Title: **Using Archived Data to Measure Operational Benefits of ITS Investments**

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Abstract:
The objective of this project is to use the existing data, surveillance and communications infrastructure (to the extent possible) to develop two case study evaluations for Oregon, including an evaluation of the COMET incident management program and the Portland ramp metering system. The COMET evaluation will include a thorough literature review of other incident management program evaluations, as well as a determination of the costs and benefits of the program. Benefits will include reduction in vehicular delay, fuel consumption and emissions due to early incident response, prevention of secondary accidents as well as benefits stemming from public perceptions. To the extent possible, the existing ITS infrastructure, Oregon State Patrol computer aided dispatch database and statewide accident database will be used as data sources to minimize the amount of new data collection required. It is envisioned that one corridor will be selected for a focused analysis, using video surveillance to observe actual incident durations and COMET response times. The ramp metering system case study will select a corridor where "before" and "after" data are available. The intent will be to measure savings in delay, emissions and fuel consumption and safety improvements due to the implementation of the ramp metering system. Existing data sources are the ITS infrastructure and the statewide accident database, thus no dedicated data collection program is necessary. These two case studies will set a precedent for future evaluations of ITS programs. These evaluations are immediately feasible using existing data sources.

Scope of Work
The text of the proposal must contain the following information. Exact headings as listed below are required by the USDOT.

Objectives:
The objectives of this project are to:

- Use existing ITS data sources to the extent possible to develop evaluation program for operational investments.
- Develop two case studies, including ODOT Region 1's incident management program and ramp metering program.
- Demonstrate benefits of archiving ITS data.
- Establish framework for future evaluations.

Technical Description:
Background
The Oregon Department of Transportation (ODOT), the City of Portland, Tri-Met, Metro and other regional jurisdictions are partners in the advanced technology **TRANS**portation **PORT**land project—**TransPort**. This system is designed to provide traffic management, incident response and traveler information. Its goals are to reduce traffic congestion, stabilize travel times and prevent accidents on the highway system. It is hoped that this will be achieved by improving safety and efficiency of auto, truck, and transit modes, and by relaying real-time route and mode choice information to all travelers. TransPort also complements future improvements to the

region's light rail, commuter rail, transit and highway system. This system is compatible with Metro's 2040 Framework Plan and enhances Portland's livability and quality of life while accomodating growth. As with other transportation management and information system implementations, the vision is that TransPort will provide long-term benefits without the need to add more travel lanes to the region's roadway system. TransPort is comprised of three main systems:

Transportation management: traffic monitoring and surveillance equipment identifies incidents and accidents, thereby helping system operators manage traffic flows.
Incident response: COMET (COrridor ManagEment Team) is dispatched to the incident and other appropriate emergency services are notified.
Traveler information: drivers are notified by variable message signs or on the car radio of an incident ahead, enabling them to choose alternate routes to avoid congestion.

It is important to recognize that for state departments of transportation, ITS projects such as TransPort are conceptually new types of projects. They do not consist of pavement and bridges where elected officials can hold ribbon-cutting ceremonies. Instead, the ITS projects that have been implemented rely on an unseen communications network, mostly invisible sensors, and software that is housed within the transportation management center. A relatively small number of individuals are required to operate the transportation management system, and in many cases users do not even know they are benefitting from the system. Therefore, it will important to develop an evaluation program so that benefits can be demonstrated an communicated. The results of such an evaluation program will be very helpful for decision-making and also as part of a system feedback loop. As in any systems design process, lessons learned from evaluation should be fed back into the planning, operations and maintenance of the existing system and also into the planning, design and implementation of any expansions to the system.

Problem Statement
The objective of this project is to use the existing data, surveillance and communications infrastructure (to the extent possible) to develop two case study evaluations using the Portland, Oregon metropolitan area as the testbed. These will include an evaluation of the COMET incident management program and the Portland ramp metering system. Existing data sources are the ITS infrastructure and the statewide accident database, thus no dedicated data collection program is necessary. These two case studies will set a precedent for future evaluations of ITS programs. These evaluations are immediately feasible using existing data sources.

