

# BUILDING PLANNING AND OPERATIONS ANALYSIS TOOLS ON AN ARCHIVED ITS DATA PLATFORM: WHO ARE THE USERS?

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**ABSTRACT:** An ITS data archive provides a unique opportunity to measure how a transportation system operates over time. An ITS data archive has been developed in Portland, Oregon at relatively low cost, taking advantage of sensors and communications used to operate the system in real time. The value of the data archive is governed by the quality of the analysis tools provided for users. The objective of this paper is to describe the results of a survey conducted to gauge ADUS user needs and experiences from both the planning and operations perspectives. Recommendations for improvements and next steps are provided.

## INTRODUCTION

The Portland Oregon Regional Transportation Archive Listing (PORTAL) is the official intelligent transportation systems data archive for the Portland metropolitan region. PORTAL has been archiving 20-second speed, count, and occupancy data from the approximately 500 inductive loop detectors (at an average spacing of 1.2 mi) in the Portland metropolitan region since July 2004. PORTAL data are stored in a PostgreSQL relational database management system, and the database is approximately 300GB in size. PORTAL's web-based front (Figure 1) is written primarily in PHP and provides user-friendly access to the data archive. As shown in Figure 2, PORTAL also includes weather data and 140,000 incident logs. PORTAL has a web-based interface that provides performance metrics designed to assist practitioners and researchers. Currently PORTAL has 254 registered users from transportation agencies, consultants and academia. The objective of this paper is to describe how PORTAL's constituents are actually using the ITS data archive in their daily work, in both planning and operations environments. This work is based on a recent web-based survey of PORTAL's users, along with follow-up interviews. Results of this

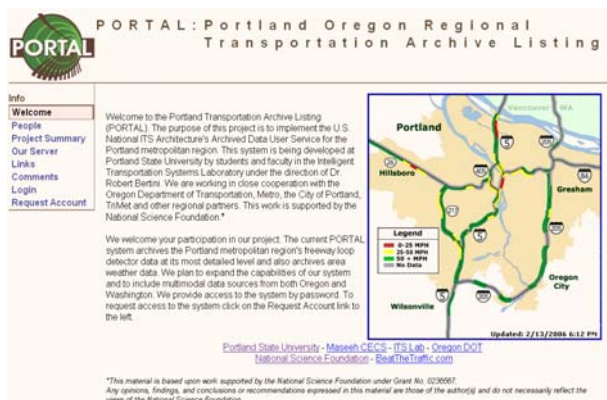


Figure 1. PORTAL User Interface



**Loop Detector Data**

20 s count, lane occupancy, speed from 500 detectors (1.2 mi spacing)



**Incident Data**

140,000 since 1999



**Weather Data**



**VMS Data**

19 VMS since 1999

Figure 2. PORTAL Data Sources

project will be used to improve PORTAL's user interface, as well as its tools, and will be useful for cities or regions with existing ITS data archive systems and for those planning future implementations.

Archived ITS data is viewed as an integral component of the U.S. ITS Architecture (1). PORTAL was developed in accordance with the Archived Data User Service (ADUS) framework developed by the U.S. Department of Transportation (DOT) as part of the architecture and has been designated by the Portland ITS and operations agencies as the official ITS data archiving entity for the Portland region. As suggested in the FHWA ITS Guidelines (2), user access to PORTAL is via a web-based interface providing easy access to both raw data and a wide range of common summary data and standard performance measures. Currently, PORTAL's users include transportation planners, metropolitan planning organizations (MPOs), traffic management operators, transit operators, and transportation researchers. PORTAL is made possible by the fact that transportation agencies in the Portland metropolitan region freely share their data, and make it available free to the public. This underlying philosophy is critical to the success of the system.

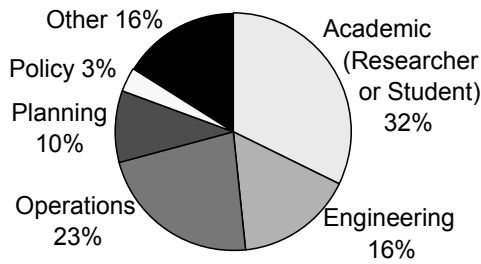
## **ITS DATA ARCHIVE USER SURVEY**

In order to assess overall user satisfaction and to learn how PORTAL's constituents are using the system, a web-based unscientific survey was developed and distributed to all registered PORTAL users. There were a total of 42 responses (a 17% response rate), and respondents helped assess overall user satisfaction and revealed how PORTAL's constituents are using the system. The survey asked questions about the respondents' jobs and day-to-day data needs. The survey asked questions about the respondents' jobs and day-to-day data needs. Figure 3 shows that about two thirds of the users who responded consider themselves in an academic category, followed by nearly a quarter of users in an operations environment, with the remainder in engineering, planning, and policy arenas. To gauge the range of user employers

