Preliminary Investigation (PI-0195)

Caltrans Division of Research, Innovation and System Information

# Traffic Incident Management (TIM) Data Collection

*Requested by*
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# Executive Summary

## Background

The California Department of Transportation (Caltrans) is investigating the tools and data needed to report on the three national traffic incident management (TIM) performance measures recommended by the Federal Highway Administration (FHWA) under the fourth round of Every Day Counts (EDC-4) initiative:

- Roadway clearance time.
- Incident clearance time.
- Number of secondary crashes.

Currently Caltrans accesses this data from multiple systems, including the Major Incident Database and the California Highway Patrol (CHP) computer-aided dispatch (CAD). A central, standardized system would allow Caltrans to gather all TIM data and report on performance statewide. As part of its efforts to establish a standardized system, Caltrans is interested in evaluating the data systems and data collection practices used by other state departments of transportation (DOTs).

To assist Caltrans in this evaluation, CTC & Associates conducted an online survey of state DOTs that examined these agencies' available data systems and data collection practices associated with the EDC-4 performance measures. Consultations with a representative from the University of Maryland Center for Advanced Transportation Technology (CATT) Laboratory were also conducted to learn about the sources of the data residing in the CATT Lab's Regional Integrated Transportation Information System (RITIS) and other details about this platform's capabilities and potential applications. A literature search identified recent research and other resources about TIM data systems and practices.

## Summary of Findings

### Survey of Practice

An online survey was distributed to members of the American Association of State Highway and Transportation Officials (AASHTO) Committee on Transportation System Operations who had experience with TIM data systems and practices. Representatives from 21 state DOTs and one state highway patrol responded to the survey. Sixteen state agencies have a system, process or database that collects TIM data to report on one or more of the three national performance measures.

Roadway Clearance Time

Fourteen state agencies responding to the survey gather data to measure roadway clearance time. Six of these states (Georgia, Maine, Nebraska, North Carolina, Oregon and Wisconsin) gather data for the duration of the incident, typically beginning with the notification of the incident until the roadway is clear and open to traffic. Other states gather data based on the type of incident (Georgia, Kansas and Minnesota); lane closure time (Maryland); or type of roadway (Kansas). Georgia DOT also relies on incident reports from two freeway service patrol (FSP) programs in metropolitan Atlanta: Towing and Recovery Incentive Program (TRIP) and

Highway Emergency Response Operations (HERO). Nevada DOT intends to collect roadway clearance time on all crashes statewide that are reported to law enforcement. In urban areas, the agency strives to collect roadway clearance times for all incidents on state routes within the reach of the traffic management center (TMC). Table ES1 summarizes survey results.

**Table ES1. Roadway Clearance Data Gathered**

| State | Incident Notification to Road Open | Lane Closure Time | Type of Incident/ Event | Type of Roadway | All Lanes Cleared | Other |
|---|---|---|---|---|---|---|
| **Arizona** | | | | | X | |
| **Georgia** | X | | X | | | X |
| **Kansas** | | | X | X | | |
| **Maine** | X | | | | | |
| **Maryland** | | X | | | | |
| **Minnesota** | | | X | | | |
| **Nebraska** | X | | | | | |
| **Nevada** | | | | | | X |
| **North Carolina** | X | | | | | |
| **Oregon** | X | | | | | |
| **Utah** | | | | | | X |
| **Wisconsin** | X | | | | | |
| **TOTAL** | **6** | **1** | **3** | **1** | **1** | **3** |

TMCs and traffic operations centers (TOCs) play a role in providing TIM data to all the states collecting data. Law enforcement is a key source of TIM data in Maryland, Nebraska, Nevada, North Carolina, Oregon, Utah and Wisconsin. Table ES2 summarizes survey results.

**Table ES2. Roadway Clearance Time Data Sources**

| Data Source | State |
|---|---|
| **TMC/TOC** | Arizona, Georgia, Kansas, Maine, Maryland, Michigan, Minnesota, Nebraska, Nevada, North Carolina, Oregon, Utah, Wisconsin |
| **Law Enforcement** | Maryland, Nebraska, Nevada, North Carolina, Oregon, Utah, Wisconsin |
| **Service Patrol** | Maryland, Michigan, Minnesota, Nevada, North Carolina, Oregon |
| **911 Dispatch Centers** | Michigan, Nebraska, Oregon |
| **CCTV** | Michigan, Minnesota, Wisconsin |
| **First Responders** | Maryland, Michigan, Utah |
| **CAD** | Michigan[1], Wisconsin |
| **Crowdsourcing** | Maryland, Nevada |

| Data Source | State |
|---|---|
| **DOT/Highway Field Staff** | Wisconsin |
| **Maintenance Facilities** | Maryland |
| **Other** | Arizona, Minnesota, Nevada, Utah, Wisconsin |

1 SEMTOC has access to Michigan State Police CAD system for incident notification but not CAD integration.

When receiving data from these sources, five states (Georgia, Kansas, Maine, Maryland and Michigan) primarily rely on an advanced transportation management system (ATMS). Other frequently used formats are CAD (Minnesota, Oregon and Utah) and reports (Kansas, Nebraska and Nevada). Table ES3 summarizes survey results.

**Table ES3. Roadway Clearance Time Data Formats**

| Data Format | State |
|---|---|
| **ATMS** | Georgia, Kansas, Maine, Maryland, Michigan, |
| **CAD** | Minnesota, Oregon, Utah |
| **Reports** | Kansas, Nebraska, Nevada |
| **Audio/Voice Communications** | Oregon, Utah |
| **Radio** | Minnesota, Nebraska |
| **Excel Spreadsheet** | Michigan |
| **Software** | Utah |
| **Other** | Michigan, Nevada, North Carolina, Wisconsin |

These states reported on several challenges with roadway clearance time data collection, including delays in receiving notification of an event (Michigan, Nebraska and Oregon); data collection in rural areas (Maryland and Michigan); data verification (Maine, North Carolina and Utah); and human error (Georgia and Nevada).

Incident Clearance Time

Eleven states gather data to measure incident clearance time. In five states (Arizona, Georgia, Maine, Maryland and Oregon) data collection typically begins with incident notification and ends with roadway clearance. In Michigan, incident clearance time data collection is limited to freeway and major arterials in 13 western counties. In Minnesota, data is collected during specific travel times for all incidents along the Minneapolis/St. Paul metropolitan freeway system that are observed on camera or reported by FSP or the State Patrol through 911 dispatch calls. Utah DOT relies on the observations of its TOC control room operators. Table ES4 summarizes survey results.

