans to implement Next Generation TSP, which will support more robust communications between transit vehicles and the traffic signal system to help keep buses on schedule. As Next Generation TSP expands, more sophisticated consideration of the roadway network as a whole will help determine whether to activate TSP at a given location.

During both planned and unplanned events, transit ITS is instrumental in providing additional capacity and optimizing the transit system. With transit ITS in place, operators can effectively provide support such as increased service frequency, rerouting, bus bridges, and evacuation services.

FREIGHT ITS

Designated freight routes in the study area include:

- Freeways (I-84, I-5, and I-205)

Portland metro region freight ITS includes:

ignal dilemma zone protection – Detection can identify approaching heavy and their speed, and extend the green signal phase or the conflicting red signal o prevent the potential for a collision.

phasing and timing (SPaT) data – Freight vehicles on the roadway will soon be enhance their GPS tracking and on-board navigation with signal phasing and (SPaT) data provided by regional and state signal systems. Signal timing tells the now long they will wait at a red light or the likelihood they will pass through on green or need to stop, giving additional safety to their movements in traffic. This is an enhancement of the TripCheck Traveler Information Portal that is updating systems for the connected vehicle future.

- owell Blvd. and Highway 26
- irand Avenue and Martin Luther King, Jr. Blvd.
- NE 181st/182nd Avenues to NW Burnside Rd
- I-84 connection to SE 242nd

VISION, GOALS, OBJECTIVES, AND NEEDS



The project steering committee collaboratively developed the draft vision and goals for this project. The operational objectives listed in this memorandum were developed with the project steering committee.

VISION: Operate the I-84 travel shed in a safe, multimodal, integrated, reliable and efficient fashion where the focus is on the transportation user, and equitably sharing the economic and quality of life benefits.



GOALS

- Improve Safety. Improve safety for all multimodal transportation users toward zero deaths.
 - » Operational Objectives:
 - Eliminate fatal and serious injury crashes by 2040.
 - Reduce crash rates for all travelers and incident responders.
 - Reduce conflicts through school zones and areas with a high portion of vulnerable users.
- Improve Performance. Improve efficiency, mobility, and/or reliability of the transportation system.
 - » Operational Objectives:
 - Reduce clearance time for lane or shoulder blocking freeway incidents.
 - Reduce clearance time for incidents on surface streets.
 - Improve transit reliability and optimize operations.
 - Improve travel time reliability on I-84 and parallel arterials, measured in the percent of interstates that have reliable travel times (MAP-21 PM).
 - Strengthen the economic vitality of the I-84 travel shed by improving freight connections and reliability of commute options to employment opportunities.
- Integrate Transportation Choices. Provide improved connections among transportation choices to support traveler decisions and multimodal options.
 - » Operational Objectives:
 - Improve equitable access to transportation choices.
 - Improve real-time information to support transportation choices.
 - Enhance Advanced Traveler Information Systems (ATIS).
 - Improve safety along multimodal facilities.
 - Reduce conflicts between modes.
- Deepen Partnerships. Build on and formalize current partnerships, and form new partnerships.
 - » Operational Objectives:
 - Improve data sharing between agencies that operate adjacent roadway facilities.
 - Improve partnerships with third party information providers.
- **Promote Environmental Stewardship.** Promote transportation projects that address both the climate and human health.
 - » Operational Objectives:
 - Promote the guidelines established by the City of Portland and Multnomah County Climate Action Plan.
 - Increase proportion of non-single-occupant passenger vehicle trips; increase trips made by walking, biking, transit, carpool and vanpool.
 - Reduce emission along the I-84 travel shed.



Racial and social equity is a key consideration for this project and consistent with regional goals. When implementing any of the operations alternatives, equity should guide the discussion, and project leaders need to consider the benefits and burdens of each project to be consistent with the RTP Goal 8:

"The benefits and adverse impacts of regional transportation planning, programs and investment decisions are equitably distributed among population demographics and geography, considering different parts of the region and census block groups with different incomes, races and ethnicities." (2014 RTP)

Key equity considerations for this project include:

- Improving travel experience for underserved communities
- Integrating transportation choices for all travelers
- Understanding who will see improvements from each project, and whether there are negative impacts to recognize and mitigate





SUMMARY OF NEEDS

During the interviews, online survey, and workshop, the project team learned about numerous needs across the corridor related to multimodal integrated corridor management.

Summary of Key Corridor Multimodal ICM Needs:

- Improve cross-agency coordination and decision making.
- Improve data availability across agencies and to third party information providers.
- Improve how short-term demand surges on the roadway network and transit system are managed.
- Improve dynamic management of traffic through key pinch points.
- Improve dynamic management of incident response across agencies.
- Improve pre-trip traveler information across all modes.
- Improve en-route traveler information across all modes.
- Improve travel time reliability for auto and freight throughout the corridor.
- Improve transit travel time reliability.
- Improve amenities that help people walk, bike and take transit.

A complete list of the corridor needs uncovered through each process (interviews, online survey, and the workshop) is documented in the *Vision, Goals, Objectives and Needs Memorandum*³.

³ Vision, Goals, Objectives and Needs Memorandum. Prepared for ODOT and Metro by DKS Associates. November 22, 2017.

IDENTIFICATION AND SCREENING/ SELECTION OF OPERATIONS ALTERNATIVES



PRELIMINARY SCREENING

The preliminary screening used the project goals and needs to help narrow the selection of operations alternatives. At the November 2017 project steering committee meeting, a dot exercise was used to better understand priorities among the group and determine whether the preliminary screening results as completed by the project team aligned with the project steering committee input. Based on the results, 18 strategies moved into Advanced Screening.



Preliminary Screening Criteria

Each of the original 53 operations alternatives was evaluated with the following criteria:

- 1. Does the operations alternative meet an identified need? Y/N
- 2. How well does the operations alternative achieve each of the project goals? Compare each of the strategies to the goals on a level of 0 to 4.

Summary of Goals:

- Improve Safety
- Improve Performance
- Provide Transportation Choices
- Enhance Partnerships
- Promote Environmental Sustainability

Ranking	Meaning
4	Best achieves the project goal
3	Achieves most of the project goal
2	Achieves some of the project goal
1	Achieves little of the project goal
0	Does not achieve the project goal





ADVANCED SCREENING

The advanced screening step relied on a combination of technical knowledge, data sources and averaged scoring around subjective elements. Scores are for the operational alternative being applied to the entire study area (mapped boundary), unless otherwise specified (e.g., freight travel shed, I-84-only, or other specified facilities or services).

Advanced Screening Criteria

A scale of o to 4 was used to rank the criteria for each of the 18 strategies that advanced.

- 1. Feasibility: How easy is the operations alternative to implement?
 - **a. Institutional factors.** What is the level of intra-agency and inter-agency support? Are there political challenges?
 - **b.** Physical factors. What is the initial capital cost? (See range on next page).
 - **c. Operational and maintenance factors.** What are the expected annual O&M cost (see range on next page) and are resources available?
 - **d. Expected timeline.** What is the estimated timeline for implementation? (See range on next page).
 - e. Leveraging other projects and resources. Does the operations alternative leverage strategies included in other regional projects?
- 2. Benefits: What are the expected benefits and magnitude of benefits?
 - **a. Crash reduction.** Does it reduce crashes or crash severity? By what magnitude? Is the benefit a significant step toward achieving Vision Zero (zero deaths and zero severe injuries)?
 - b. Operations. Does the strategy improve traffic operations?
 - **c. Equity.** Does the operations alternative provide access to a safe and connected transportation system for vulnerable or economically disadvantaged transportation users?
- 3. Performance Management: How does the operational alternative contribute to performance management?
 - **a. Performance monitoring.** To what degree does the operations alternative enrich partner-agency performance monitoring?
 - **b. Data Acquisition.** Does the operations alternative develop new or improve existing data sources? Does it replace an obsolete data source?



4. Are there negative impacts to consider? (Yes/No)

- a. Does it negatively impact high pedestrian areas (for example, commercial areas, main streets, school zones)?
- b. Does it negatively impact transit service reliability in the corridor?
- c. Does it negatively impact active transportation access and safety (trips by bike, walking, rolling, or accessing transit) in the corridor?
- d. Does it negatively impact environmental justice communities? Does it negatively impact historically underserved transportation users?

Initial Capital or One-Time Cost

Ranking	Initial Capital Cost Range
4	Less than \$50,000
3	\$50,000 to \$100,000
2	\$100,001 to \$500,000
1	\$500,001 to \$2,000,000
0	\$2,000,001+

Annual Operations and Maintenance Costs

Ranking	Annual O&M Cost Range
4	Less than \$10,000
3	\$10,001 to \$30,000
2	\$30,001 to \$80,000
1	\$80,001 to \$150,000
0	\$150,001+

Expected Timeline

Ranking	Timeline
4	Less than 1 year
3	1 to 3 years
2	3 to 5 years
1	5 to 10 years
ο	Over 10 years



Advanced Screening Results

The full set of operations alternatives evaluated in the advanced screening is provided in Appendix B. Ultimately, the PSC arrived with six recommended operations alternatives (described in detail in the next chapter):





Implement a Decision Support System (DSS)



Advancing to these six was a natural progression for the PSC. In some cases operations alternatives got combined, and in other cases the PSC determined that while a particular operations alternative should advance, the Multimodal ICM Plan may not be the means to advance it.

Value pricing, also known as congestion pricing, is an example of an operational alternative, that became combined into a broader category: "Implement Dynamic Multimodal Travel Demand Management Solutions". Value pricing is a user fee system, that charges drivers for using a roadway. The intent of value pricing is to reduce congestion and provide more reliable travel times. There are a variety of ways to implement value pricing, such as at certain times, for individual lanes or the full roadway, or triggered by congestion levels.