Figure 4 shows that most users are affiliated with universities, followed by private/consulting firm users. Nearly 20% of users work for regional or local agencies, followed by users employed by state and federal agencies. It was important to gain an understanding of how PORTAL is used, so respondents were asked to describe how often they use PORTAL as a tool. As shown in Figure 5, almost 60% of those surveyed use PORTAL on special occasions, when they have a particular need. Reasonable fractions use PORTAL weekly or monthly followed by small percentages of users in the yearly, never, and other categories. As shown in Figure 6, about half of the survey respondents consider PORTAL's user interface to be very easy or easy. About one quarter consider the interface to be difficult or very difficult—the PORTAL team is targeting these users further to aim training or system improvements toward making the system more accessible and less difficult in perception and in reality. One survey question asked specifically if a user would like a personalized PORTAL demonstration, and 10% responded yes. These inputs will be used as a basis upon which to improve and expand PORTAL in the future.

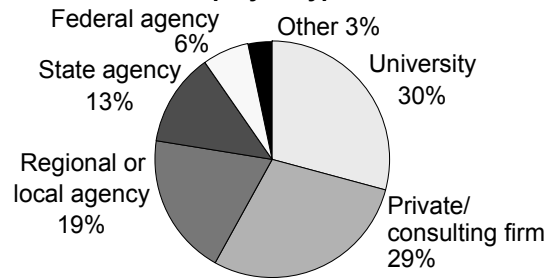
There are several major categories of analysis possible within PORTAL, available via selection of a particular "tab." Respondents were asked to rate their use and level of familiarity with each tab. Figure 7 shows the results. It's clear that the largest fractions of users are familiar with the Timeseries and Congestion tabs, followed by the Incident Reports

**What Kind of User Do You Consider Yourself?**



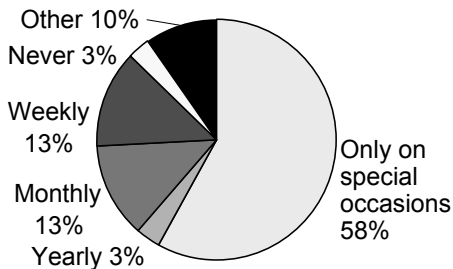
**Figure 3. PORTAL User Types**

**Employer Type**



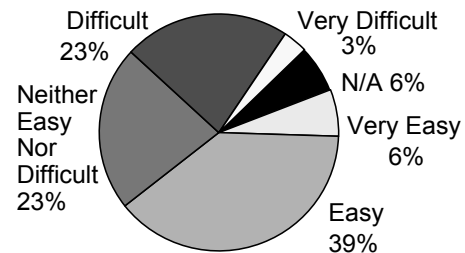
**Figure 4. PORTAL User Employer Type**

**How Often Do You Use PORTAL as a Tool?**



**Figure 5. PORTAL Use Frequency**

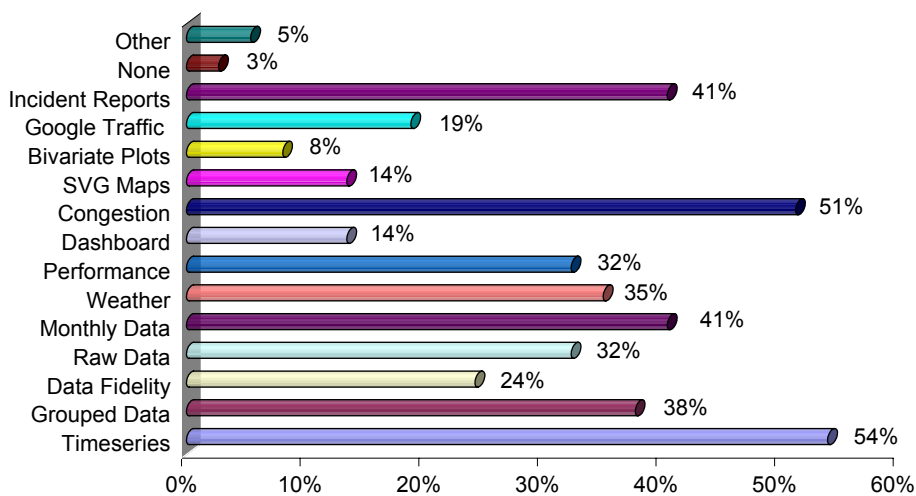
**How Do You Find PORTAL's User Interface?**