**Table ES4. Incident Clearance Data Gathered**

| State | Incident Notification to Road Open | Type of Incident/ Event | Other |
|---|---|---|---|
| **Arizona** | X | | |
| **Georgia** | X | | |
| **Kansas** | | X | |
| **Maine** | X | | |
| **Maryland** | X | | |
| **Michigan** | | | X |
| **Minnesota** | | | X |
| **Nevada** | | | X |
| **Oregon** | X | | |
| **Utah** | | | X |
| **TOTAL** | **5** | **1** | **4** |

TMCs and TOCs are a significant source of TIM data in all states collecting data. Other data sources include law enforcement (Maryland, Minnesota, Nebraska, Nevada, Oregon and Utah) and FSPs (Maryland, Michigan, Minnesota, Nevada and Oregon). Table ES5 summarizes survey results.

**Table ES5. Incident Clearance Time Data Sources**

| Data Source | State |
|---|---|
| **TMC/TOC** | Arizona, Kansas[1], Maine, Maryland, Michigan, Minnesota, Nebraska, Nevada, Oregon, Utah |
| **Law Enforcement** | Maryland, Minnesota, Nebraska, Nevada, Oregon, Utah |
| **Service Patrol** | Maryland, Michigan, Minnesota, Nevada, Oregon |
| **CCTV** | Maryland, Michigan[2], Minnesota |
| **First Responders** | Maryland, Michigan[2], Utah |
| **ATMS** | Georgia, Michigan |
| **CAD** | Michigan[3], Minnesota |
| **Crowdsourcing** | Maryland, Nevada |
| **911 Dispatch Centers** | Nebraska |
| **DOT/Highway Field Staff** | Minnesota |
| **Maintenance Facilities** | Maryland |
| **Other** | Arizona, Georgia, Oregon, Utah |

1 TMCs in Wichita and Kansas City only.

2 WMTOC obtains data from CCTV, dispatch centers and first responders.

3 SEMTOC has access to Michigan State Police CAD system for incident notification but not CAD integration.

ATMS is the data format most frequently used in three states (Kansas, Maryland and Michigan); other formats include CAD (Minnesota, Oregon and Utah), audio or voice communications (Oregon and Utah) and reports and Excel spreadsheets (Georgia, Kansas, Michigan and Nevada). Table ES6 summarizes survey results.

**Table ES6. Incident Clearance Time Data Formats**

| Data Format | State |
|---|---|
| **ATMS** | Kansas, Maryland, Michigan |
| **CAD** | Minnesota, Oregon, Utah |
| **Audio/Voice Communications** | Oregon, Utah |
| **Excel Spreadsheet** | Georgia, Michigan |
| **Reports** | Kansas, Nevada |
| **Crowdsourcing** | Nevada |
| **Radio** | Minnesota |
| **Software** | Utah |
| **Other** | Nevada |

The challenges in collecting incident clearance time data were similar to those for collecting roadway clearance data: delays in receiving notification of an incident (Michigan and Oregon); data collection in rural areas (Maryland and Michigan); data verification (Utah); and human error (Georgia and Nevada).

Number of Secondary Crashes

The number of secondary crashes is monitored in 10 states collecting data. Four states (Idaho, Maine, Maryland and Wyoming) investigate associated events—those events that were caused by the first incident. All events in Maryland that are determined to be related to the main incident, including secondary crashes, are recorded. Law enforcement agencies in Maryland and Nevada indicate that a collision is a secondary crash by selecting a check box in a crash report. Table ES7 summarizes survey results.

**Table ES7. Secondary Crash Data Gathered**

| State | Associated Incidents | Crash Type | Totals Only | Reporting Practice | Other |
|---|---|---|---|---|---|
| **Arizona** | | | | | X |
| **Idaho** | X | | | | |
| **Kansas** | | | X | | |
| **Maine** | X | | | | |
| **Maryland** | X | | | | |
| **Michigan** | | | | | X |
| **Minnesota** | | | | | X |
| **Nevada** | | | | X | |

| State | Associated Incidents | Crash Type | Totals Only | Reporting Practice | Other |
|---|---|---|---|---|---|
| **North Carolina** | | X | | X | |
| **Wyoming** | X | | | | |
| **TOTAL** | **4** | **1** | **1** | **2** | **3** |

Law enforcement accident records and police reports are the primary sources of the number of secondary crashes in six states (Arizona, Idaho, Maine, Maryland, Nevada and Wyoming). Other common sources include TMCs and TOCs (Kansas, Maryland and Michigan); closed-circuit television (CCTV) (Michigan and Minnesota); first responders (Michigan); and CAD (Minnesota). Table ES8 summarizes survey results.

**Table ES8. Secondary Crash Data Sources**

| Data Source | State |
|---|---|
| **Law Enforcement** | Arizona, Idaho, Maine, Maryland, Nevada, Wyoming |
| **TMC/TOC** | Kansas[1], Maryland, Michigan |
| **CCTV** | Michigan, Minnesota |
| **CAD** | Minnesota |
| **First Responders** | Michigan |
| **Other** | Maryland, Minnesota, North Carolina |

1 TMCs in Wichita and Kansas City only.

The data format most frequently used in five states (Idaho, Kansas, Maryland, Michigan and Wyoming) is electronic reports, often in conjunction with an ATMS. Table ES9 summarizes survey results.

**Table ES9. Secondary Crash Data Formats**

| Data Format | State |
|---|---|
| **Reports** | Idaho, Kansas, Maryland, Michigan, Wyoming |
| **Databases** | Idaho, Maine, Maryland, Michigan |
| **ATMS** | Kansas, Maryland, Michigan |
| **Other** | Minnesota, Nevada |

The primary challenge in collecting the number of secondary crashes was determining whether the incident was a secondary crash (Idaho, Maryland, Michigan and North Carolina). Other challenges include accurate reporting on police reports and forms (Maryland, Michigan, Nevada and Wyoming); delays in receiving notification of an incident (Michigan); and lack of information about the original crash (Wyoming).

## Consultation With the Center for Advanced Transportation Technology Laboratory

We spoke with Michael Pack, director of the CATT Lab at the University of Maryland, to learn about the California data residing in RITIS and to learn about the platform's capabilities and potential applications. Researchers at the CATT Lab gather a range of data, including the incident data from the CHP CAD system; crowdsourced event data; speed and sensor data from Caltrans, INRIX (a private company providing location-based data and analytics) and FHWA's National Performance Management Research Data Set; National Weather Service (NWS) real-time radar and radar predictions; and first responders. The data is displayed in real time within RITIS and archived indefinitely. Data visualizations and analytics tools enable researchers to compute TIM performance measures.