While value pricing warrants exploration as a solution along the corridor, it is part of a broader solution that should be explored. Dynamic multimodal travel demand management encompasses not only value pricing, but also dynamic parking pricing, incentivizing non-SOV trips in real-time (bikeshare, transit, carpool), and evaluating curb space use to enhance multimodal mobility. Also, ODOT is currently evaluating value pricing along segments of I-5 and I-205, which could help launch a similar study for the I-84 corridor.



RECOMMENDED MULTIMODAL ICM OPERATIONS ALTERNATIVES



This section describes in detail the six operations alternatives the Multimodal ICM Deployment Plan is advancing. This section includes:

- A description of the operations alternative
- Feasibility considerations
- Typical benefits
- Performance management capabilities
- Potential negative impacts
- Lead agencies and participating stakeholders
- Recommended next steps



CURRENT AGENCY ACTIVITIES AND PROGRAMS

Figure 13 lists current activities and programs for partner agencies, and identifies how each activity relates to the proposed operations alternatives. The list is intended as a starting point, to help understand which programs and activities can be used to help launch the next steps for the six proposed operations alternatives. The list is also intended to provide insight as to why it makes sense for particular agencies to lead each of the operations alternatives.

TriMet is in the process of developing a Mobility on Demand app – an all in one app that allows travelers to both plan and pay for a trip across multiple modes of travel. Providing a single app to plan trips, learn about service alerts and incentives, make reservations, and pay for services will streamline the process for travelers. It will also promote dynamically shifting between modes in a proactive manner.

For more information visit the website at: https://trimet.org/mod/





Figure 13. Current Agency Activities and Programs Related to Multimodal ICM

Proposed Operations Alternatives

Establish a Multimodal Detour Policy Across Agencies

- 🕗 Create a Data Sharing Policy
- **E** Form Agreements with Third Party Traveler Information Providers
- 4 Share Construction Schedules Across Agencies
- **Implement Dynamic Multimodal Demand Management Solutions**
- **6** Implement a Decision Support System (DSS)

Current Agency Activities and Programs and How Each Relates to the Six Proposed Operations Alternatives

ODOT

- Operates TripCheck, TTIP, and real-time ACM and VMS 2036
- Maintains TripCheck Local Entry (TLE)
- Operates the TMOC and Incident Response (24/7) 26
- Provides data to PORTAL 2
- Operates Flash Alert System 20
- Integrated WAZE into TripCheck 28
- Formed past agreements with Inrix for traffic data and Strava for bike data **23**
- Investigating congestion pricing on I-5 and I-205
- Operates field devices 6
- Communicates with other agencies via phone or email 103
- Participates in TransPort
- Co-leads Traffic Incident Management (TIM) Coalition 🜀

PBOT

- Maintains and operates shared regional traffic signal system server. Remote communications to TransSuite is supported by Multnomah Co, Gresham, ODOT, and other regional operators outside the corridor 200
- Maintains "Get Portland Moving" (construction projects)
- Manages the Regional Construction Coordination Committee
- Partner in PUDL (Portland Urban Data Lake) and manages the Traffic Safety Sensor Pilot project to monitor bike, ped, vehicle, and parking data 233
- Reached out to WAZE requesting routing around school zones (no agreement in place yet)
- Operates Parking Kitty (mobile app) and parking lots/garages 🕞
- Operates maintenance 24/7
- Provides data to PORTAL 2
- Operates field devices 6
- Shares video images with ODOT (TripCheck) 🕗
- Participates in TransPort 1
- Maintains a TDM program 🕒
- Maintains operating agreements with Biketown 6
- Developing a Smart Automated Vehicle Initiative (SAVI) 🕗

Multnomah County

- Provides bridge lift info provided to mobile app and other media 2 📀
- Participates in TransPort

Shared Mobility

• Operates bikeshare, carshare, and transportation network companies (TNCs)

TriMet

- Developing a Mobility on Demand app 2 🛙 🗗
- Provides data in Open API format 2 🕄
- Operates the TriMet Operations Command Center 24/7 20
- Maintains TriMet website, mobile apps, and transit tracker 235
- Operates mobile payment
- Operates In-house app "Alerts" to notify PIOs of incidents 🕗
- Provides data to PORTAL 2
- Operates field devices
- Operates transit services
- Participates in TransPort
- Manages park & rides and bike & rides

Port of Portland

- Provides data to PORTAL (planned) 🕗
- Manages parking system at PDX 53
- Operates field devices (parking and VMS) 6
- Participates in TransPort

Metro

- Operates the RTO Program
- Participates in TransPort 🕕
- Planning for operations and emerging technology 2356

PSU

- Maintains PORTAL 283
- Participates in TransPort 1
- Partner in PUDL 2 🖸 🗿
- Piloting DSRC with Portland Streetcar
- Developing a Smart Cities Action Plan 2 🗗

Gresham

- Provides data to PORTAL 😢
- Operates field devices
- Participates in TransPort 1
- Partner in data sharing with TTS 🕗

Emergency Management Center

• Operates the emergency management center **6**



INFRASTRUCTURE ASSESSMENT

While some of the operations alternatives initially focus on developing agreements and processes, all of them can benefit from additional ITS infrastructure along the corridor. Additional ITS infrastructure contributes to the ability to manage the transportation facilities and demand in realtime and adjust to planned and unplanned events. Table 1 provides an initial list of additional ITS devices and locations to consider that will enhance the I-84 Multimodal ICM Deployment Plan.

Infrastructure Element	Current and Future Locations		Approximate Capital Construction Cost (per each)
Arterial Variable Message Signs (VMS)	Existing: • I-84 • I-205 • Powell Blvd (west of I-205) • 82nd Ave	Future: Sandy Blvd Powell Blvd (east of I-205) Halsey St Burnside Rd Division St 122nd 181st/182nd Ave 233rd Ave 257th Ave	Approx. \$200,000 (includes VMS and support)
ATC Traffic Signal Controllers	All traffic signals		Approx. \$6,000
Traffic Signal Timing Plans	All corridors		Varies by corridor size
Transit Signal Priority	Existing – Direct communication between bus and traffic signal: • Several transit corridors	Future - NextGeneration TSP:Current transit routesRoutes parallel to current transit routes	Central system cost TBD
Communications	(See Regional Communication Plan) Advance communications on prioritized corridors		Approx. \$50 to \$100/ foot
CCTV Cameras	Existing: • I-84 • I-205 • Bridges crossing Willamette River	Future: • Same as arterial VMS locations	Approx. \$5,000 per PTZ camera
Travel Time Devices	Existing: • I-84 • I-205 • Powell Blvd	Future: • Same as arterial VMS locations	Approx. \$4,000 per device

Table 1. Infrastructure Elements





ESTABLISH A MULTIMODAL DETOUR POLICY ACROSS AGENCIES

Description

Create a policy to establish protocols for detouring traffic from I-84 and I-205 on to safe non-freeway facilities and then back on to I-84 and I-205. The policy would include agencies within the I-84 travel shed (ODOT, Gresham, Portland, Wood Village, Troutdale, Fairview and Multnomah County). Policy should improve high crash corridors before adding (detour) traffic, prioritize transit and other HOV's, address target routes for potential detours to minimize use of neighborhood streets, bicycle boulevards, or other roadways not designed, nor intended for, high vehicle volumes. Freight detours will need special considerations.

The agreements reached in this Multimodal Detour Policy would be used as rules for the DSS to follow.

General components:

- Form agreements between agencies allowing official detours on other agency's safe facilities during specified circumstances.
- Establish communication and coordination procedures across agencies during times of detours.
- Develop methods to identify areas of construction and specific roadways to avoid during a detour, with consideration of safety, equity, occupancy, and time.
- Prepare signal timing plans in advance of detours and activate to respond to real-time conditions.
- Determine locations that require additional ITS devices (VMS, cameras, detection, etc.) to help direct the flow of traffic, monitor for safe operations and minimize the impact to surface streets during an event. This includes directing detoured traffic back to the freeway past the incident location, or providing comparative arterial travel times.
- Prepare designated detour routes to prioritize safe multimodal accessibility when detours increase traffic volumes.
- Re-deploy or expand incident response during detour.

Event Re	lated	$^{\circ}$

Recurring Congestion Related 🛛 🔘



Pedestrian/bicycle elements:

- Evaluate bicycle and pedestrian needs when preparing specialized signal timing plans. Avoid or minimize bicycle and pedestrian delay on high volume routes.
- Determine areas to avoid routing traffic such as unimproved high crash corridors, school zones, neighborhood streets, bicycle routes, and high pedestrian areas.
- Determine active transportation improvements needed to support safe multimodal use of those facilities when detours occur.

Transit elements:

- Consider including next generation transit signal priority along routes that are not regular transit routes, but function as a transit route during a detour. Enhance traveler information supporting shared trips using both mobile apps and on-street wayfinding.
- Determine locations with common recurring extended delays (such as railroad crossings) and develop plans for detouring buses and notifying travelers with real-time information on the bus, on mobile devices, and with dynamic bus stop signage at the canceled stop.
- Determine appropriate stop locations and evaluate and fund (when needed) safe multimodal access and crossing needs when transit detours are in effect.

Freight elements:

• Prepare freight-specific detour plans based on regional freight network and protocols for communicating with freight drivers.

Integration: This strategy focuses on institutional integration, adopting new ways to approach detours jointly across agencies.

