Using an Incident Autopsy to Improve Travel Reliability

Max Coffman, Robert L. Bertini and Bill Kloos

ABSTRACT
Incidents cause about half of the congestion experienced by passengers and freight. Incident detection, response, and clearance are complex tasks that can significantly affect the level of service on our freeways. The Oregon Department of Transportation (ODOT) works with the City of Portland and other agencies to provide proactive incident management with its COMET incident response program. This paper describes the incident autopsy process used in the City of Portland to assess incident response actions and to reveal opportunities for improvements in the process. As a case study, the paper will focus on a two-car crash on northbound I-5 near Skidmore that occurred between 08:15 to 9:27 AM on June 12, 2006. The incident was reported by three 911 callers, was confirmed within four minutes, a COMET vehicle responded and two lanes were closed while the vehicles were removed. The incident was reported on three radio stations between 8:30 and 10:00. Delays were measured using ODOT’s sensor data that are archived at Portland State University. This incident caused more than 5,000 hours of delay, and an economic cost of $150,000. The objectives of this paper are to review what happened during the incident, review media coverage, determine the impact area of the incident and describe the tow truck dispatch procedure to the scene. The paper will also document the costs of this incident to freeway users, describe lessons learned, what could have been done better, and discuss recommended further actions on how to improve response to and clearance of incidents.

INTRODUCTION
The nation’s transportation system is the driver of its economic engine, and its increasing traffic congestion is causing that engine to slow down. The Texas Transportation Institute estimates that between 52 and 58 percent of total traffic delay in our urban areas is attributable to crashes and other roadway incidents (1). Improving incident response represents an extraordinary opportunity to increase effective capacity without expensive and politically challenging roadway expansions.

In Portland, Oregon, the region’s directly elected metropolitan planning organization, Metro, partnered with a variety of public and private entities to commission a report titled “The Cost of Congestion to the Economy of the Portland Region”. The report finds that Portland’s freight-oriented economy is more dependent on transportation than many other regions, and that congestion is already affecting the competitiveness of businesses large and small. It calls for a doubling of transportation investment over the next 20 years, which is expected to save 28 hours of travel time per household each year through 2025. The study translates these time savings into an estimated $844 million per year over the same period—roughly a $2 return on each dollar invested (2).

However, transportation funding is stretched thin, and there is a strong political desire to avoid road expansion projects that could displace existing homes and businesses. Sam Adams, Portland’s Commissioner-in-Charge of Transportation, witnessed a particularly
protracted traffic jam following a freeway incident. He recognized this as an opportunity to identify cost-effective ways of reducing congestion, and requested a detailed dissection of the crash in the style of the Cost of Congestion report. This paper recounts the process by which the staff prepared this Autopsy of a Crash, and the findings that it produced.

RESEARCH OBJECTIVES

The Autopsy seeks to deconstruct a particular freeway incident, determining when and how communications were transmitted and how responders handed off responsibility. These response steps are examined individually and areas of potential improvement are identified. The study then conducts an economic impact assessment, calculating the amount of delay experienced by drivers as a result of the incident, and estimating the dollar value of that delay. Finally, hypothetical economic impact estimates are developed for the incident as if it had been cleared ten or twenty minutes faster. Ultimately, this study is intended to approximate the economic benefits of improved incident response times in order to make a more compelling case to decision-makers.

STUDY CASE

The incident in question took place on June 12, 2006 at 8:15 AM. Two cars collided traveling northbound on Interstate 5, north of downtown Portland near Skidmore Street. Responders reported that one of the drivers spoke no English. Oregon Department of Transportation (ODOT) communication logs report the following series of events during response to the crash:

- 8:15 AM – Two vehicles collide
- 8:19 AM – ODOT learns about the crash after witnesses called 911
- 8:27 AM – ODOT posts on variable message sign: CENTER LANES CLSD
- 8:40 AM – ODOT responder requests a tow from the city’s Tow Desk
- 9:10 AM – Tow truck arrives on scene
- 9:27 AM – Vehicle is in tow, all lanes clear

By 10:00 AM, all of the backed-up congestion had cleared and traffic began to flow as usual.

During the incident, traffic lined up from the crash site southward on I-5, all the way past downtown Portland to SW Macadam Blvd. ODOT has four vehicle sensors active in this study corridor, as shown in Figure 1. They are located at NE Going St., the Broadway Bridge, the Morrison Bridge, and SW Macadam Blvd.
The first major handoff of responsibility was between the witnesses who called 911 and ODOT. ODOT’s incident response team was immediately dispatched to the scene to assess the situation. Once ODOT’s team arrived, roughly 20 minutes later, it was able to determine that a tow truck was needed, at which point it called the City’s tow desk. The tow truck arrived thirty minutes after the request was issued, and promptly cleared the incident.

Major opportunities for faster clearance include requesting a tow before ODOT’s response team is dispatched, or enabling ODOT’s trucks to push the disabled vehicles off the highway and out of the travel lane. However, legislative and procedural obstacles prevent these improvements from being made.

DATA ANALYSIS

This study is based primarily on ODOT’s sensor data, which are collected continuously and archived at 20-second resolution by the Portland State University Intelligent Transportation Systems Lab. The PORTAL (Portland Oregon Regional Transportation Archive Listing) system uses the data to produce a variety of indicators of traffic congestion, including travel time, volume, speed, delay. These and other indicators can be manipulated into a variety of data products via a web interface. For this study, the traffic data were aggregated to the 5-minute level to identify major turning points in traffic patterns quickly.
PORTAL’s delay values for the study area and time are displayed in Figure 2. This timeseries graph shows the milepost location along I-5 Northbound on the vertical axis and time on the horizontal axis. The level of delay at each location and time is indicated by the color of each cell. The study incident, outlined in black, is comprised of a wave of congestion traveling upstream. Other congestion activity is visible farther upstream, but is not likely related to this incident.