Currently data is obtained electronically from multiple sources and data feeds established when the CATT Lab was under contract with FHWA to evaluate Integrated Corridor Management deployment in San Diego. These sources include CHP and 911 dispatch calls, DOT operations staff, field units and third parties such as INRIX and NWS. Some of the data sources are easily validated (for example, probe, speed sensor and weather data). However, incident and event data are much more difficult to validate. To determine the credibility of these types of data, researchers use several factors, including timeliness indicators, number and location of incidents, and data agreement from multiple sources.

## Related Research and Resources

An in-depth literature search of domestic and international resources was conducted to gather information about TIM data systems and practices. Below are highlights of publications and other resources that were identified in this literature search. Complete details and additional citations are available in the **Detailed Findings** section of this report.

National Resources

Several FHWA publications address TIM performance measures, including a 2019 report that summarizes current state activities related to TIM data use; a 2019 online tool that provides TIM reference materials to transportation and public safety professionals; and a 2016 report on the state of the practice in data access, sharing and integration (RITIS and other data environments are summarized in Chapter 3 of this report). A 2018 webinar features representatives from three agencies that actively collect, analyze and use TIM data.

Other citations address data collection and reporting practices, including guidance and agency case studies for implementing TIM performance measurement, and presentations about using data to improve TIM data collection.

State Practices

A Kentucky DOT research study in progress is updating methodologies for TIM performance measures and developing a dashboard to track the performance and evaluate the effectiveness of TIM improvements (expected project completion date: June 2020). A 2019 Utah DOT report analyzes performance measures, and a 2019 Virginia DOT web page provides incident duration data by district and date range, as well as a summary of the information based on percentages or numbers of incidents.

A 2018 Arizona DOT study identifies the benefits of effective TIM practices on secondary crashes in terms of improved safety for motorists and first responders, and a 2018 presentation describes the agency's two traffic data collection and reporting systems: Traffic and Criminal Software (TraCS) and Arizona Crash Information System (ACIS). A 2018 Iowa DOT report establishes specific objectives for TIM management in the state, and a 2018 Texas DOT presentation looks at how TIM data can be used to report on incident management activities.

International Resources

Recent international research includes a 2018 journal article that provides an overview of traffic incident duration analysis and prediction. A framework to coordinate incident management approaches in Australasia is discussed in a 2017 journal article, and 2011 and 2012 publications address TIM best practices in Europe.

## Gaps in Findings

Survey respondents from transportation agencies that collect TIM data provided less feedback about secondary crash incidents in their states. Further attempts to engage with these agencies could provide useful details about data collection for this performance measure. Additionally, contacting agencies that did not respond to the survey could produce further guidance and perspectives about TIM data systems and practices.

## Next Steps

Moving forward, Caltrans could consider:

- Contacting the respondents from Georgia and Maine DOTs, which both use ATMS, to discuss their agencies' roadway clearance time and incident clearance time data format and collection practices.
- Contacting the respondents from Maryland DOT State Highway Administration (SHA) and Michigan DOT since they use similar data sources and ATMS for roadway clearance time and incident clearance time.
- Investigating Maryland DOT SHA's secondary crash data capture practices, and also discussing the type of training the agency provides to assist responders and operators in identifying an incident as a secondary crash.
- Contacting Utah DOT about its use of Blyncsy to collect data in and around Salt Lake (for example, from universities, ski resorts and signal devices). The data can be shared with anyone who has a Blyncsy account. Caltrans District 11 will be working with the city of Oceanside, which recently opened an account with Blyncsy; data could possibly be extracted from this account.
- Reviewing documentation provided by survey respondents, specifically TIM analytics from Louisiana Department of Transportation and Development and Georgia, Michigan and Nevada DOTs.
- Reviewing incident reports at WICHway.org and kcscout.net.
- Monitoring the Kentucky DOT research study in progress that is updating methodologies for TIM performance measures and developing a dashboard to track TIM performance.
- Evaluating Waycare, a technology used by several agencies to analyze TIM data.
- Engaging with state agencies not responding to the survey to potentially identify other experience with TIM data collection.

# Detailed Findings

## Background

As part of its commitment to the fourth round of the Federal Highway Administration (FHWA) Every Day Counts (EDC-4) initiative, the California Department of Transportation (Caltrans) is investigating the tools and data needed to adopt the three national traffic incident management (TIM) performance measures recommended under EDC-4:

- Roadway clearance time.
- Incident clearance time.
- Number of secondary crashes.

Although Caltrans has access to multiple data systems that provide partial data, including the Major Incident Database and the California Highway Patrol (CHP) computer-aided dispatch (CAD), the agency does not have a central location that provides all the data needed for these specific performance measures. To establish a standardized system for gathering TIM data and reporting on performance, Caltrans is interested in evaluating the data systems and data collection practices used by other state departments of transportation (DOTs).

To assist Caltrans in this evaluation, CTC & Associates summarized the results of an online survey of state DOTs that examined these agencies' available data systems and data collection practices. In addition, we consulted with a representative from the University of Maryland Center for Advanced Transportation Technology (CATT) Laboratory to learn about the sources of the data residing in the Regional Integrated Transportation Information System (RITIS), and other details about the platform's capabilities and potential applications. A literature search was also conducted to identify publicly available sources of TIM data systems and practices. Findings from these efforts are presented in this Preliminary Investigation in three areas:

- Survey of state practice.
- Consultation with the CATT Laboratory.
- Related research and resources.

# Survey of State Practice

An online survey was distributed to members of the American Association of State Highway and Transportation Officials (AASHTO) Committee on Transportation System Operations who had experience with TIM data systems and practices. The survey questions are provided in Appendix A. The full text of survey responses is presented in a supplement to this report.

## Summary of Survey Results

Twenty-three respondents from 21 state DOTs and one state highway patrol responded to the survey:

- Alaska.
- Arizona.
- Arkansas.
- Georgia.
- Idaho.
- Kansas.
- Louisiana.
- Maine.
- Maryland.
- Massachusetts (two responses).
- Michigan.
- Minnesota.
- Nebraska.
- Nevada.
- North Carolina.
- North Dakota.
- Oregon.
- South Carolina.
- South Dakota.
- Utah.
- Wisconsin.
- Wyoming.