Feasibility Consideration	15
Institutional Factors	Historically, ODOT has not detoured traffic to non-ODOT facilities. This will require cross-agency coordination and policy language and agreements.
	While there are some challenges to overcome, the agencies across the I-84 travel shed are supportive of this effort.
Leveraging Regional Pursuits	 Ties into or supports: TransPort Regional ITS Architecture (2016)⁴

4 Regional ITS Architecture and Operational Concept Plan for the Portland Metro Region. Prepared for TransPort, ODOT, and Metro, by DKS Associates. Website: https://www.oregonmetro.gov/sites/default/files/2017/10/18/Trans-Port%20ITS%20Architecture%20Report_2016-12-16.pdf



1. ESTABLISH A MULTIMODAL DETOUR POLICY ACROSS AGENCIES (CONTINUED)

Physical Costs	Cost to establish detour policy and protocols, coordinate across agencies, obtain approvals: \$50,000 - \$100,000
	Cost to develop incident response and/or detour timing plans for I-84 and I-205 within the study area, including selected surface streets: \$750,000 - \$1,500,000
	Total: \$800,000 - \$1,600,000
O&M Costs	High-level policy must be set and then followed by operations policies that will be part of a living document, revised regularly to address changing conditions along the study area. Signal timing plans will also need to be evaluated on a regular basis, and after incidents, to refine them to ensure continued refinement.
	Annual O&M costs: \$25,000 - \$50,000
Timeline	 Detour policy and protocols development and approvals – 1 to 2 years. Signal timing plan development – 3 to 6 months after detour
	 policies are approved and accepted. Multimodal improvements to designated detour routes – 3 to 12 months after detour policies are approved and accepted.
	 Total timeline: 15 to 32 months
Typical Benefits	
Crash Reduction	An efficient, coordinated detour plan can reduce congestion, number of crashes, and crash severity on both the freeways and surface streets.
Operational Benefits	ICM Detour route strategies can reduce average delay by up to 26%, reduce average number of stops up to 42%, and increase average speeds up to 9% on arterials with traffic signal control.
	Source: "Improving Traffic Signal operations for Integrated Corridor Management", Liu, Henry X. and Heng Hu, Minnesota DOT (2013).
Equity	The detour policy and timing plans will be implemented to prioritize transit and vulnerable road users.



1. ESTABLISH A MULTIMODAL DETOUR POLICY ACROSS AGENCIES (CONTINUED)

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Performance Manageme	ent Capabilities
Performance Monitoring	Moderate – The policy should include provisions for regular inspection and evaluation of detour routes and signal timing plans during incidents.
Data Acquisition	The ITS devices implemented to assist in the detour policy will collect data (such as signal performance measures and travel times). More information sharing between agencies could be an outcome of this strategy.
Potential Negative Impa	icts
High Pedestrian Areas	Minor to moderate – Signal timing designs will accommodate pedestrian activity. Detour routes may impact pedestrian activity as a result of higher traffic loads and longer cycle lengths resulting in increased pedestrian delay. Detouring higher volumes to lower- classification facilities can decrease comfort or increase delay at unsignalized pedestrian crossings. Prevent or minimize delay at high volume pedestrian crossings.
Transit Service Reliability	Minor to moderate – Agencies should ensure transit operations are prioritized on detour routes and signal timing updates. Transit vehicles must be detoured only to facilities that can accommodate them.
Active Transportation Access	Moderate to major – Prevent or minimize delay at high volume bicycle crossings and prevent detour traffic on designated bicycle routes. Evaluate the need for temporary ITS control during detours. Additional traffic on detour routes can decrease comfort for people walking or biking along these routes. Evaluate how to provide safe active transportation access to temporary transit stops along detour routes.
Environmental Justice (EJ) Communities	Moderate to major – Avoid or minimize detour routes through EJ areas and are well-coordinated with agencies and publicized. Evaluate the impact to surface street operations.



Lead Agencies and Participating Stakeholders

Lead agencies are identified for each of the operations alternatives in an effort to ensure there is ownership in advancing each project forward. Reviewing the current programs and activities agencies are involved in (shown in Figure 2) lends itself to selecting appropriate lead agencies, by advancing current programs and involvement.

The Project Steering Committee identified the following three agencies to lead this effort:

PBOT. In the case of an event on I-84, a large portion of the impacted roadways will be City of Portland facilities, creating a vested interest in successfully implementing this operations alternative. PBOT will help lead the effort, providing perspective from local roadway operations.

ODOT. ODOT operates the Traffic Management and Operations Center, which could serve as a hub for implementing detour routes. Detours are often initiated due to congestion or incidents on an ODOT facility, making ODOT a key stakeholder for this operations alternative.

Metro. Metro does not own or operate any roadway facilities, which enables them to provide impartial guidance in reviewing the equity elements in determining detour routes and agreements.

The table below lists other participating stakeholders and their areas of interest and key responsibilities.

Other Participating Stakeholders	Areas of Interest and Responsibilities
TriMet	 Provide input in developing the detour policy and ensuring transit vehicles are considered for the detours.
	 Operate transit vehicles along detours and across agency boundaries.
City of Gresham	Coordinate detour routes along agency facilities.Develop signal timing plans for detours along facilities.
OSP	• Work with agencies to direct traffic on designated detours.
911 or Bureau of Emergency Communications	• Communicate detour needs for emergency vehicles to ensure safe and reliable access.
ODOT Incident Responder	 Work with agencies to direct traffic on designated detours.
Multnomah County	• Maintain bridge infrastructure and real-time bridge lift and maintenance activity.



1. ESTABLISH A MULTIMODAL DETOUR POLICY ACROSS AGENCIES (CONTINUED)

Recommended Next Steps

Lead Agencies

Metro, ODOT, and PBOT

Identify detour routes:

- Evaluate the following elements when developing detour routes:
 - » High crash locations⁵
 - » Sensitive land uses such as hospitals and schools
 - » Rail crossing locations
 - » Areas with vulnerable roadway users (bike facilities, high pedestrian areas, senior living facilities, etc.)
 - » Current construction activity
 - » Transit routes
 - » Identify freight detour routes/freight issues
 - » Understand where buses are capable of operating
 - » Understanding roadway grades
- Develop maps showing possible detours.
- Develop signal timing plans for detour routes.
- Determine if additional field devices are necessary to safely and effectively activate and operate detours.
- Evaluate advancing installation of TSP on non-transit routes for detour purposes.

Define the operations of a detour:

- Determine level of automation to activate detours.
- Document device control agreements.
- Develop business rules.
- Determine hours of operation.
- Identify how the detour information will be relayed to travelers (en-route and pre-trip).

Evaluate before and after implementation:

- Identify performance measures to evaluate.
- Structure a report.

Engage the public:

- Coordinate public outreach to inform the public and businesses and property owners along potential detour routes.
- Help residents and business owners understand the intended operations and characteristics of the roadway network.
- Explain how this effort will mitigate the ad hoc rerouting currently in place due to navigation apps.
- 5 Metro's 2017 report on High Injury Corridors provides an important reference point: https://www.oregon metro.gov/ sites/default/files/2018/05/25/high-injury-corridors-report-April-2017.pdf





CREATE A DATA SHARING POLICY

Description

Advance the work already underway including: the Portland Urban Data Lake (PUDL) Project, the Traffic Safety Sensor Pilot Project, TripCheck Traveler Information Portal (TTIP), and TripCheck Local Entry (TLE) to improve transportation-related data sharing capabilities across the region. The intent is to provide an open data platform that will improve information flow and availability to both agencies and transportation system operators, as well as travelers. Investigate the addition of real-time data to the database, with the potential to feed data to the Decision Support System (see Operations Alternative #6).

Third party information service providers may also join as a corridor partner to develop traveler information applications that incorporate information across multiple agencies and Transportation Network Companies (TNCs). Promote and prioritize walking, bicycling, ride sharing and trip time shifting.

This data policy and platform is critical to the success of several other operations alternatives identified in this Multimodal ICM Deployment Plan.

policy is critical to the success of the other operations alternatives. Sharing data between agencies is necessary to deal with a complex closure or detour, and for operators to efficiently make decisions.

Creating a data sharing

Organization of this operations alternative:

- 1. Convene a consortium representing all agencies to form a working group that meets regularly to address the data needs for the region.
- 2. Determine what the data will be used for, ensure alignment with regional goals, and then identify the necessary data to achieve those results.
- 3. Determine how the data will be disseminated and shared, both between public agencies and private sector companies.

Potential uses:

- Provide access to on-going performance measures and mechanism to view dashboard metrics.
- Inform the decision support system.
- Inform demand management decisions and actions.
- Feed into 3rd party traveler information systems and mobile apps, helping travelers make informed decisions.

Event Related 🔊

Recurring Congestion Related 🛛 🔘



Policy issues to address:

- **Privacy issues.** Protecting transportation system users from being linked to data. (Noted issues around matching users to data when three or more data points are known).
- Liability issues. Addressing agency liability in the case of inaccurate data that is dispersed.
- **Private use issues.** Ensuring the way in which the data is being used promotes the six regional goals (equity, vibrant communities, regional climate change leadership, transportation choices, economic prosperity, and clean air and water.

Some data are already available in real-time, such as TriMet bus and MAX train arrivals, and ODOT information on TripCheck and through TTIP.

This data sharing policy also feeds into the DSS operations alternative.

Figure 14. Examples of Data Sharing Elements from NACTO

	Data	Submission type
1. Better Data for	Speed	
Transportation Planning	Volume	Corridor
-	Travel Time	
	Pick-up Location and Time	Dlools food
	Drop-off Location and Time	BIOCK IACE
	Vehicle Occupancy	Corridor
	Non-Revenue Vehicle Miles Travelled	Log: Miles/month
	Vehicle Dwell Time	Log: Hours/month
2. Equity in	Number, Date, and Time of Unfulfilled Rides	
Mobility Options	Number, Date, and Time of Declined Rides	Log: Number/quarter
	Number, Date, and Time of Cancelled Rides	
	Vehicle Availability by Type	GPS Location Data
3. New Tools	Collision Occurrence	
for Safety	Collision Severity	GPS Location Data
	Rapid Acceleration	GFS LOCATION Data
	Rapid Deceleration	
	Autonomous Vehicle Operation Disengagement	Time, Location, and Protocol



Operational assumptions:

- Data sharing is automated. Need to determine what data will be shared and the data format.
- Data is scrubbed of personal identifier information (example: Bluetooth travel time information is not associated with an individual).
- Data is readily shared to achieve corridor outcomes, for use by for public partners and third-party information providers (mobile device app developers, media, data warehousing, etc.).
- System performance data will be collected, evaluated, reported, and used for evaluation.