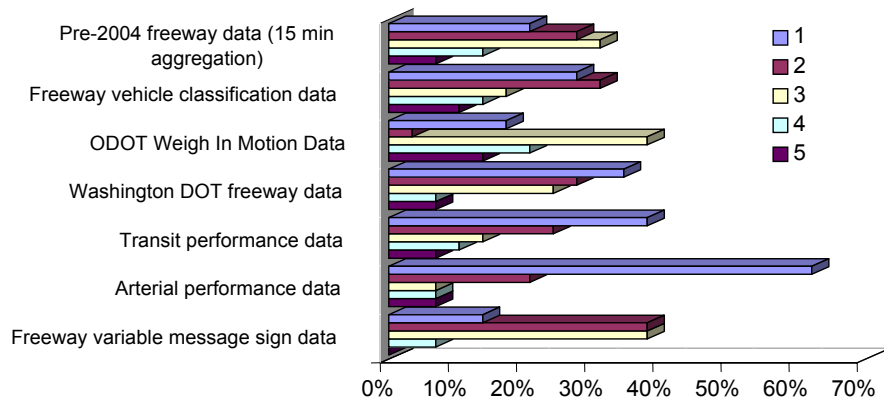
**Figure 6. PORTAL User Interface**

and Monthly Data tabs. Some of the “tabs” have been created for particular users, so this is a helpful signal that users are relatively familiar with many of the key functions.

Each respondent was asked to report their satisfaction with the system and for specific comments. These inputs will be used as a basis upon which to improve and expand PORTAL in the future. Each respondent was also asked to provide specific examples of how they use PORTAL in their job. The paper will describe the survey results more fully and will provide some examples (see below) of actual uses of the ITS data archive. The PORTAL system will be expanding to include additional data sources including: city arterial performance data from traffic signal systems; transit bus data from the automatic vehicle location (AVL) system; variable message sign (VMS) data; freeway data from the Washington State Department of Transportation for the Vancouver area; more detailed weather data; and pre-2004 freeway loop detector data aggregated at 15-minute levels. As a final set of survey questions, users



**Figure 7. PORTAL Category Use Frequency**



**Figure 8. Desired Future PORTAL Extensions**

were asked to rate each of the new sources so that priorities can be set in a rigorous way.

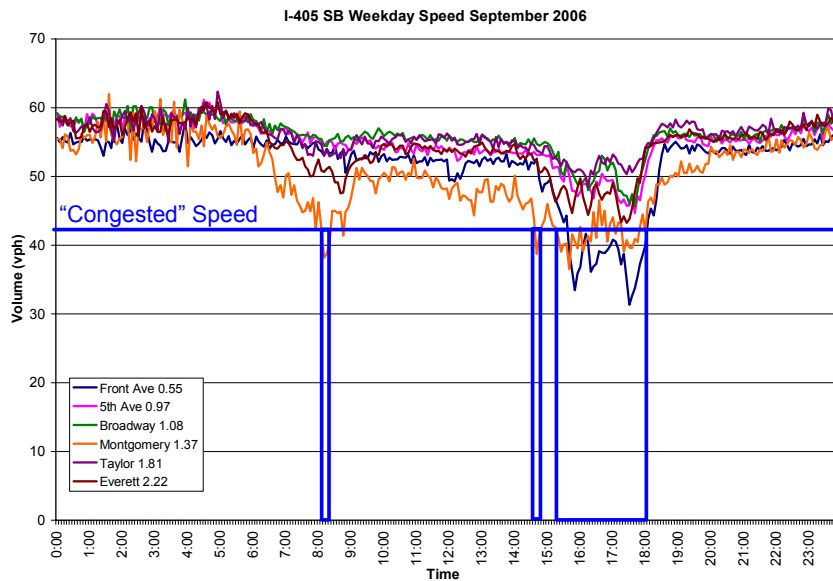
The PORTAL system will be expanding to include additional data sources including: city arterial performance data from traffic signal systems; transit bus data from automatic vehicle location (AVL) systems; tools for analyzing variable message sign (VMS) data; freeway data from the Washington State Department of Transportation (WSDOT) for the Vancouver area; more detailed weather data; and pre-2004 freeway loop detector data aggregated at 15-minute levels. Finally, users were asked to rate each potential new data source so that priorities for the expansion can be set in a more rigorous way. Respondents rated each of the seven expansion categories on a scale of 1 to 5, where 1 was the most desired. Figure 8 shows that the strongest response was for the arterial performance data (mean score of 1.8). The next two strongest categories were the transit performance and WSDOT data (mean scores of 2.2). Each respondent was also asked whether they had specific examples of how they use PORTAL in their job—a total of 21% of users surveyed offered sample PORTAL uses. This paper provides some examples of actual uses of the ITS data archive.