Research Approach
The COMET evaluation will include a thorough literature review of other incident management program evaluations, as well as a determination of the costs and benefits of the program. Benefits will include reduction in vehicular delay, fuel consumption and emissions due to early incident response, prevention of secondary accidents as well as benefits stemming from public perceptions. To the extent possible, the existing ITS infrastructure, Oregon State Patrol computer aided dispatch database and statewide accident database will be used as data sources to minimize the amount of new data collection required. It is envisioned that one corridor will be selected for a focused analysis, using video surveillance to observe actual incident durations and COMET response times.

The ramp metering system case study will select a corridor where "before" and "after" data are available (for example, I-205). The intent will be to measure savings in delay, emissions and fuel consumption and safety improvements due to the implementation of the ramp metering system. Video observations will add to the comprehensiveness of the database. With the data collected, different metering strategies may be explored an/or tested using a simulation platform such as Corsim or Paramics.

Project Work Plan:

PHASE 1 INCIDENT MANAGEMENT PROGRAM EVALUATION

Task 1-1 Literature and Peer State Review

This will include a quick review of recent and urban incident management literature. A list of references will be maintained but no formal literature review report will be prepared. Also, incident management programs in selected peer states will be reviewed, with a focus on urban applications in cities with similar characteristics to Portland.

- Perform TRIS search as well as checking with the National Transportation Library and the Institute of Transportation Studies Library and the PATH database located at the University of California at Berkeley.
- Review FHWA Freeway Management handbook and results of other incident management evaluations.
- Quickly survey incident response programs and evaluations conducted in peer states, with focus on urban programs and measured incident data.

Task 1-2 Field and Corridor Reconnaissance

The project team will become familiar with the characteristics of the Portland freeway corridors in cooperation with ODOT staff. This task will also include familiarization with general incident response issues across all corridors and specific issues related to the selection of a particular corridors for detailed scrutiny. It is anticipated that the I-5/Barbur Blvd. Corridor will be a top candidate. This task may consist of the following activities:

- Drive the corridors.
- Document verbal descriptions of daily, weekly, and seasonal travel patterns and incident-related issues.
- Ride-along(s) with COMET personnel.
- Review of aerial photos, GIS maps and review of video logs as needed.
- Review origins of local tow trucks, fire equipment, ambulances, ODOT maintenance personnel and state patrol personnel in relation to location of potential incidents.
- Document start dates, staffing levels and roving procedures of COMET program on each corridor.

Task 1-3 Corridor Selection

In cooperation with the project stakeholders, using the reconnaissance results from task 1-2, a corridor will be selected on which to focus a detailed analysis.

Task 1-4 Inventory and Categorize CAD Data
Computer Aided Dispatch (CAD) data will be obtained from the inception of the system through the most recent available. The intent is to estimate the reduction in incident duration resulting from the presence of the COMET program. It is recognized that the effectiveness of this analysis may be restricted somewhat due to the fact a true "before" and "after" controlled experiment will not be possible.

- Develop database format for storing relevant incident data, so that the same format can be used for future analyses.
- Extract incidents from database for study corridors and develop numbering system for incidents of interest.
- Sort database for incidents on each corridor, for before and after the implementation of the COMET programs (if possible).
- For "before" and "after" scenarios, construct incident tree categorizing each type of incident.
- Estimate duration, response time, vehicular delay and other relevant parameters for each incident if possible.
- For "after" scenario estimate response time, duration, vehicular delay and other relevant parameters for each incident as if there were no COMET program in place.
- Document statistical reliability of above parameters, recognizing limitations due to sample sizes and curve fitting.

Task 1-5 Analyze Supplemental Data
The incident data from the CAD system will be augmented by field reconnaissance, customer surveys already collected by ODOT, data from the Oregon State Highway Transportation Volume Tables, and data on reported crashes to be obtained from the ODOT Crash Analysis & Reporting Unit. ODOT's Integrated Transportation Information System (ITIS) may also be consulted for information on cross section attributes (e.g., number of lanes, lane width, shoulder width, climbing/passing lanes), pavement condition and treatments, roadside conditions (side slopes, obstacles), characteristics of medians (width, turn lanes, guard rails/restrictions), horizontal and vertical curves, and posted speeds.