Potential data to be shared:

Transit elements:	Roadway elements:	Pedestrian/bicycle
• Travel time	• Travel time	elements:
• Park and Ride availability	• Traffic signal operations	• Air quality data
• Bus and MAX occupancy	Incident information	• Bus bike rack availability
• Bus bike rack availability	Parking lot occupancy	Bikeshare bike availability/location
Integration: This operations alternative focuses on all three levels of integration		
Institutional. Forming agreements between agencies to share data.		

- Operational. Determining methods and means to share information.
- Technical. Adopting technical capabilities to share and exchange data.

Feasibility ConsiderationsInstitutional FactorsSupport from agencies; however, there may be privacy or
security concerns related to data sharing platforms that need to
be addressed.Leveraging Regional
PursuitsTies into or supports:
• TTIP Enhancements
• Get Portland Moving enhancements
• PORTAL activity and enhancements
• TransPort Regional ITS Architecture (2016)Physical CostsCapital costs primarily involve staff time for development of a new
data sharing policy and obtaining necessary agency approvals.



O&M Costs	Periodic updates to the sharing agreement may be needed, but annual O&M costs should be minimal.
	Annual hours to maintain: 40 - 80 hours
	Annual cost to maintain @ \$85/hr: \$3,000 to \$6,000
Timeline	9-12 months
Typical Benefits	
Crash Reduction	Enhanced data feeds to third party service providers allows quicker notification to the traveling public of lane closures and congestion, resulting in more efficient use of detour routes and mode selection. This is likely to reduce crashes and secondary crashes.
Operational Benefits	 In a study that allowed travelers to optimize a trip by cost, time, calories, carbon use, and other preferences, the results showed that 13% of travelers changed traveler behavior due to the information received. (Source: "The Trip Itinerary Optimizing Platform: A Framework for Personal Travel" Kwasnik, Ted, et al. 2017) One simulation study showed that providing real-time reliability information to travelers improved on-time arrival by 6%. (Source: "Effectiveness of Different Approaches to Disseminating Traveler Information on Travel Time Reliability", TRB, 2013) A simulation study of the road network in Seattle, Washington demonstrated that providing information on arterials as well as freeways in a traveler information system reduced vehicle-hours of delay by 3.4% and reduced the total number of stops by 5.5%. (Source: "Impacts of Supplementing Web-Based Urban Freeway ATIS With Parallel Arterial Travel-Time Data", Wunderlich, Karl and James Larkin, 7th World Congress Conference on ITS. 2000.) Supports public awareness and enhances route planning and mode selection capabilities. Reduces congestion, delay, and crashes.
Equity	Consideration should be made to ensure data is distributed across platforms accessible to all, not just those with access to the internet.



2. CREATE A DATA SHARING POLICY (CONTINUED)

Performance Management Capabilities		
Performance Monitoring	Major improvement. Agencies may benefit from reception of interpreted data from the third party vendors.	
Data Acquisition	This strategy would provide a mechanism to receive interpreted data from a third party vendor.	
Potential Negative Impacts		
High Pedestrian Areas		To be evaluated during implementation
Transit Service Reliability		To be evaluated during implementation
Active Transportation Access		To be evaluated during implementation
Environmental Justice (EJ) Communities		To be evaluated during implementation

Lead Agencies and Participating Stakeholders

Lead agencies are identified for each of the operations alternatives in an effort to ensure there is ownership in advancing each project forward. Reviewing the current programs and activities agencies are involved in (shown in Figure 2) lends itself to selecting appropriate lead agencies, by advancing current programs and involvement.

The Project Steering Committee identified the following five agencies to lead this effort:

PSU. Portland State University provides data management expertise. They are a partner in the effort to develop Portland Urban Data Lake (PUDL), as well as piloting three different cloud-based data sharing platforms. PSU also maintains the regional database PORTAL. While these all deal with archived data, advancing to real-time data could be the next step.

TriMet. TriMet is a pioneer for the region in developing an open API format for specified data feeds, enabling third party vendors to access that data and develop valuable apps and interfaces for travelers. TriMet also operates its Operations Command Center 24/7, maintains a website and transit tracker with real-time information, and is developing a Mobility on Demand app, all of which are integral in developing a data sharing policy.

ODOT. ODOT is one of the key stakeholders who will use data to operate the roadway network. ODOT operates the TMOC on a 24/7 basis and maintains TripCheck and TTIP.

PBOT. PBOT is a partner in the PUDL project and operates the shared regional traffic signal system server. Establishing a way to better share the data from the traffic signal system server is important for real-time agency operations.

Metro. Metro can provide impartial guidance to help evaluate options that best suit the need of all agency stakeholders and ensure that data is used as intended.

Note that ALL the lead agencies will be included as part of the consortium.





The table below lists other participating stakeholders and their areas of interest and key responsibilities.

Other Participating Stakeholders	Areas of Interest and Responsibilities
City of Gresham	 Use data to better manage agency transportation facilities.
	• Option to participate in the consortium.
Port of Portland	 Use data to better manage agency transportation facilities.
	• Option to participate in the consortium.
Multnomah County	 Use data to better manage agency transportation facilities.
	• Option to participate in the consortium.
Emergency Response Agencies (police, fire, ODOT incident response)	• Use data to improve incident response
Private Sector Companies	 Use data to develop traveler information apps and management and operations tools for agencies that operate transportation facilities.





2. CREATE A DATA SHARING POLICY (CONTINUED)

Recommended Next Steps

Lead Agencies

TriMet, ODOT, PSU, PBOT, and Metro

Organize a consortium representing all agencies to form a working group that meets regularly to address the data needs for the region:

• Determine who will be members of this group and how often the group will meet.

Options to consider:

- » PUDL group currently meets monthly and could be expanded to encapsulate this broader data policy.
- » Develop a TransPort subcommittee.
- Document the by-laws of the consortium that outlines how the consortium makes decisions (examples: unanimous agreement, majority vote, lead agency decision, etc.).
- Document the intended use of shared data and show how it will be used to ensure it promotes the six regional goals.
- Review existing data privacy policies across the region and develop a data privacy policy for the ICM project.
- Create a policy that outlines expectations for sharing data between agencies for purposes of transportation operations, planning, and/or maintenance.
- Document how data sharing equity issues will be addressed.
- Address liability issues.

Determine what decisions the data will be used for, and then identify the necessary data to support those decisions:

- Determine how data will be used. Examples: detour purposes, performance metrics, construction impacts, before and after studies, etc.
- Review existing available data and databases (Ex: PORTAL, TripCheck, PUDL).
- Identify gaps in the existing data and determine if agencies can provide the additional data.
- Investigate the use of data from the private sector to fill gaps (see Operations Alternative #3).

Determine how the data will be disseminated and shared, between public agencies, private sector companies, and the traveling public:

- Advance the work already completed by PSU and PBOT investigating different cloud database options and define the data sharing platform.
- Establish consistent data format and fields for all users.
- Determine appropriate dissemination for the data flows (ex: what stays between agencies, what data goes to third party providers, and what data goes to the public.)
- Establish how data liability issues will be addressed.
- Publish performance reports on a regular basis.





FORM AGREEMENTS WITH THIRD PARTY TRAVELER INFORMATION PROVIDERS

Description

Develop a task force, both within the region and with other regions, to coordinate and form agreements with third party information providers and mobility app providers. Collaborating beyond the Portland region may provide additional leverage and opportunity to engage with third party traveler information providers and change outcomes. Intended purposes include:

- Encourage routing around school zones, high bicycle and pedestrian zones, unimproved high crash corridors
- Discourage or prevent additional vehicle traffic on neighborhood greenways
- Promote and prioritize transit, shared rides, bicycling, walking, and trip time shifting
- Consider roadway grades when directing traffic during inclement weather
- Consider grades for bike and pedestrian travel during inclement weather
- Coordinate exchange of information developed through the other ICM operations alternatives so the third party traveler information providers can disseminate that information to travelers.
- Enable two-way data sharing.

Note that this operations alternative is different than the Data Sharing operations alternative. This one focuses on developing common shared goals for the region and presenting one regional perspective for third party information providers to achieve outcomes for multimodal and efficient people and goods travel.

Integration: This operations alternative focuses mainly on institutional integration, forming agreements with private sector information providers.

Event Related	0

Recurring Congestion Related 🛛 🔘



3. FORM AGREEMENTS WITH THIRD PARTY TRAVELER INFORMATION PROVIDERS (CONTINUED)

Feasibility Considerations	
Institutional Factors	General support for this strategy among public agencies; however, may be challenges involving the private sector.
Leveraging Regional Pursuits	 Ties into or supports: TransPort Regional ITS Architecture (2016) PBOT's Vision Zero Action Plan <u>https://www.portlandoregon.gov/transportation/71730</u>
Physical Costs	Capital costs will primarily be for staff time to develop and gain approval of a standard agreement, then coordinate and negotiate with third party vendors to implement its terms. Estimated cost: \$40,000 - \$60,000
O&M Costs	Periodic updates to the terms and stakeholder roster may be needed. Annual O&M hours: 40 to 160 Annual O&M cost @ \$85/hr: \$3,000 to \$15,000
Timeline	1 - 3 years
Typical Benefits	
Crash Reduction	Dissemination of context- and time-sensitive routing information will reduce traffic in high-risk areas such as school zones and steeply graded roadways (e.g., during ice events). This activity should help marginally reduce crashes.
Operational Benefits	Coordinating with third party information providers reduces the amount of staff time needed to disseminate traveler information to the public.
	Supports enhanced route planning and mode selection capabilities.
Equity	Working with mobility app providers to route traffic away from school zones and neighborhood greenways supports safe and reliable transportation choices for all users. Agencies may consider partnerships with vendors which emphasize accessibility to their data – to achieve equity, ensure that the information is available from free and common sources such as radio (and not solely from connected devices such as smart phones).