## EXAMPLE DATA ARCHIVE USES

How is PORTAL being used? From its inception it has been envisioned as a tool to be used on a day to day basis by planners, engineers, consultants, operations personnel, and even managers and decision makers. Some of PORTAL’s features are specifically aimed at particular people—for example, the data quality tab is aimed at improving the quality of the loop detector data that forms the core of the system. PORTAL has helped ODOT identify a communications issue that was creating a bottleneck in the data transmission, and that is now being alleviated through the installation of new fiber optics switching equipment. By providing a “top ten” detector error report PORTAL helps ODOT prioritize field personnel to target the “worst” detectors and repair them. Based on the survey results, three main areas of PORTAL application are now presented: congestion monitoring, linking operations with transportation planning and improving techniques for reducing non-recurring congestion.

## TRACKING RECURRENT CONGESTION

PORTAL is being used to monitor freeway performance over time. As the region’s MPO, Metro is responsible for developing the region’s long range transportation plan and the congestion management program. Metro began to use speed maps to compare freeway speeds

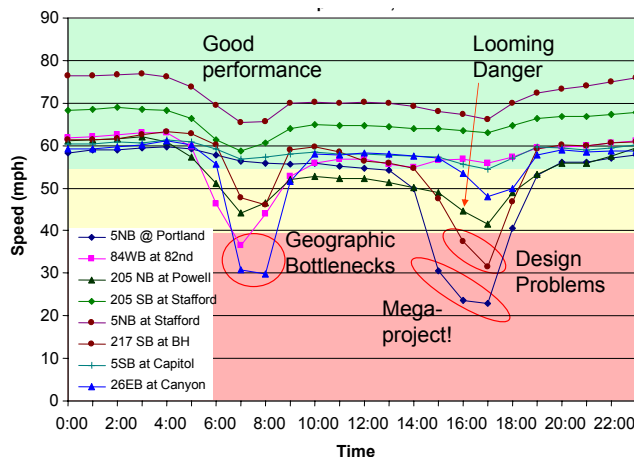


**Figure 9. Monthly Congestion Monitoring**

during particular time periods. This tool can be used for any corridor (or the entire region) and for any time period. The visualization aspect of the mapping tool has proven to be useful in conveying the impacts of capital improvement projects (e.g. freeway widening and bottleneck alleviation) to a wide audience. The FHWA has encouraged Metro to use performance tools such as this in the update to its Congestion Management Program, which is currently underway. Figure 9 shows a sample portion of a monthly congestion monitoring report for a section of southbound I-405. This shows the locations and durations where actual average weekday speeds dropped below the FHWA congested speed of about 42 mph. This can be tracked from month to month and on any corridor. This is an example of how PORTAL makes new kinds of analysis possible quickly and at little additional cost.

## STRENGTHENING LINKS BETWEEN OPERATIONS AND PLANNING

In updating its Regional Transportation Plan (RTP), Metro has used PORTAL to conduct a



**Figure 10. Regional Cross Sectional Analysis**

regional cross sectional analysis at key points on the freeway network. Figure 10 shows annual average daily speeds (from weekdays in 2005) at eight key locations on the region’s freeways. The results show high speeds during off-peak periods, and highlights the presence of a mid-day off peak period between 10:00 and 2:00 at most locations. Clearly at some points speeds drop well below 40 mi/hr in both the morning and afternoon peak periods. Several are bottlenecks that occur when one freeway “tees” into another, while several others are the subject of current environmental and planning studies for improvement. This tool highlights the value of the archived speed data throughout the network.

In addition, Metro and ODOT have used PORTAL to assess the impact of a major capital construction project on a key east-west freeway corridor. Figure 11 contains a Hwy 26 Cross Section Study, and illustrates how speed on the eastbound Sunset Highway changed between 2004, when construction was active, and 2005, when it was complete. Note that each speed curve follows the same basic pattern—slow during the morning peak and slightly slow during the evening peak—but that the speeds are substantially lower in 2004 than they were in 2005.