Of these agencies, respondents from 16 states—Arizona, Georgia, Idaho, Kansas, Maine, Maryland, Massachusetts–Highway Operations Center, Michigan, Minnesota, Nebraska, Nevada, North Carolina, Oregon, Utah, Wisconsin and Wyoming—reported that their agencies use a system, process or database to collect TIM data to report on one or more of the three national performance measures that are recommended under FHWA's EDC-4 initiative.

Respondents from seven states—Alaska, Arkansas, Louisiana, Massachusetts–Emergency Preparedness, North Dakota, South Carolina and South Dakota—reported that their agencies do not use a system, process or database to collect and report TIM data for these performance measures. Additional information provided by these respondents is summarized below:

- Louisiana Department of Transportation and Development (DOTD) and South Dakota DOT plan to report on these performance measures.
    - Louisiana DOTD stores TIM data in the Intelligent NETworks (iNET) advanced transportation management system (ATMS) provided by Parsons Corporation (the iNET system was originally developed by Delcan Technologies, which Parsons acquired in 2014). The system can provide records or information related to TIM performance measures; however, the agency is currently not participating in this national initiative. See **Related Resources**, page 30, for more information about iNET.
    - South Dakota is developing methods to collect data from a CAD system and crash reports.

- Alaska Department of Transportation and Public Facilities, Massachusetts–Emergency Preparedness, and Arkansas and South Carolina DOTs have an interest in reporting on these performance measures but lack the resources to do so.
- North Dakota DOT has no interest in reporting on these performance measures. The respondent added that the agency currently doesn't gather data to measure the number of secondary crashes but is adding this information to its crash reporting.

Below are survey results from the 16 agencies that use a system, process or database to collect TIM data to report on the following performance measures:

- Roadway clearance time.
- Incident clearance time.
- Number of secondary crashes.

Results for each of these performance measures are further categorized according to:

- Type of data gathered.
- Data sources.
- Data formats.
- Data collection challenges.

Following these survey results is supplemental information about TIM data systems and practices in Nevada and Utah along with resources provided by these and other survey respondents. Contact information for additional agency staff who can provide more information about an agency's TIM data system and practices is available on page 51.

## Roadway Clearance Time

Of the 16 agencies collecting TIM data related to the three performance measures, all but two—Idaho and Wyoming—gather data to measure roadway clearance time. Below is information about the type of roadway clearance time data gathered, the sources used to gather this data, the data format provided by these sources and the challenges that agencies experience in gathering the data.

### Type of Data Gathered

Six states—Georgia, Maine, Nebraska, North Carolina, Oregon and Wisconsin—gather data for the duration of the incident, typically beginning with the notification of the incident until the roadway is clear and open to traffic. Other data gathered includes the type of incident (Georgia, Kansas and Minnesota), lane closure time (Maryland) and type of roadway (Kansas).

Additional agency practices are described below:

- Among the data gathered by Georgia DOT are times to clear Towing and Recovery Incentive Program (TRIP) incidents and information from the Highway Emergency Response Operations (HERO) log report. TRIP was implemented in metropolitan Atlanta to "facilitate improved management of large-scale commercial vehicle incidents." HERO is a freeway service patrol (FSP) that provides roadside assistance in metropolitan Atlanta. See **Related Resources**, page 29, for more information about these programs.

- In Maryland, lane closures are tracked within the agency's ATMS. Its reporting tool, developed by the University of Maryland CATT Laboratory, calculates the total time a lane was closed (the duration of the incident).
- Michigan DOT operates four Transportation Operations Centers (TOCs): the Southeast Michigan Transportation Operations Center (SEMTOC), Statewide Transportation Operations Center (STOC), West Michigan Transportation Operations Center (WMTOC) and Blue Water Bridge Transportation Operations Center (BWBTOC). SEMTOC only collects data for freeways in three counties in southeast Michigan. The remaining TOCs collect data for freeway and major arterials statewide.
- Minnesota DOT gathers data on all blocking incidents on the Minneapolis/St. Paul metropolitan area freeway system that are observed on camera or reported by the FSP or State Patrol (Monday through Friday, from 4:30 a.m. to 10 p.m., and Saturday and Sunday, 10 a.m. to 8 p.m.).
- Nevada DOT intends to collect roadway clearance time on all crashes statewide that are reported to law enforcement. In urban areas, the agency strives to collect roadway clearance times for all incidents on state routes within the reach of the Traffic Management Center (TMC).

Survey results are summarized in Table 1 below.

**Table 1. Roadway Clearance Data Gathered**

| Type of Data or Practice | State | Description |
|---|---|---|
| **Incident Notification to Road Open** | Georgia, Maine, Nebraska, North Carolina, Oregon, Wisconsin | *Georgia:* Time to clear TRIP incidents.<br>*Maine*: Time of notice of crash. Time lanes are cleared. Time roadway is clear.<br>*Nebraska, North Carolina*: Time incident is called into dispatch to the time roadway is open.<br>*Oregon, Wisconsin*: Event start, all lanes clear, all responders clear. |
| **Lane Closure Time** | Maryland | *Maryland:* Number of days/hours/minutes a lane is closed. |
| **Type of Incident/Event** | Georgia, Kansas, Minnesota | *Georgia*: Emergency/nonemergency events.<br>*Kansas*: Average clearance time by type of incident.<br>*Minnesota*: All blocking incidents on freeway system. |
| **Type of Roadway** | Kansas | *Kansas*: Average clearance time by roadway and type of incident. |
| **All Lanes Cleared** | Arizona | N/A. |
| **Other** | Georgia, Nevada, Utah | *Georgia*: HERO log reports.<br>*Nevada*:<br>• Statewide: All crashes.<br>• Urban areas: All incidents on state routes within the TMC area.<br>*Utah*: Observations of the TOC control room operators. |

Data Sources

Survey respondents reported on a range of data sources and practices to gather roadway clearance time data. Of the 13 states providing information, all indicated a TMC or TOC, and seven states (Maryland, Nebraska, Nevada, North Carolina, Oregon, Utah and Wisconsin) indicated law enforcement. Key findings of survey responses are highlighted below; all results are summarized in Tables 2 and 3 following these highlights:

- In Arizona, data is sourced from accident records and TOC logs.
- Kansas gathers data from TMCs in Wichita and Kansas City only.
- In Maryland, TMCs enter data observed on CCTV or reported by law enforcement and fire department partners, FSPs, agency maintenance facilities and citizens (information is later verified by response units).
- Michigan TOCs obtain data from CCTV, dispatch centers, FSP and first responders using ATMS software and the operator database. SEMTOC also has access to the Michigan State Police CAD system for notification of incidents and information regarding incidents that may be used to determine lane closures, roadway clearance time and incident clearance time, but it does not have CAD integration.
- Minnesota DOT's TMC is integrated with the State Patrol's CAD system. Incident start time is the event creation time (determined either by the DOT or State Patrol). Lane clearance time is either observed on camera or reported by FSP or State Patrol on radio.
- In Nevada, roadway clearance times are reported by law enforcement agencies statewide on a standard crash form. It takes several months for the data to get back to the agency. The TMC also evaluates road clearance using crowdsourced data through Waycare software. (Waycare uses predictive analytics to optimize transportation systems. See **Related Resources**, page 32, for more information.) FSP reports on the clearance times of its incidents but that data is already captured in other reports that Nevada DOT uses to provide data to FHWA. Currently, Nevada DOT does not compare FSP data with other clearance data.
- Utah DOT sources data from its TOC, law enforcement, incident management teams and third parties.
- Wisconsin DOT's TMC retrieves data from law enforcement, DOT and highway field personnel and media, cameras, the CAD system in Milwaukee, and dispatch centers in Waukesha and Dane counties.

**Table 2. Data Sources: Roadway Clearance Time**

| State | TMC/ TOC | Law Enforce ment | Service Patrol | First Responders | DOT/ Highway Field Staff |
|---|---|---|---|---|---|
| **Arizona** | X | | | | |
| **Georgia** | X | | | | |
| **Kansas** | X | | | | |
| **Maine** | X | | | | |
| **Maryland** | X | X | X | X | |
| **Michigan** | X | | X | X | |

| State | TMC/ TOC | Law Enforce ment | Service Patrol | First Responders | DOT/ Highway Field Staff |
|---|---|---|---|---|---|
| **Minnesota** | X | | X | | |
| **Nebraska** | X | X | | | |
| **Nevada** | X | X | X | | |
| **North Carolina** | X | X | X | | |
| **Oregon** | X | X | X | | |
| **Utah** | X | X | | X | |
| **Wisconsin** | X | X | | | X |
| **TOTAL** | **13** | **7** | **6** | **3** | **1** |

**Table 3. Data Sources: Roadway Clearance Time**

| State | Maintenance Facilities | Crowd sourcing | CCTV | 911 Dispatch Centers | CAD | Other |
|---|---|---|---|---|---|---|
| **Arizona** | | | | | | X |
| **Maryland** | X | X | | | | |
| **Michigan** | | | X | X | X[1] | |
| **Minnesota** | | | X | | | X |
| **Nebraska** | | | | X | | |
| **Nevada** | | X | | | | X |
| **Oregon** | | | | X | | |
| **Utah** | | | | | | X |
| **Wisconsin** | | | X | | X | X |
| **TOTAL** | **1** | **2** | **3** | **3** | **2** | **5** |

1 SEMTOC has access to Michigan State Police CAD system for incident notification but not CAD integration.

Data Formats

Twelve agency respondents reported on the format used when receiving data from its sources. Five agencies—Georgia, Kansas, Maine, Maryland and Michigan—primarily rely on ATMS. Other frequently used formats are CAD (Minnesota, Oregon and Utah) and reports (Kansas, Nebraska and Nevada). Highlights of survey results are provided below; all results are summarized in Table 4 following these highlights:

- Maryland captures data electronically within its ATMS and keeps the data perpetually within a Structured Query Language (SQL) database that is replicated and shared with the University of Maryland CATT Lab.
- Michigan DOT TOCs export data from ATMS and the operator database into Excel files that the agency's TIM unit combines with the statewide TIM database and uses for analysis.

- Minnesota captures data from its Intergraph CAD (a commercial product provided by Hexagon Safety and Infrastructure) and a statewide radio system.
- In Nevada, law enforcement data is processed by a third party, summarized by the month and provided to the department with some metadata. Waycare data is analyzed by the software provider, which can produce custom summary reports. The agency currently requests monthly and quarterly reports.
- North Carolina DOT's data formatting process is not fully automated.
- The data format received by Oregon DOT depends on the source (CAD-to-CAD or audio).
- In Wisconsin, the data format that is used for roadway clearance time looks at the percent of time incident types are cleared within a specific time frame (less than two hours for intermediate incidents and less than four hours for major incidents). The agency defines an intermediate incident as an incident that partially blocks highway lanes and/or a service ramp; a major incident is an incident blocking all lanes in one or both directions and/or a system ramp.

**Table 4. Data Formats: Roadway Clearance Time**

| State | ATMS | Reports | Excel Spreadsheet | CAD | Radio | Audio/ Voice | Software | Other |
|---|---|---|---|---|---|---|---|---|
| **Georgia** | X | | | | | | | |
| **Kansas** | X | X | | | | | | |
| **Maine** | X | | | | | | | |
| **Maryland** | X | | | | | | | |
| **Michigan** | X | | X | | | | | X |
| **Minnesota** | | | | X | X | | | |
| **Nebraska** | | X | | | X | | | |
| **Nevada** | | X | | | | | | X |
| **North Carolina** | | | | | | | | X |
| **Oregon** | | | | X | | X | | |
| **Utah** | | | | X | | X | X | |
| **Wisconsin** | | | | | | | | X |
| **TOTAL** | **5** | **3** | **1** | **3** | **2** | **2** | **1** | **4** |

<u>Data Collection Challenges</u>

Respondents reported on several challenges with collecting roadway clearance time data, including data collection on arterials and in rural areas, data verification, human error and delays in event notification. Survey responses are summarized below by topic.

**Data Collection on Arterials and in Rural Areas**

- *Maryland*: In metropolitan areas, the data for interstates and primary U.S. routes is very accurate and comprehensive because FSPs are active on these roadways and because of the agency's long-standing relationship with law enforcement. However, gathering data on arterials and in rural areas can be difficult. If the area does not have a Coordinated Highways Action Response Team (CHART) emergency patrol or CCTV coverage, TOCs can go unnotified unless or until agency assistance is required or requested.

- *Michigan*: The agency is not always notified immediately when an incident occurs or when an incident clears the roadway, especially in rural areas.