3. FORM AGREEMENTS WITH THIRD PARTY TRAVELER INFORMATION PROVIDERS (CONTINUED)

Performance Management Capabilities

Performance MonitoringImpacts to performance monitoring depend on the type ofand Data Acquisitioncoordination with information providers. If third party partnersprovide data to agencies, performance monitoring processesmay improve due to additional data. This could be included as arequirement within data sharing agreement.

Potential Negative Impacts	
High Pedestrian Areas	To be identified during implementation
Transit Service Reliability	To be identified during implementation
Active Transportation Access	To be identified during implementation
Environmental Justice (EJ) Communities	To be identified during implementation

Lead Agencies and Participating Stakeholders

Lead agencies are identified for each of the operations alternatives in an effort to ensure there is ownership in advancing each project forward. Reviewing the current programs and activities agencies are involved in (shown in Figure 2) lends itself to selecting appropriate lead agencies, by advancing current programs and involvement.

The Project Steering Committee identified the following three agencies to lead this effort:

PBOT. PBOT began an effort reaching out to WAZE to coordinate routing around school zones. PBOT is also a partner in PUDL. When traffic routes off I-84, many impacts in this study area are on PBOT facilities, which creates a vested interest in ensuring that neighborhood streets remain safe and low volume. This also aligns with PBOT's Vision Zero initiative.

ODOT. ODOT already has agreements in place with WAZE, as well as previous agreements with other third party traveler information providers which could be used as an incentive and basis for future agreements.

Metro. Metro servers as a regional coordinator. This operations alternative will be most effective if all agencies in the region support advancing it forward, which Metro can help lead.



3. FORM AGREEMENTS WITH THIRD PARTY TRAVELER INFORMATION PROVIDERS (CONTINUED)

The table below lists other participating stakeholders and their areas of interest and key responsibilities.

Other Participating Stakeholders	Areas of Interest and Responsibilities	
TriMet	• Use the shared data to enhance transit mobility apps.	
	 Provide input about routing preferences that may impact transit. 	
City of Gresham	 Ensure third party apps route traffic around areas with vulnerable users. 	
Portland State University	 Gain access to additional data (research and performance measures?). 	
Port of Portland	Coordinate two-way data sharing.	
	 Improve traveler experience by enhancing available information. 	
Multnomah County	Coordinate sharing bridge lift information.	
Metro	• Gain access to additional data (publish performance measures?).	

Recommended Next Steps		
Lead Agencies	PBOT, ODOT, Metro	

Coordinate route preferences:

- Form a working group to develop common goals for the region to work with third party traveler information services to encourage routing around specific areas. Elements to consider:
 - » School zones
 - » Bicycle boulevards
 - » Steep grades during inclement weather or for bike and pedestrian travel
- Pursue routing agreements with third party traveler information providers based on developed goals.

Share data:

- Evaluate existing agreements.
- Review intent of data (Operations Alternative #2) and determine what data is needed from third party vendors to fill the gaps (especially on arterials).
- Leverage opportunities for two-way data sharing.
- Determine what data is available from third party vendors, as well as associated costs or whether data can be exchanged or provided for free.
- Schedule presentations by the private sectors to demonstrate their products.
- Pursue new agreements or leverage existing agreements to meet the data needs determined through this evaluation.




SHARE CONSTRUCTION SCHEDULES ACROSS AGENCIES

Description

Establish a policy and method (such as a website) for all agencies to identify, coordinate, and mitigate safety, equity, and multimodal impacts from construction activities and detours. This effort complements but is different than the information exchange network and detour policy efforts. Constuction schedules affecting ROW are generated by the permitting process (e.g., buildings and road work) but are also put into effect under emergency conditions (e.g., building failure, sink hole). While the permitting process gives agencies time to plan around construction, it also leaves huge windows open where no construction is taking place. In order to serve road and transit operators along with the traveling public, the I-84 Multimodal Corridor needs real-time or near-real-time understanding of construction that affects the ROW.

Today, agencies receive much of their construction information through traveler reported systems (e.g., Waze). Coordination of construction on a corridor level will reduce compounding impacts such as multiple closures of preferred east/west arterials that may be in different jurisdictions but create impacts from cut-through traffic (north/south movements). Coordination also ensures preventing and keeping impacts minimal to transit, bike, and walk trips by limiting the number of concurrent closures of preferred routes. Significant cost savings are accrued to agencies through this coordination where agency projects overlap or have adjoining construction or overlapping utility work.

Note: ODOT offers the TripCheck Local Entry (TLE) site for local agencies to log events and City of Portland recently launched Get Portland Moving <u>www.movepdx.net</u>. Both services are receiving more resources for enhancements in 2018.

Event Related

Recurring Congestion Related



Concepts to include:

- Coordinate construction activity and construction-related detours across agencies to increase safety, transit and shared rides, walking, and bicycling, and minimize impact to transportation system users and optimize construction efficiency.
- Use this as a tool and data to support the Decision Support System (DSS).
- Use this tool to provide information to travelers (either directly or through a third party information provider).
- Assess the different alternatives that could serve as a centralized resource to share construction project schedules and detours.
- Gather consensus from stakeholders on proposed centralized resource.
- Determine how to integrate existing tools (e.g., TripCheck, TTIP, and PBOT Get Portland Moving) into the proposed centralized resource, or working in concert through standards and APIs.
- Establish agreements and policies between agencies on how to use the coordination tool.
- Maintain the tool so it is useful in the long term.

Ped/bike/transit:

• Prevent and minimize detour impacts to pedestrians, bicyclists, and transit users. Use smart phone apps and other platforms to promote shared rides, bicycling, and transit.

Figure 15. Example of a Construction Coordination Map from Get Portland Moving

Get Portland Moving Project Map





4. SHARE CONSTRUCTION SCHEDULES ACROSS AGENCIES (CONTINUED)

Integration: This operations alternative focuses on all three levels of integration

- Institutional. Forming agreements between agencies to share construction data.
- **Operational.** Determining methods and means to share information.
- Technical. Adopting a platform in which to post and share construction information.

Feasibility Consideratio	ns								
Institutional Factors	 Strong support across agencies and some tools are already in place (TripCheck, TTIP, and PBOT Get Portland Moving website). TripCheck offers a local entry tool (TLE) for local agencies to enter information that gets displayed on TripCheck. Key challenges are establishing a centralized platform and coordination across agencies. 								
Leveraging Regional Pursuits	 Ties into or supports: TTIP Enhancements Get Portland Moving TLE tool (TripCheck) TransPort Regional ITS Architecture (2016) 								
Physical Costs	Capital costs will vary depending on the scope and complexity of the platform. Simple project scheduling software with sharing capability (per enterprise license): \$25,000 Robust scheduling software, dynamic map generation, notification capabilities, etc. (per enterprise license): \$500,000								
O&M Costs	 Significant ongoing support needed from agencies. Some savings are possible if the tool replaces an existing scheduling process. Annual hours to maintain: 100 hours per agency Annual cost to maintain @ \$75/hr: \$7,500 per agency 								
Timeline	 Identification of functional requirements and definition of data sharing procedures: 12 - 18 months Procurement of platform, integration, training: 6 - 12 months Total: 18 - 30 months 								



4. SHARE CONSTRUCTION SCHEDULES ACROSS AGENCIES (CONTINUED)

Typical Benefits										
Crash Reduction	Coordination of det conjunction with im anticipated to reliev	etours and construction schedules, in mproved monitoring of the affected areas, is eve congestion and reduce crashes.								
Operational Benefits	Ensures detours are ped capacity, signal detours, etc.	e properly planned with respect to transit/bike/ timing, pavement width, pedestrian and bike								
	Allows agencies to a agencies do not try the same time; not cut-through issues)	o optimize detour scheduling (i.e., that two y to detour traffic down the same road at t constraining parallel capacity, creating s).								
Equity	This strategy will identify, prevent, and mitigate potential safety and equity impacts applied across the entire transportation network for all construction areas and will not advantage one group more than another.									
Performance Managem	ent Capabilities									
Performance Monitoring	Minor – coordinatic encourages agency region and to monit construction events	on of construction and detour scheduling staff to be mindful of events throughout the tor the transportation network throughout 5.								
Data Acquisition	Data AcquisitionSharing of data between agencies provides new sources of construction activity data for all partners.									
Potential Negative Impa	acts									
High Pedestrian Areas		Will be identified during implementation								
Transit Service Reliability		Will be identified during implementation								
Active Transportation Acc	cess	Will be identified during implementation								
Environmental Justice (E.	J) Communities	Will be identified during implementation								



Lead Agencies and Participating Stakeholders

Lead agencies are identified for each of the operations alternatives in an effort to ensure there is ownership in advancing each project forward. Reviewing the current programs and activities agencies are involved in (shown in Figure 2) lends itself to selecting appropriate lead agencies, by advancing current programs and involvement.

The Project Steering Committee identified the following two agencies to lead this effort:

PBOT. PBOT already operates the Get Portland Moving website and manages the Regional Construction Coordination Committee, both of which could be stepping stones to advance this operations alternative.

ODOT. ODOT maintains TripCheck Local Entry (TLE) where local agencies manually input construction activity information that will then be shared on the TripCheck website.

The table below lists other participating stakeholders and their areas of interest and key responsibilities.