Figure 11 also couples hourly traffic volumes with speeds measured during 2005 which highlights the heavy morning flows on this corridor. The figure reveals that flows remain high on this corridor throughout the day, even during the midday. The ability to quickly produce studies such as these aids greatly in planning and operational analysis. In fact, PORTAL’s capabilities have been used to aid in the completion of the requirements of a FHWA Regional Concept of Transportation Operations (RCTO) grant. The aim of the grant is to advance planning regionally for operations.

## IMPROVING RESPONSE TO NON-RECURRING CONGESTION

Generally speaking nonrecurrent congestion is a target area for improvement, since it accounts for a large proportion of the nation’s total congestion. While it is more difficult to make permanent capacity-increasing improvements to the network, incident management is a low cost, highly effective strategy for reducing congestion. The incident reports provided within PORTAL are designed to give traffic operations managers the tools to examine how their assignment of incident response resources matches the incident rates in the field. For example the automated incident report provides the average number of ongoing incidents by time of day which can be compared to the number of response personnel. Incident data are entered into ODOT’s traffic management system database at the regional traffic management operations center (TMOC). These data are incorporated automatically into PORTAL, for mapping and analysis. Figure 12 shows a sample of the monthly incident analytical tools currently available within PORTAL for December 2006. The figure shows that incidents for a

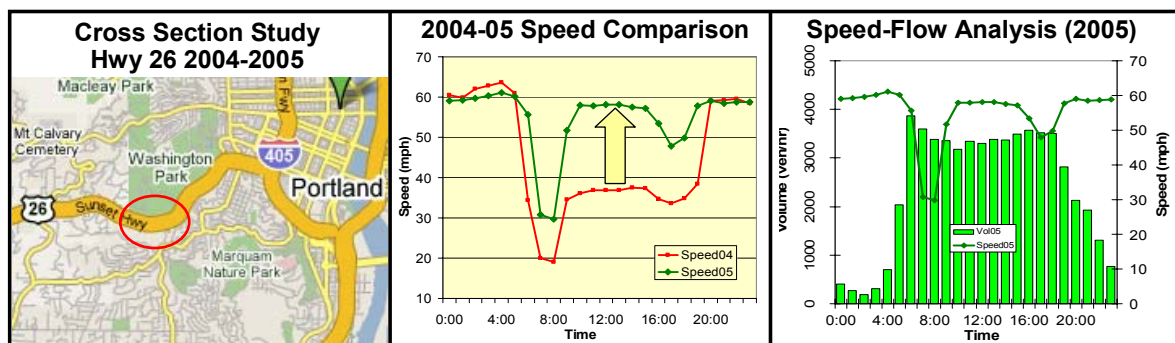
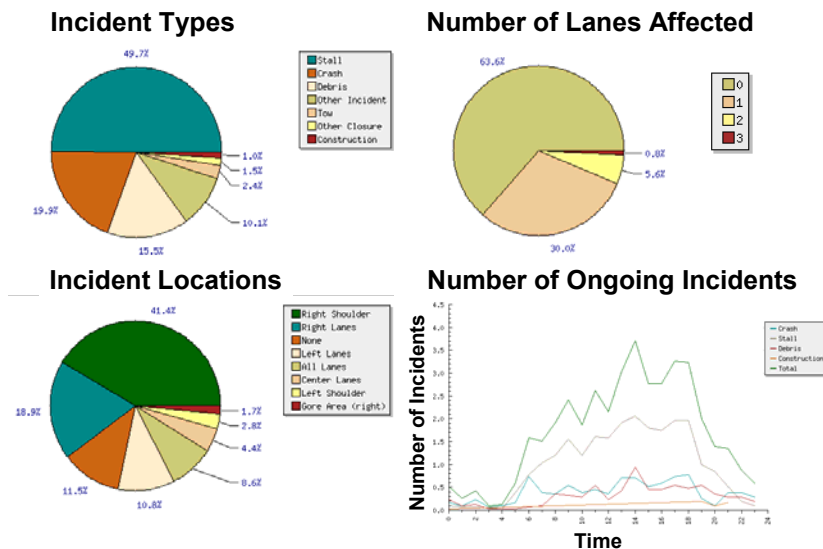