**Data Verification**

- *Maine*: The agency is recording the data but needs to manually verify the times.
- *North Carolina*: Some divisions want to visually verify an incident, especially events that are more severe and complex. The number of reported events compared to the number of crashes recorded is a small fraction.
- *Utah*: Verification of data accuracy and timeliness is challenging.

**Human Error**

- *Georgia*:
  - Operators sometimes forget to update the appropriate event status.
  - Sometimes communication is lost in the field, and incidents must be manually input on the HERO log. Once communication is restored, the log may not be uploaded into the system.
- *Nevada*:
  - Data reported by law enforcement is often incomplete, estimated or improperly defined.
  - The terms "roadway clearance" and "incident clearance" are regularly confused or left blank. The time recorded is clearly rounded to the nearest 15 minutes and not the actual time of clearance.

**Notification Delays/Lapses**

- *Michigan*:
  - The agency is not always notified immediately when an incident occurs or when an incident clears the roadway.
  - TOCs may be aware of an incident, but details are unknown, such as if lanes are blocked or how many lanes are affected.
  - TOCs may never be notified of the incident. Enhancements made to ATMS in 2019 allow all TOCs to collect roadway clearance time data. The agency's TIM unit is currently determining how to best leverage these enhancements to measure and report on the performance measure statewide.
- *Nebraska*: Responders are not always able to call in times or record times on crash reports "in the heat of the moment."
- *Oregon*: TOCs are often not notified about incidents occurring on the highway network.

**Other**

- *Minnesota*: The TMC has been gathering this data for about 30 years. Logging lane clearance times accurately, promptly and simultaneously with FSP clearing the event can be challenging.

- *Nevada*:
    - Waycare data is limited by cost, available communications and population density.
    - Outside of the population centers of the state, communication limitations and the limited sample size of the crowd lead to a breakdown in the algorithm learning of the system.
- *Wisconsin*: The challenges are the unknown factors that play into gathering data, such as the responders' performance, the specific location, time of day, weather condition, incident complexity and the number of simultaneous incidents. These factors all affect the amount of time required to clear the highway.

## Incident Clearance Time

Of the 16 agencies collecting TIM data related to the three performance measures, all but five—Idaho, Massachusetts–Highway Operations Center, Nebraska, Wisconsin and Wyoming—gather data to measure incident clearance time. While North Carolina DOT does collect incident clearance time data, the respondent did not provide information about agency practices. Below is information about the type of incident clearance time data gathered, the sources used to gather this data, the data format provided by these sources and the challenges agencies experience in gathering the data.

### Type of Data Gathered

Five states—Arizona, Georgia, Maine, Maryland, Oregon—reported on specific types of data collected, typically beginning with incident notification through roadway clearance. In Maryland, the incident duration is tracked within the agency's ATMS, where an opened and closed time is recorded for each event. The University of Maryland CATT Lab reporting tool then automatically calculates the event duration, in addition to the lane closure time.

Other respondents provided more general information about their agencies' data collection practices:

- Incident clearance time data collection is limited in Michigan. WMTOC only collects this data from freeway and major arterials in 13 counties in the western part of the state.
- Minnesota DOT gathers data for all incidents in the Minneapolis/St. Paul metropolitan freeway system that are observed on camera or reported by FSP or State Patrol (911 dispatch calls) at specific travel times (4:30 a.m. to 10 p.m. Monday through Friday, and 10 a.m. to 8 p.m. Saturday and Sunday).
- Statewide, Nevada DOT intends to collect incident clearance time on all crashes reported to law enforcement. In urban areas, the agency strives to collect data for all incidents on state routes within the reach of the TMC.
- Utah DOT relies on the observations of its TOC control room operators.

Survey results are summarized in Table 5 below.

**Table 5. Incident Clearance Data Gathered**

| Type of Data or Practice | State | Description |
|---|---|---|
| **Incident Notification to Road Open** | Arizona, Georgia, Maine, Maryland, Oregon | *Arizona:*<br>• Response times to incident.<br>• All lanes cleared.<br>*Georgia*:<br>• Dispatch notification.<br>• Event response.<br>• Lane clearance.<br>• Incident clearance times.<br>*Maine*:<br>• Event notification.<br>• Lane clearance.<br>• Roadway clearance.<br>*Maryland*. Event duration is tracked within the agency's ATMS.<br>*Oregon*. From event start to all responders clear. |
| **Type of Incident/Event** | Kansas | *Kansas.* Average incident clearance time by roadway. |
| **Other** | Michigan, Minnesota, Nevada, Utah | *Michigan*. Incident clearance time data collected from freeway and major arterials in 13 west Michigan counties only.<br>*Minnesota*. All freeway system incidents observed on camera or reported by service patrols (911 dispatch calls).<br>*Nevada*:<br>• Statewide: All crashes reported to law enforcement.<br>• Urban areas: All incidents on state routes within the reach of the TMC.<br>*Utah*. Observations of TOC control room operators. |

Data Sources

Survey respondents reported on a range of data sources and practices to gather incident clearance time data. Key findings of survey responses are highlighted below; all results are summarized in Tables 6 and 7 following these highlights:

- Arizona DOT collects data from accident records and TOC logs, while Georgia DOT retrieves data from HERO logs and from its ATMS.
- Maryland TMCs enter data observed on CCTV or reported by law enforcement and fire department partners, State Highway Administration (SHA) emergency response patrols, SHA maintenance facilities and citizens (information is later verified by response units).
- In Michigan, WMTOC gets data from CCTV, dispatch centers and first responders. Data has also been collected using ATMS software and an operator database. In 2019, the agency began managing the data using only ATMS software. SEMTOC also has access to Michigan State Police CAD for notification of incidents and information regarding

incidents that may be used to determine lane closures, roadway clearance time and incident clearance time; SEMTOC does not have CAD integration.

- The Minnesota TMC is integrated with the State Patrol's CAD system. Incident start time is the event creation time (reported either by Minnesota DOT or the State Patrol). Incident clearance time is either observed on camera or reported by FSP or the State Patrol on radio.
- In Nevada, incident clearance times are reported by law enforcement agencies statewide on a standard crash form. Data is sent to Nevada DOT several months later. The agency's TMC also evaluates incident clearance using crowdsourced data through Waycare. Service patrols report on incident clearance times but that data is already captured in other reports that are used to provide data to FHWA. Currently the agency does not compare FSP data with DOT clearance data.
- Utah DOT gathers data from its TOC, law enforcement, incident management teams and third parties.