Other Participating Stakeholders	Areas of Interest and Responsibilities
TriMet	 Operates transit vehicles along routes often impacted by construction activity.
	 Enable TriMet to plan detour routes during construction activities.
City of Gresham	• Provide construction activity information to the system.
Multnomah County	• Provide bridge construction activity to the system.
Utility companies	 Provide construction activity information that impacts the transportation network to the system.



4. SHARE CONSTRUCTION SCHEDULES ACROSS AGENCIES (CONTINUED)



Recommended Next Steps

Lead Agencies

PBOT and ODOT

Evaluate platforms to share construction information:

- Evaluate existing platforms in use for sharing construction information (including: TripCheck TLE, Get Portland Moving, and Regional Construction Coordination Committee).
- Consider streamlining the services of PUDL, Get Portland Moving, and TLE through open APIs. Allow one data stream to be consumable by others.
- Determine future platform for sharing the construction information using systems engineering:
 - » Document system requirements.
 - » Determine criteria and data fields for entering construction information.

Establish procedures:

- Establish procedures and operations and maintenance agreements to address coordination for using the tool.
- Identify a process to include utility construction and maintenance activity.
- Develop roles and responsibilities for participating agencies.
- Provide a process for the information to feed into the Decision Support System.
- Develop impact identification, prevention, and mitigation assessment policy and tool.

Evaluate mitigation strategies:

- Determine performance measures to evaluation.
- Review before and after data to determine the effectiveness of the program and how to improve it.





IMPLEMENT DYNAMIC MULTIMODAL DEMAND MANAGEMENT SOLUTIONS

Description

Develop a multi-agency demand management work group to explore incentives and pricing strategies to advance and implement along the I-84 corridor. This operations alternative goes beyond the traditional Transportation Demand Management (TDM) program currently managed by Metro called Regional Travel Options (RTO). Where RTO conducts education and outreach campaigns to residents and commuters, the corridor demand management tools will offer a means to shift demand to manage the system during event-related or recurring conditions, offering a means for the real-time application of incentives and disincentives. The regional 2010-2020 TSMO Plan calls for an incentive/disincentive system. Other ICM projects have employed related tools (e.g., Houston). FHWA calls for Active Transportation Demand Management (ATDM) which complements demand management in real-time.

Concepts to address:

- Study congestion and value pricing concepts for I-84 freeway as a tool to improve operations.
- Determine where along the corridor parking changes, including reallocation of curb space, permitting, and pricing, could be used to manage demand and incentivize a shift to nondrive alone modes of travel.
- Develop coordination across agencies and TNCs to dynamically price SOV's, shared rides, transit and other modes (such as Biketown) when capacity on roadways is at a maximum level.
 - » Example reduce the price of transit or bikeshare to incentivize mode shift during peak hours or during an event that reduces capacity.
 - » Example increase the price of parking during planned events to encourage non-drive alone trips.
 - » Example add a surge price to low occupancy TNC trips.
- Explore the option of closing certain freeway access points during full blockages.
- Develop coordination across agencies and TNCs to increase capacity on other modes when roadway capacity is at maximum levels.
 - » Example increase transit service or add shuttle trips to offer more capacity and improved travel times during events.
 - » Example develop agreements with TNCs to increase availability and advertisement of high occupancy rides during events.

Event Related

Recurring Congestion Related 🛛 🔘



- Encourage agencies, TNCs, and other transportation providers to supply information to third party information providers, so that incentives can be offered to non-drive alone travelers in real-time.
- Encourage incentives (carpooling, alternate work hours, gamification, etc.)
- Develop partnerships with major corridor employers to explore additional options for managing employee travel demand at commute times.
 - » Example develop shuttle/express bus concepts serving major employers at shift change times, and explore opportunity for shift coordination among major employers to better support expanding transit options.
 - » Example implement or increase parking pricing during major planned events, such as construction.
- Evaluate how curb space is used and improve signage, regulations, and user education to minimize traveler behavior that impacts multimodal mobility (i.e. circling for parking, TNC vehicles doing pickup/dropoff at transit stops or in bikeways, etc.)

Note that there is currently a project investigating different congestion pricing options for the *I-5* and *I-205* facilities.

Integration: This operations alternative focuses on two levels of integration

- Institutional. Developing agreements across agencies about how to approach demand management.
- Operational. Developing ways to dynamically manage demand across multiple modes.



Feasibility Consideratio	ns								
Institutional Factors	Demand management is a Metro and ODOT policy for the region. Several corridor agencies recognized that without demand management, it would be difficult if not impossible to achieve multimodal outcomes to balance demand.								
Leveraging Regional	Ties into or supports:								
Pursuits	• State and regional coordination of rideshare								
	• TriMet Mobility on Demand (MOD)								
	 Demand management implementation at employment sites throughout the corridor 								
	 Individualized marketing in neighborhoods 								
	Investment in community-based organization outreach								
Physical Costs	Capital costs would include building capacity to coordinate and automate incentives by geography and by corridor user. An automated system could range from \$200,000 to \$500,000 with cost factors including integration with DSS and private partner investment.								
O&M Costs	Staff capacity needed to maintain a corridor-wide demand management system ranges from 2 to 5 FTE, with costs of \$150,000 to \$400,000 per year.								
Timeline	• 1 year of development, including securing or augmenting incentives from a range of partners.								
	 1 year start-up, growing user base. Ongoing effort to refine targeted approaches to increase ICM outcomes. 								
Typical Benefits									
Crash Reduction	Indirect, based on increasing transit ridership (a safe mode) and expanding awareness.								
Operational Benefits	Moderate with incentives but greater benefits will be achieved if disincentives are also part of the system.								
Equity	While this tool has the potential to promote equity, careful consideration needs to be instrumented to ensure that populations with lower incomes are not negatively impacted by congestion pricing or other dynamic pricing. It has the potential to decrease the cost of transit and non-driving modes during peak periods, and even increase capacity on alternate modes.								



Performance Manageme	ent Capabilities
Performance Monitoring	An organization will be built around demand management with a shared responsibility with DSS partners to monitor the effectiveness of responding to recurring congestion and events with targeted incentives and disincentives. Already, people use employer-subsidized transit pass incentives and respond to price surges on TNCs, which both indicate travel choices change accordingly.
Data Acquisition	This alternative would be an excellent place for gathering corridor-user data on an opt-in basis from willing participants. The corridor's demand management organization would need to establish its role as a trusted aggregator of user and private- partner data (e.g., employee information).
Potential Negative Impa	cts
High Pedestrian Areas	To be identified during implementation
Transit Service Reliability	To be identified during implementation
Active Transportation Access	To be identified during implementation
Environmental Justice (EJ) Communities	Managing demand to prioritize transit disproportionately benefits transit-dependent people. Any demand management approach that increases prices for transportation services will need to receive a thorough environmental justice analysis, in order to avoid, minimize, or
	mitigate any disparate impacts.



Lead Agencies and Participating Stakeholders

Lead agencies are identified for each of the operations alternatives in an effort to ensure there is ownership in advancing each project forward. Reviewing the current programs and activities agencies are involved in (shown in Figure 2) lends itself to selecting appropriate lead agencies, by advancing current programs and involvement.

The Project Steering Committee identified the following four agencies to lead this effort:

PBOT. PBOT maintains a transportation demand management (TDM) program as well as operating agreements with BIKETOWN, car-share companies, ride-share companies, and parking facilities. PBOT also operates the Streetcar.

ODOT. ODOT is currently leading the congestion pricing study for I-5 and I-205. Congestion pricing could be evaluated for I-84.

Metro. Metro operates the Regional Travel Option (RTO) Program.

TriMet. TriMet provides transit service, with mobile payment options and apps to enable travelers to make informed transit decisions in real-time. TriMet is the region's primary provider of employee commute options outreach (TDM) to employers.

The table below lists other participating stakeholders and their areas of interest and key responsibilities.

Other Participating Stakeholders	Areas of Interest and Responsibilities
City of Gresham	 Coordinate with transit and shared mobility companies to reduce congestion on agency facilities.
Multnomah County	 Coordinate with transit and shared mobility companies to reduce congestion on agency facilities.
Port of Portland	 Coordinate with transit and shared mobility companies to reduce congestion on agency facilities.
City of Troutdale and Fairview	 Coordinate with transit and shared mobility companies to reduce congestion on agency facilities.
Shared mobility companies	• Coordinate with public agencies to help balance demand.



Recommended Next Steps

Lead Agencies

Metro, ODOT, TriMet, and PBOT

Determine overarching components:

- Identify participating agencies and partners, and establish roles and responsibilities in developing the demand management solutions.
- Establish a corridor-wide demand management team and partners.
- Investigate equity impacts for all proposed options.

Explore concepts:

- Study congestion and value pricing concepts for I-84.
- Evaluate parking opportunities (Ex: dynamic parking pricing, removal and/or ease of parking restrictions, or removal of occupancy).
- Evaluate dynamic incentives for bikeshare and transit (offer incentives when congestion or events arise).
- Evaluate opportunities to increase capacity on transit and high occupancy rideshare during events.
- Explore funding opportunities and logistics.

Coordinate and expand programs:

- Develop scopes to expand demand management programs.
- Coordinate with bikeshare and transit for incentive programs.
- Expand the existing RTO program and explore new incentives.
- Develop/expand partnerships with corridor employers.

Evaluate demand management solutions:

- Determine performance measures to evaluate.
- Publish reports documenting the effectiveness of the programs.





IMPLEMENT A DECISION SUPPORT SYSTEM (DSS)

Description

A DSS is an information system that supports organizational decision making in real-time. To create a successful DSS, all participating agencies need to develop and agree upon a set of

business rules that address predefined inter-agency permissions and criteria. One critical piece of the DSS is implementing the multimodal detour policy (operations alternative #1). Without the detour policy in place, the DSS has limited capabilities. The detour policy addresses the Policy aspect, and the DSS addresses the implementation aspect.