- Summarize additional data for each corridor (longitudinally if possible), particularly volumes, accident rates and types and cross-section.
- Augment incident characteristics with supplemental data in "before" and "after" database.
- Perform a qualitative analysis of customer surveys, and consider design of a simple expanded customer questionnaire for distribution on study corridors (to gain insights into highway users' willingness to pay for COMET service).

Task 1-6 Benefit Estimation
Benefits of the Region 1 COMET program will include consideration of improvements in safety, traffic congestion/delay, fuel consumption, air quality, customer satisfaction, community event coordination, police support, motorist assistance, prevented collisions, increased capacity.

- Estimate incremental reduction in incident duration and response time due to presence of COMET program.

- Explore relationship of benefits to characteristics of corridor.

Task 1-7 Costs
With input from ODOT, document the costs of the COMET program, including labor, overhead, management, vehicles, equipment, fuel, depreciation and expendable items.

Task 1-8 Evaluation
Compare quantitative and qualitative results measured in Tasks 1-6. Develop simple criteria based on evaluation for creation and/or expansion of COMET program.

PHASE 2 RAMP METER SYSTEM EVALUATION

Task 2-1 Literature and Peer State Review
This will include a quick review of recent ramp metering system evaluation literature. A list of references will be maintained but no formal literature review report will be prepared. Also, ramp metering programs in selected peer states will be reviewed, with a focus on urban applications in cities with similar characteristics to Portland.

- Perform TRIS search as well as checking with the National Transportation Library and the Institute of Transportation Studies Library and the PATH database located at the University of California at Berkeley.
- Quickly survey ramp metering systems and evaluations conducted in peer states, with focus on systems using measured data.

Task 2-2 Field and Corridor Reconnaissance
The project team will become familiar with the characteristics of the Portland freeway corridors that include ramp metering in cooperation with ODOT staff (this task will be conducted in parallel with task 1-2). This task will also include familiarization with general metering and congestion issues across all corridors and specific issues related to the selection of a particular corridors for detailed scrutiny. It is anticipated that the I-205 Corridor will be a top candidate for a "before" and "after" study. PSU is already working with ODOT to collect loop detector and video surveillance data after the surveillance system is installed but before the ramp meters are turned on. The I-5/Barbur Blvd. Corridor may be a candidate for an "after only" study. This task may consist of the following activities:

- Drive the corridors.
- Document congestion patterns and seasonal variation issues.
- Observe onset of congestion and metering via video or field viewing.
- Review of aerial photos, GIS maps and review of video logs as needed.

Task 2-3 Corridor Selection
In cooperation with the project stakeholders, using the reconnaissance results from task 2-2, corridor(s) will be selected on which to focus a detailed analysis.

Task 2-4 Inventory and Process Loop Detector and Video Data
Loop detector data at 20-second aggregation (flow, occupancy and speed) will be collected along with video data at relevant on-ramps. This task will include:

- Develop database format for storing relevant loop and video data, so that the same format can be used for future analyses.
- Analyze data for ramps and mainline, constructing queueing diagrams and recording queue lengths on ramps.
- Estimate total vehicle miles and vehicle hours traveled (VMT and VHT) for corridor in "before" and "after" scenarios.

Task 2-5 Benefit Estimation

Benefits of the Region 1 ramp metering program will include consideration of improvements in safety, traffic congestion/delay, fuel consumption, air qualityand customer satisfaction.

- Estimate changes in VHT and VMT due to ramp metering program.
- Estimate changes in total delay for ramp and mainline vehicles.
- Consider queue impacts on local arterials.
- Compute estimates of air quality and fuel consumption impacts of ramp metering.

Task 2-6 Evaluation

Compare quantitative and qualitative results measured in Tasks 1-5. Develop framework for future evaluations.

PHASE 3 REPORTING

Reporting requirements will include primarily the final report, as well as the following:

- Simple monthly reports will be prepared (by email) to inform the external project contact of the project status.
- The PI and external project contact will communicate and/or meet as necessary to obtain data and review project status.
- Prepare a final draft report (with appendices) summarizing results and recommendations for review by June 30, 2003. The executive summary will also include recommendations for future research.