Figure 11. Freeway Cross Section Study

particular month are broken down by type (crash, stall, debris, tow, construction, and other). For this particular month, about 50% of the reported incidents were stalls, and 20% were crashes. Incidents are shown by number of lanes affected; 0.8% affected 3 lanes, 5.6% affected two lanes, 30% affected one lane, and the rest did not affect any lanes. Incident locations are also important for gauging incident response actions. Most incidents affected the right lanes and right shoulder. Finally, the figure shows a plot of the number of ongoing incidents by time of day through the month. For example, at 2:00 PM there was an average of



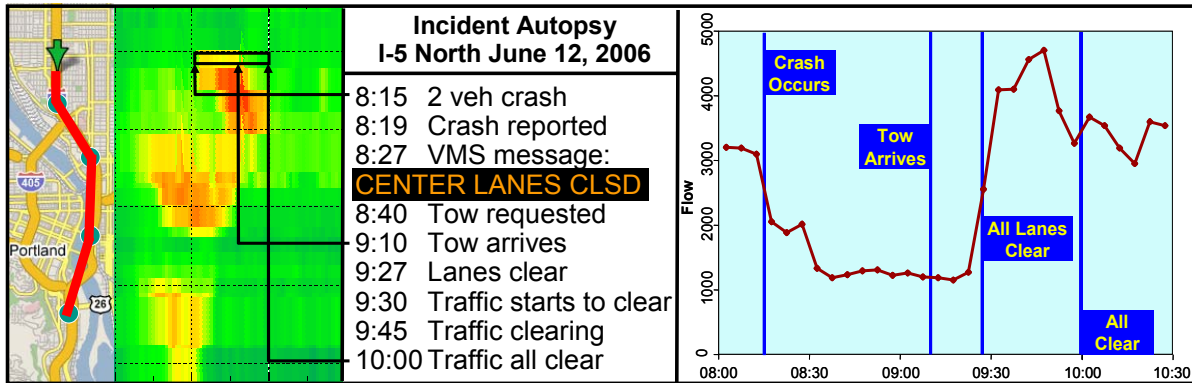
**Figure 12. Monthly Incident Reporting**

3.5 ongoing incidents. This reflects the need for about four incident responders during the afternoon so that all incidents can be managed effectively.

It is possible to delve more deeply into the details of one incident, as shown in Figure 13. On June 12, 2006, a two-car crash occurred on northbound I-5 near Skidmore. The two left lanes were blocked from 8:15 to 9:27 AM. As shown in the figure, ODOT received three 911 calls, and confirmed the incident at 8:19. By 8:27 a message was posted on three nearby VMS, and at 8:40 a tow was requested. At 9:26 the first vehicle was towed and the second vehicle was removed. According to PORTAL speed and flow data, the traffic did begin to flow again at about 9:30, and by 10:00 all effects of the incident were cleared. The City of Portland used PORTAL to estimate that this one incident caused more than 5,000 veh-hr of delay, and converted this to a user cost of \$144,000. System users could have saved more than \$10,000 if the tow truck had arrived ten minutes earlier. As a result of this incident, and the subsequent analysis via PORTAL, a new regional task force known as the Portland Operations Steering Team (POST) has been established in order to develop better incident management strategies that will result in faster incident clearance. The availability of the PORTAL system enabled the preparation of the standard incident autopsy shown in Figure 13, and has led to new levels of discussion and action regarding incidents in the region. It is hoped that further decision support capabilities such as this can be provided in the future.

## CONCLUSIONS

ITS data archive systems are in operation in several locations, including California, Washington, Maryland, Texas, Virginia, Texas, and Oregon. This paper has described the



**Figure 13. Incident Autopsy**

results of a recent survey of the registered users of Oregon’s PORTAL system. Users are generally satisfied with the system, are typically “periodic” users (as opposed to regular use), a few users requested personal demonstrations, and many offered example uses of the system. This paper has demonstrated several example applications using PORTAL data including congestion monitoring, linkages between planning operations, and nonrecurrent congestion.

In a research environment, it is critical to obtain feedback on the products that are developed so that improvements can be made in an ongoing feedback loop. This user survey and subsequent analysis of the results has been helpful in identifying priorities for PORTAL and has revealed the potential to improve transportation planning and operations in the Portland metropolitan region. In the future, continuing improvements will be aimed at providing resources to agency staff and decision makers. Some arenas that are being considered continue to be incident management, ways to improve travel time reliability, links to freight planning and tools aimed at members of the general public.

## **ACKNOWLEDGEMENT**

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