For a successful DSS, data needs to be accurately input and shared between all participating agencies. The DSS can be used to dynamically adjust vehicle operations and multimodal operations during both recurring congestion and event-related congestion.

Develop a process and platform to share information between agencies using online and automated methods instead of requiring a phone call to pass along Developing a DSS and implementing within the framework of ODOT's TMOC could greatly enhance the capabilities of the transportation network. Depending on the level of automation, the system could enable after-hours agreements between agencies, connect to other operations centers such as TriMet's OCC, and allow for more proactive and instantaneous response to planned and unplanned events.

Cities such as San Diego and Dallas implemented DSS that use predictive algorithms to optimize the transportation network, especially during events. Event Related

Recurring Congestion Related 🛛 🔘

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information (e.g., information exchange network). See the operations alternative: "Create a Data Policy Promoting Data Sharing".





6. IMPLEMENT A DECISION SUPPORT SYSTEM (DSS) (CONTINUED)

As part of this operations alternative, formation of a 24/7 virtual Traffic Management and Operations Center (TMOC) should be considered in order to address events that arise during non-business hours.

General components and elements to address:

Business Rules:

- Determine the participating agencies and current operations.
- Develop inter-agency permissions and operation agreements.
 - » Develop agreements between agencies to operate traffic signals and ITS devices during hours when agency staff is not available
 - » Determine whether to establish a virtual 24/7 TMOC for all partner agencies
 - » Determine transit system capacity (transit vehicle capacity and park-and-ride capacity) along with other high-occupancy vehicles (e.g., ridesharing, TNCs with multiple passengers (Lyft Line/Uber Pool)
 - » Determine modifications to transit operations and availability of related one-way services (e.g., bikesharing, carsharing, TNCs and microtransit)
 - » Establish control capabilities for ITS devices owned and operated by various stakeholders:
 - Primary control
 - Viewing capability
 - Override control
- Determine desired level of automation for DSS (manual flow chart vs simulation models and predictive algorithms).

Information Exchange:

- Establish communication protocols between agencies and determine a platform for sharing information across agencies.
- Incorporate elements of the "Create a Data Sharing Policy" operations alternative to feed into the DSS.
- Incorporate elements of the other ICM operations alternatives into the DSS.

Traveler Information:

• Consider how to provide data to third party information providers to keep travelers well-informed (see "Coordinate with Third Party Traveler Information Providers") and to prioritize transit and shared rides.



Transportation Incident Management:

- Evaluate and prepare DSS to provide a multimodal, demand management scenario to alleviate demand in an area of the corridor such as a crash site.
- Evaluate and prepare incident response to prioritize transit and HOV reliability.
- Incorporate transportation incident management (TIM) practices with DSS.

Integration: This operations alternative focuses on all three levels of integration

- Institutional. Achieving coordination and collaboration between agencies to work towards developing a DSS.
- Operational. Determining operational rules and methods to implement a DSS.
- Technical. Developing a means in which to implement a DSS.

Figure 16. Example DSS Process from the Dallas Area Rapid Transit⁶



⁶ Miller et al. 2015, Final Report - Dallas Integrated Corridor Management (ICM) Demonstration Project



6. IMPLEMENT A DECISION SUPPORT SYSTEM (DSS) (CONTINUED)

Feasibility Consideratio	ns									
Institutional Factors	Strong support across agencies. Requires coordination between all agencies that operate roadway facilities in the travel shed.									
Leveraging Regional Pursuits	 Ties into or supports: TTIP Enhancements Get Portland Moving TransPort Regional ITS Architecture (2016) 									
Physical Costs	Depending on the level of integration, a simple DSS could be supported with current infrastructure. DSS grows as more ITS equipment and detection is added and connected to data communications, further improving the system. The capital costs for a DSS will heavily depend upon its scope, level of integration, and complexity. Cost for development of basic ideas and process flows, cross- agency coordination, and approvals: \$25,000 - \$50,000 Cost for development of an integrated tool (software process) to automate and disseminate decision information: \$50,000 - \$100,000 Total: \$75,000 - \$150,000									
O&M Costs	May require dedicated staff to maintain, depending on complexity									
	and agency integration needs.									
	• Hours to maintain = 80-200 hr/year									
	• Cost to maintain @ \$82/hr = \$7,000 - \$17,000									
	If a virtual 24/7 TOC is included, additional staffing cost should be considered. Assuming an additional staff for 12 hrs/night and weekends:									
	Annual additional O&M hours: 5,500									
	• Annual O&M costs @ \$85/hr: \$500,000									
Timeline	Depending on the complexity, a simple DSS could be implemented within 1-2 years. A more advanced system could evolve over the next 5 to 10 years.									



6. IMPLEMENT A DECISION SUPPORT SYSTEM (DSS) (CONTINUED)

Typical Benefits										
Crash Reduction	This strategy will likely have minimal impact upon initial cra but more efficient decision making may lead to a reductio secondary crashes and improve the safety of responders.	kely have minimal impact upon initial crashes, decision making may lead to a reduction in and improve the safety of responders.								
Operational Benefits	DSS scenarios modeled on the ICM Corridor in Dallas, TX, travel time savings of 9% on arterials when vehicles divert the freeway to designated arterials with capacity. (Source: Time Traffic Network State Estimation and Prediction Wit Decision Support Capabilities: Application to Integrated C Management", Hossein Hashemi, et. al, TRB, 2012).	showed from ″Real- h orridor								
	Other benefits:									
	• Streamline and standardize response process									
	• Support utilization of junior staff in decision making									
	• Reduce response and crash clearance time									
	• Reduce delay as a result of faster clearing of crashes									
	• Reduce secondary crash risk									
Equity	By prioritizing transit and HOV's, the DSS will minimize imp underserved communities.	pacts on								
Performance Managem	ent Capabilities									
Performance Monitoring	Adds significant ability to monitor travel and performance r	measures								
Data Acquisition	The DSS will involve the development of new and/or improdute data sources by providing enhanced and automated documentation of decisions. This data can be reviewed to identify areas for improvement.	e the development of new and/or improved oviding enhanced and automated decisions. This data can be reviewed to nprovement.								
Potential Negative Impa	acts									
High Pedestrian Areas	Will be identified during implementa	tion								
Transit Service Reliability	Will be identified during implementa	tion								
Active Transportation Acc	Will be identified during implementa	tion								

Environmental Justice (EJ) Communities Will be identified during implementation



Lead Agencies and Participating Stakeholders

Lead agencies are identified for each of the operations alternatives in an effort to ensure there is ownership in advancing each project forward. Reviewing the current programs and activities agencies are involved in (shown in Figure 2) lends itself to selecting appropriate lead agencies, by advancing current programs and involvement.

The Project Steering Committee identified the following two agencies to lead this effort:

ODOT. ODOT operates the region's Traffic Management and Operations Center (TMOC), which will be an integral part of the DSS. The TMOC is already equipped with communications to cameras and ITS devices throughout the region.

Metro. Metro can provide impartial guidance to help lead the implementation of a DSS that addresses equity issues and ensure that the system provides the necessary support to all agencies.

The	table	below	lists	other	participating	stakeholders	and	their	areas	of	interest	and
kev r	espons	sibilities										

Other Participating Stakeholders	Areas of Interest and Responsibilities
TriMet	 Operate in a dynamic manner in response to unplanned events and proactively in advance of planned events.
City of Portland	 Rely on information from the DSS to better manage transportation facilities during planning and unplanned events.
City of Gresham	 Rely on information from the DSS to better manage transportation facilities during planning and unplanned events.
Bureau of Emergency Communications (911)	• Use the DSS to better manage emergencies.
ODOT Incident Responder	• Use the DSS to improve incident response.
Multnomah County	 Rely on information from the DSS to better manage transportation facilities during planning and unplanned events.
Portland State University	• Use the DSS to support data review and research.
Port of Portland	 Rely on information from the DSS to better manage transportation facilities during planning and unplanned events.
City of Troutdale and Fairview	• Rely on information from the DSS to better manage transportation facilities during planning and unplanned events.
Oregon State Police and Local Law Enforcement	• Use the DSS to support law enforcement.
Emergency Responders	• Use the DSS to improve incident response.
Railroad	• Provide information to the DSS to support vehicle routing decisions.



6. IMPLEMENT A DECISION SUPPORT SYSTEM (DSS) (CONTINUED)



Recommended Next Steps

Lead Agencies

Metro and ODOT (supported by all partner agencies)

Organize participating agencies and information exchange network:

- Identify participating agencies and data users (public and private).
- Define desired outcomes. This may include environmental benefits from implementation of the strategy.
- Establish an Information Exchange Network (see Operations Alternative #2 Data Sharing Policy).
- Identify sources of data and communication protocols for sharing information between agencies and third party vendors (see Operations Alternatives #2 and #3).
- Apply systems engineering to define the requirements and capabilities of the system (manual vs automated, simulation models, etc.).
- Evaluate available DSS software options (off the shelf).
- Establish how travelers will be informed of actions that result from the DSS.

Develop business rules:

- Develop agreements between agencies to operate traffic signals and ITS devices during hours when agency staff is not available.
- Determine whether to establish a virtual 24/7 TMOC for all partner agencies.
- Determine how to prioritize non-drive alone trips.
- Determine transit system capacity (transit vehicle capacity and park-and-ride capacity) along with other high-occupancy vehicles (e.g., ridesharing, TNCs with multiple passengers (Lyft Line/Uber Pool).
- Determine modifications to transit operations and availability of related one-way services (e.g., bike-sharing, car-sharing, TNCs and microtransit).
- Establish control capabilities for ITS devices owned and operated by various stakeholders.
- Define the desired level of automation (from manual decision trees to advanced predictive algorithms).