**Table 6. Data Sources: Incident Clearance Time**

| State | TMC/ TOC | Law Enforce ment | Service Patrol | First Responders | DOT/ Highway Field Staff | Maintenance Facilities |
|---|---|---|---|---|---|---|
| Arizona | X | | | | | |
| Kansas | X[1] | | | | | |
| Maine | X | | | | | |
| Maryland | X | X | X | X | | X |
| Michigan[2] | X | | X | X | | |
| Minnesota | X | X | X | | X | |
| Nebraska | X | X | | | | |
| Nevada | X | X | X | | | |
| Oregon | X | X | X | | | |
| Utah | X | X | | X | | |
| TOTAL | 10 | 6 | 5 | 3 | 1 | 1 |

1 TMCs in Wichita and Kansas City only.

2 WMTOC obtains data from CCTV, dispatch centers and first responders.

**Table 7. Data Sources: Incident Clearance Time**

| State | Crowd sourcing | CCTV | 911 Dispatch Centers | ATMS | CAD | Other |
|---|---|---|---|---|---|---|
| Arizona | | | | | | X |
| Georgia | | | | X | | X |
| Maryland | X | X | | | | |
| Michigan[2] | | X | | X | X[3] | |

| State | Crowd sourcing | CCTV | 911 Dispatch Centers | ATMS | CAD | Other |
|---|---|---|---|---|---|---|
| Minnesota | | X | | | X | |
| Nebraska | | | X | | | |
| Nevada | X | | | | | |
| Oregon | | | | | | X |
| Utah | | | | | | X |
| TOTAL | 2 | 3 | 1 | 2 | 2 | 4 |

1 TMCs in Wichita and Kansas City only.

2 WMTOC obtains data from CCTV, dispatch centers and first responders.

3 SEMTOC has access to Michigan State Police CAD system for incident notification but not CAD integration.

Data Formats

Eight agency respondents reported on the format used when receiving data. Three agencies—Kansas, Maryland and Michigan—primarily rely on ATMS. Other frequently used formats are CAD (Minnesota, Oregon and Utah), Excel spreadsheets (Georgia and Michigan) and voice communications (Oregon and Utah). Highlights of survey results are provided below; all results are summarized in Table 8 following these highlights:

- Maryland captures data electronically within its ATMS and keeps the data perpetually within an SQL database that is replicated and shared with the University of Maryland CATT Lab.
- In Michigan, WMTOC had exported data from ATMS and operator databases into Excel files that are analyzed by the agency's TIM unit. Beginning in 2019, WMTOC data is exported using only ATMS software.
- In Nevada, law enforcement data is processed by a third party, summarized each month and provided to the department with some metadata. Waycare data is analyzed by the software provider, which then produces monthly and quarterly custom summary reports.

**Table 8. Data Formats: Incident Clearance Time**

| State | ATMS | Reports | Excel Spreadsheet | CAD | Radio | Audio/ Voice | Crowd sourcing | Software | Other |
|---|---|---|---|---|---|---|---|---|---|
| Georgia | | | X | | | | | | |
| Kansas | X | X | | | | | | | |
| Maryland | X | | | | | | | | |
| Michigan | X | | X | | | | | | |
| Minnesota[1] | | | | X | X | | | | |
| Nevada | | X | | | | | X | | X |
| Oregon | | | | X | | X | | | |
| Utah | | | | X | | X | | X | |
| TOTAL | 3 | 2 | 2 | 3 | 1 | 2 | 1 | 1 | 1 |

1 CAD vendor: Intergraph. Radio: statewide radio system.

Data Collection Challenges

The challenges in collecting incident clearance time data were similar to those for collecting roadway clearance data. Delays in data collection on arterials and in rural areas, data verification, human error and incident notification delays were all cited by respondents. Survey results are summarized below by topic.

**Data Collection on Arterials and in Rural Areas**

- *Maryland*: In metropolitan areas, the data for interstates and primary U.S. routes is very accurate and comprehensive because the sources of the data are emergency response patrols and law enforcement. However, gathering data on arterials and in rural areas can be difficult if the area does not have a CHART emergency patrol or CCTV coverage (TOCs often are not notified until agency assistance is required or requested).
- *Michigan*: The agency is not always notified immediately when an incident clears the roadway, especially in rural areas.

**Data Verification**

- *Utah*: Verification of data accuracy and timeliness is challenging.

**Human Error**

- *Georgia*: Excel spreadsheet lacks manually recorded data.
- *Nevada*:
    - Data reported by law enforcement is often incomplete, estimated or improperly defined.
    - The terms “roadway clearance” and “incident clearance” are regularly confused or left blank. The time recorded is clearly rounded to the nearest 15 minutes and not the actual time of clearance.

**Notification Delays/Lapses**

- *Michigan*:
    - The agency may not be notified immediately when an incident clears the roadway.
    - TOCs may never be notified of the incident. Enhancements made to ATMS in 2019 allow all TOCs to collect incident clearance time. The agency’s TIM unit is currently determining how to best leverage these enhancements to measure and report on the performance measure statewide.
- *Oregon*: TOCs are often not notified about incidents occurring on the highway network.

**Other**

- *Minnesota*: The TMC has been gathering this data for about 30 years, and the volume of incidents increased as the system grew. CAD integration was “a great help” in managing data.

- *Nevada*:
    - Waycare data is limited by cost, available communications and population density.
    - Outside of the population centers of the state, communication limitations and the limited sample size of the crowd lead to a breakdown in the algorithm learning of the system.

## Number of Secondary Crashes

Of the 16 agencies collecting TIM data related to the three performance measures, 10 agencies—Arizona, Idaho, Kansas, Maine, Maryland, Michigan, Minnesota, Nevada, North Carolina and Wyoming—gather data to measure the number of secondary crashes. In Utah, data gathering is observational only; currently there is no direct reporting form.

Below is information about the type of secondary crash data gathered, the sources used to gather this data, the data format provided by these sources and the challenges agencies experience in gathering the data.

Type of Data Gathered

Four states (Idaho, Maine, Maryland and Wyoming) reported that their agencies investigate associated events—those events that were caused by the first incident—when gathering data on the number of secondary crashes. Maryland DOT SHA records all associated events that are determined to be related, including secondary crashes. In addition, police agencies in the state indicate that a collision is a secondary crash by selecting a check box in the Automated Crash Reporting System (ACRS).