PORTAL’s delay indicator is measured relative to theoretical free-flow travel time. Because the incident took place during the typically congested morning peak hour, calculating delay relative to free-flow does not yield meaningful results for the purposes of an impact analysis. To estimate delay due to this crash, travel times during the incident were compared to the average values at the same time period for several Mondays before and after the incident, excluding one for which the values were significantly different from the others.

Once the delay in travel-time is calculated for each segment in each five-minute period, the next step is to determine the number of vehicle-hours of delay caused by this incident. This is a simple matter of multiplying the delay by the volume of traffic observed during each period. Figure 3 shows vehicle-hours of delay experienced during the incident across the study segment.
Figure 3: Vehicle-Hours of Delay Caused by Incident

Deviation from the average volume can also provide a measure of the incident’s impact. Figure 4 shows the difference between the cumulative volume along the entire study corridor on July 12 and on an average Monday morning. The trend line curves away from the average until the incident is cleared, but never quite recovers. This is because about 25,000 vehicles were discouraged by the mounting congestion and took other routes or avoided travel altogether.
That estimate of diverted traffic is probably the most accurate measure of this incident’s impact that can be conveniently calculated. However, that measure is not the primary goal of this effort. To create an estimate of the incident’s economic impact, the vehicle-hours of delay must be converted to dollars and cents. Because this study is a response to the Cost of Congestion report, it uses the same values for travel time. These values are displayed in Table 1, though the idling costs were modified to reflect the gasoline prices at the time of the incident.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Engine idling cost/hr</th>
<th>Person cost/hr</th>
<th>Delivery cost/hr</th>
<th>Total cost/hr of delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass. Car / Lt Truck</td>
<td>$2.02</td>
<td>$21.57</td>
<td>$0.00</td>
<td>$23.59</td>
</tr>
<tr>
<td>Freight Truck</td>
<td>$8.80</td>
<td>$35.00</td>
<td>$20.00</td>
<td>$63.80</td>
</tr>
</tbody>
</table>

**TABLE 1: Cost Estimates**

Applying these rates to the vehicle-hours of delay previously calculated, using ODOT’s reported passenger car vs freight truck split rates (88% car, 12% truck) and passenger vehicle occupancy (1.47 passengers per vehicle), yields the results listed in Table 2. The difference in economic cost between the incident on June 12 and an average Monday works out to about $150,000.
### TABLE 2: Estimated Cost of Delay

The next step in the process is to estimate the cost savings that could have been achieved through shorter response times. The total clearance time for the June 12 incident was 75 minutes. A 10 or 20-minute reduction in response time should result in significant cost savings. To simulate those scenarios, the detector data collected during the incident was manipulated to move up the clearance time. For each detector station, the point where the congestion began to clear was identified. In the case of the 10-minute reduction, the 10 minutes of data before the turning point was cut out to represent faster response. The 10 minutes following the turning point was also eliminated to soften the recovery as well. The same was done for the 20-minute reduction, with 20 minutes cut from before and after. The resulting approximate delay and costs are listed in Table 3. Based on these relatively conservative estimates, a 10-minute reduction in response time could have saved drivers $20,000 and a 20-minute reduction could have saved $50,000.

<table>
<thead>
<tr>
<th>Normal Monday</th>
<th>Travel time (veh-hrs)</th>
<th>Economic Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 12</td>
<td>6,500</td>
<td>$180,000</td>
</tr>
<tr>
<td>Difference</td>
<td>11,700</td>
<td>$330,000</td>
</tr>
</tbody>
</table>

### TABLE 3: Estimated Cost Reduction With Improved Response

<table>
<thead>
<tr>
<th>Clearance time (min)</th>
<th>Delay (veh-hrs)</th>
<th>Economic cost</th>
<th>Cost Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 (actual)</td>
<td>5,200</td>
<td>$150,000</td>
<td>n/a</td>
</tr>
<tr>
<td>65</td>
<td>4,400</td>
<td>$130,000</td>
<td>$20,000</td>
</tr>
<tr>
<td>55</td>
<td>3,600</td>
<td>$100,000</td>
<td>$50,000</td>
</tr>
</tbody>
</table>

### POLICY USES

These cost and savings estimates have been used to help encourage the formation of the Portland Operators Steering Team (POST), which brings together leaders from the state, county and local transportation agencies, police, fire, emergency response and private industry. The group has met regularly and has identified several areas where incident response could be improved dramatically. Its strongest recommendation has been to change the Oregon statutes restricting responders’ ability to quickly clear disabled vehicles from freeway lanes. The Oregon Legislature is expected to pass a measure to greatly reduce those restrictions during the current session. The findings of this study are cited extensively in the City of Portland Legislative Package, and have
made political consensus building much easier than they might have been otherwise (4).

CONCLUSIONS

Policymakers are eager to find inexpensive measures to reduce traffic congestion. However, keeping the issue prominent in their agendas is challenging. This exercise in estimating the economic impacts of incident congestion has enabled the transportation community in Portland to more compellingly express the potential benefits of improved incident response. The Autopsy of a Crash methodology could also be adapted to other incidents, cities and circumstances.

As traffic data collection improves, new kinds of analysis will become possible. It is important that researchers continue to explore these data and share their findings with policy leaders. While the most direct result of this study has been the movement to change state legislation governing towing, there remains great potential to reduce incident clearance time from other angles as well. The Portland Operators Steering Team is exploring many of these ideas, and its work merits further research support and public attention.

REFERENCES