This I-84 Multimodal ICM Deployment Plan blazes a trail for corridor partners to operate a safer and more reliable set of roads and transportation options. The plan emphasizes equity, improving multimodal safety, and enhancing partnerships across agencies. It looks at the complete transportation system, developing multimodal solutions to optimize the efficiency of the transportation network.

While each of the operations alternatives offers benefits independently, they also work together to support a Decision Support System that optimizes the benefits across the whole transportation system.

This planning effort is the start of the I-84 Multimodal ICM. For it to be successful, each of the operations alternatives needs to advance through implementation. The following subsections address elements that are critical to advancing the I-84 Multimodal ICM Plan: Developing a Memorandum of Understanding, Future Funding Opportunities, and Expanding the System.

DEVELOPING A MEMORANDUM OF UNDERSTANDING (MOU)

For successful implementation of the multimodal ICM Plan, inter-agency coordination is critical. A jointly developed and executed high-level MOU among the Agency Leaders that provide transportation planning and operations in the Portland area, is a major step toward achieving the goals of the I-84 ICM project. The executed document commits all entities to work together on Multimodal Integrated Corridor Management to achieve common good and improve quality of life for all. This MOU will assure buy-in and cooperation from all agencies. The MOU will ensure that agencies use the deployment plan as part of new projects for smarter system management and operations in the corridor.

Signing the MOU does not obligate agencies to contribute funding towards the operations alternatives, but rather acknowledges the agency's support to advance the operations alternative.

A copy of the MOU is included in Appendix A.

FUTURE FUNDING OPPORTUNITIES

Future funding to implement each of the recommended operations alternatives is unclear at this point. Unlike most capital projects that require large funding upfront, most of these Multimodal ICM projects require some upfront investment, and then assurance of continued funding for operations and maintenance. As agencies advance their own projects and seek funding, the MOU encourages participating agencies to weave in elements of this Multimodal ICM Plan to create a smarter transportation management system.

EXPANDING THE SYSTEM

The I-84 Multimodal ICM Deployment Plan can be easily expanded in two respects: geographically and by projects. Each of the recommended operations alternatives encompasses a means of working towards a robust decision support system. By expanding stakeholders more broadly across the region, the central systems developed from this plan can expand to benefit additional agencies and travelers.

Each of the operations alternatives can be further expanded by continuing to enhance capabilities. This report lays the foundation for guiding the beginning implementation of Multimodal ICM. As transportation continues to evolve with emerging technologies, adapting multimodal ICM will help to coordinate operations between agencies and maximize efficiencies. Once these strategies are implemented, travelers will experience safer trips and more reliable travel times, for a more enjoyable travel experience.



MULTIMODAL INTEGRATED CORRIDOR MANAGEMENT

APPENDIX A MEMORANDUM OF UNDERSTANDING

1-84

I-84 Multimodal Integrated Corridor Management (ICM) Agency Partnership

Whereas there are new challenges to the transportation system that negatively impact people's safety, travel reliability and their quality of life;

Whereas federal, state, regional and local policy guides desired outcomes from the transportation system;

Whereas public agencies that serve the I-84 Multimodal Corridor continue to be partners in Transportation System Management and Operations, building on their decades of experience enhancing Intelligent Transportation Systems (ITS) for travelers and goods movement, joined with decades of experience managing demand and connecting travelers to transit, carpool, bike, walk and other efficient options;

Whereas the region has a history of coordinating ITS deployment through the TransPort Subcommittee;

Whereas a committee met to examine the concept of Multimodal ICM for the travel shed between Troutdale and downtown Portland, Southeast Powell Boulevard and the Columbia River;

Whereas stakeholders of the Multimodal ICM committee hold a common vision to operate the I-84 travel shed in a safe, multimodal, integrated, reliable and efficient fashion where the focus is on the transportation user, and equitably sharing the economic and quality of life benefits; along with goals to improve safety, improve performance, integrate transportation choices, deepen partnerships and promote environmental stewardship;

Whereas partners recognize that achieving the vision means applying key social and racial equity considerations in project development to improve the travel experience for underserved communities; and, promoting operations strategies that address both the climate and human health;

Whereas partners learned lessons from deployments of ICM in other regions to advance operations from manual and individual efforts to faster, more informed, automated and integrated operations;

Whereas partners will measure results of operations strategies by continuing to advance capabilities with sensors and new data sources;

Whereas partners must apply innovative thinking and technology to serve the traveling public and goods movement;

Therefore, the undersigned partners hereby agree to the concept of Multimodal ICM, and pledge to work together and with others to coordinate and cooperate in planning, implementation and operations.

City of Gresham	City of Portland	Metro
Multnomah County	Oregon DOT	Port of Portland
Portland State University	TriMet	



MULTIMODAL INTEGRATED CORRIDOR MANAGEMENT

APPENDIX B ADVANCED SCREENING SUMMARY

1-84

Advanced Screening Summary

		Feasibility Rankings				Expected Benefits - Rankings			Performance Negative Impacts			Score Summary								
ID No	Operations Alternative	Institutio nal	Physical	O&M	Timeline	Leveragin g other Projects	Crash Reduction	Operation al	Equity	P. M.	Data	Ped Areas	Transit Service Reliability	Active Transp	EJ communitie s	Feasibility	Benefits	РМ	Average	Recommendation
ER-1, LB-6	Implement a Decision Support System (DSS)	3	2	3	3	4	2	4	3	4	4	None	None	None	None	3.0	3.0	4.0	3.3	Yes
ER-2, ER-5, LB-4	Establish a Detour Policy, Protocols, Signal Timing Plans, and install arterial VMS for Detours.	3	1	2	3	2	2	3	3	2	1	Minor to moderate	Minor to moderate	Moderate to major	Moderate to major	2.2	2.7	1.5	2.1	Yes
ER-7	Coordinate Construction Schedules and Detours Across Agencies	3	3	4	3	4	2	4	4	1	3	None	None	None	None	3.4	3.3	2.0	2.9	Yes
DM-1	Create an Open Data Policy for Agencies to Share Data with Third Party Information Service Providers	3	4	4	4	4	1	3	2	4	2	None	None	None	None	3.8	2.0	3.0	2.9	Yes - Discuss scope and intent.
LB-5	Create a 24/7 Transportation Operations Center for the Region	3	1	0	2	3	4	4	4	4	3	None	None	None	None	1.8	4.0	3.5	3.1	Yes - discuss scope and purpose of the 24/7 TOC
LB-7	Coordinate with Third Party Traveler Information Providers	2	3	4	3	3	1	2	2	2	2	None	None	None	None	3.0	1.7	2.0	2.2	Maybe. Discuss further.
LB-10	Expand and Upgrade Transit Signal Priority (Next Generation Upgrade)	2	1	3	3	4	1	3	4	2	2	Minor	None	None	None	2.6	2.7	2.0	2.4	Maybe. Next Generation TSP is being evaluated and implemented as part of the Division Transit Project. The Concept of Operations tests both DSRC and V2C methods.
ER-9	Revise the Tow Policy - Call the Closest Tow Truck	2	4	4	4	3	2	3	1	2	2	None	None	None	None	3.4	2.0	2.0	2.5	No - current TIM project for CAD to CAD integration that should address this strategy
DM-7	Provide Real-Time TriMet Park and Ride Availability Information	4	1	2	3	2	0	2	4	2	2	None	None	None	None	2.4	2.0	2.0	2.1	No - while this strategy has merit, it could be implemented by a single agency and is not the focus of this ICM Plan.
DM-9	Institute Value Pricing (tolling)	1	1	3	1	2	1	3	0	2	2	Minor to moderate	None to minor	None	Moderate	1.6	1.3	2.0	1.6	No - this strategy is currently being pursued through other efforts.
DM-14, DM-15	Increase Transit Service with Demand Spikes during Planned and Unplanned Events	1	1	1	3	0	1	3	4	1	0	None	None	None	None	1.2	2.7	0.5	1.5	No - continue increased service for planned events such as Rose Quarter events, but increasing service for unplanned events is not feasible at this time. Elements of strategy are linked to DSS (ER-1, LB-6)
DM-16	Coordinate Transit Service with Shift Workers	1	1	1	1	2	1	3	4	1	0	None	None	None	None	1.2	2.7	0.5	1.5	No - this can be implemented independently by TriMet
DM-17	Provide Transit Queue Jumps	2	2	4	2	1	1	3	4	1	0	None	None	None	None	2.2	2.7	0.5	1.8	No - Incorporate where roadway geometry allows as capital projects move forward.
DM-19	Reroute Transit Dynamically	2	2	1	3	0	0	1	3	1	0	None	Minor to moderate	None	Minor to moderate	1.6	1.3	0.5	1.1	No
LB-8	Update coordinated or adaptive signal timing systems	3	1	2	3	2	2	4	4	3	2	Minor	Minor	None	None	2.2	3.3	2.5	2.7	No. This can be incorporated as it relates to detour routes (ER- 2), and can be pursued independently by agencies.
LB-9	Connect Traffic Signals and ITS Devices to Communications	4	1	2	3	2	2	4	3	4	4	None	None	None	None	2.4	3.0	4.0	3.1	No - Implement communications to support selected projects and following the Regional ITS Comm Plan. This will not be pursued as an independent project for the ICM plan, based on the Regional Communications Plan the priorities for this travel shed should be implemented as funding permits.
LB-11	Implement Truck Signal Priority (also known as Truck Dilemma Zone Detection)	4	2	4	4	1	4	3	0	0	2	None	None	None	None	3.0	2.3	1.0	2.1	No - agencies can implement independently.
C-4	Explore Transit Only Lanes on Arterials	2	1	3	2	1	0	2	4	1	0	None	None	None	None	1.8	2.0	0.5	1.4	No

If you picnic at Blue Lake or take your kids to the Oregon Zoo, enjoy symphonies at the Schnitz or auto shows at the convention center, put out your trash or drive your car – we've already crossed paths.

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