Other respondents provided more general information about their agencies' data collection practices:

- In Michigan, WMTOC collects secondary crash data for freeway and major arterials for 13 counties in western Michigan. STOC collects data for some known secondary crashes on freeway and major arterials statewide. SEMTOC and BWBTOC have not been collecting secondary crash data.
- Minnesota DOT's TMC investigated the recorded traffic camera video of all crashes logged in CAD for two two-week periods in 2016 and 2017. Researchers examined the video to determine the cause of the incident and whether the crash was secondary.
- Nevada DOT collects secondary crash data statewide by selecting a check box on the law enforcement crash report form.
- North Carolina DOT has used several different algorithms with varying levels of success. Currently, the agency uses the number of rear-end crashes on freeways.

Survey results are summarized in Table 9 below.

**Table 9. Secondary Crash Data Gathered**

| Type of Data or Practice | State | Description |
|---|---|---|
| **Associated Incidents** | Idaho, Maine, Maryland, Wyoming | *Idaho and Wyoming.* If the first incident caused a secondary incident.<br>*Maine.* Time and distance away from the first crash.<br>*Maryland*:<br>• The agency records associated events, which are related to the first incident (including secondary crashes).<br>• Police agencies report collision as a secondary crash in ACRS. |
| **Crash Type** | North Carolina | *North Carolina*. Number of rear-end crashes on freeways. |
| **Totals Only** | Kansas | *Kansas*. Number of secondary crashes. |
| **Reporting Practice** | Nevada, North Carolina | *Nevada*. Data collected statewide on the law enforcement crash report.<br>*North Carolina*. Different algorithms used with varying levels of success. |
| **Other** | Arizona, Michigan, Minnesota | *Arizona*. All secondary crash data.<br>*Michigan*:<br>• WMTOC: Data from freeway and major arterials in 13 western Michigan counties.<br>• STOC: Data from some known secondary crashes on freeway and major arterials statewide.<br>• SEMTOC and BWBTOC: No data.<br>*Minnesota*: Traffic camera video of all crashes logged in CAD for two periods in 2016 and 2017. |

Data Sources

Law enforcement accident records and police reports are the primary sources of the number of secondary crashes in six states: Arizona, Idaho, Maine, Maryland, Nevada and Wyoming. Data is retrieved from State Highway Patrol accident records in Arizona and from state crash reports in Michigan, Nevada and Wyoming. Since 2016, Michigan's state crash report (UD-10) has included a field to record secondary crashes. Nevada's statewide crash form includes a check box to indicate if a crash is secondary. (The respondent added that it can take several months to receive this data. The agency is currently exploring the use of Waycare to identify secondary crashes at its TMC.) A similar check box option is available in Maryland's electronic ACRS.

Below are other key findings from survey participants; all survey responses are summarized in Table 10 following these highlights:

- In Kansas, secondary crash data is obtained from TMCs in Kansas City and Wichita only.
- In Maryland, TMCs rely on a dependable source at the scene to verify that the event is secondary and that it can then be associated to the primary event.

- WMTOC and STOC operators in Michigan are alerted to secondary crashes through CCTV and notification from first responders. TOC operators have recorded secondary crashes in ATMS and operator databases.
- Minnesota DOT gathers secondary crash data from the State Patrol's CAD and recordings from TMC cameras.
- North Carolina DOT primarily uses its crash database for this information. The respondent noted that the agency will track specific events on some projects and corridors, but statewide tracking is too labor-intensive.

**Table 10. Data Sources: Number of Secondary Crashes**

| State | TMC/ TOC | Law Enforcement | First Responders | CCTV | CAD | Other |
|---|---|---|---|---|---|---|
| **Arizona** | | X | | | | |
| **Idaho** | | X | | | | |
| **Kansas** | X[1] | | | | | |
| **Maine** | | X | | | | |
| **Maryland** | X | X | | | | X |
| **Michigan** | X | | X | X | | |
| **Minnesota** | | | | X | X | X |
| **Nebraska** | | | | | | |
| **Nevada** | | X | | | | |
| **North Carolina** | | | | | | X |
| **Wyoming** | | X | | | | |
| **TOTAL** | **3** | **6** | **1** | **2** | **1** | **3** |

1 TMCs in Wichita and Kansas City only.

Data Formats

Eight agency respondents reported on the format used when receiving data from these sources. Five of these states—Idaho, Kansas, Maryland, Michigan and Wyoming—produce reports that can be entered into a database:

- Kansas DOT uses ATMS software to create reports in PDF format.
- In Maryland, both ATMS and ACRS produce real-time electronic reports that can be printed, and information can be recorded in SQL databases.
- WMTOC and STOC operators in Michigan also record secondary crashes in ATMS and operator databases. (UD-10 reports are available in PDF format.)

The Maine DOT respondent reported that the agency uses an Oracle database. Minnesota DOT conducts a visual analysis and results are logged in an Excel spreadsheet. In Nevada, the number of crashes is reported as a statewide total each month.

Survey results are summarized in Table 11 below.

**Table 11. Data Format: Number of Secondary Crashes**

| State | ATMS | Databases | Reports | Other |
|---|---|---|---|---|
| **Idaho** | | X | X | |
| **Kansas** | X | | X | |
| **Maine** | | X | | |
| **Maryland** | X | X | X | |
| **Michigan** | X | X | X | |
| **Minnesota** | | | | X |
| **Nevada** | | | | X |
| **Wyoming** | | | X | |
| **TOTAL** | **3** | **4** | **5** | **2** |

Data Collection Challenges

Respondents from seven agencies discussed the challenges in collecting secondary crash data. The primary challenge reported by respondents was determining whether the incident was a secondary crash (Idaho, Maryland, Michigan and North Carolina). Other challenges include accurate reporting on police reports and forms (Maryland, Michigan, Nevada and Wyoming), delays in receiving notification of an incident (Michigan) and lack of information about the original crash (Wyoming). Below are key findings of the survey results by topic:

**Accurate Reporting**

- *Maryland*: Responders/operators may not report the incident as a secondary crash.
- *Nevada*: The number of secondary crashes reported statewide indicates that law enforcement officers are not checking the box on the report form as often as they should.
- *Wyoming*: Officers need to be reminded to complete the form with accuracy and narrate the initial crash.

**Determining a Secondary Crash**

- *Maryland*: Training responders/operators to identify an incident as a secondary crash has been more difficult than anticipated.
- *Nevada*: There is a lack of understanding of what qualifies as a secondary crash.

**Notification Delays/Lapses**

- *Michigan*: TOCs may never be notified of the incident. Enhancements made to ATMS in 2019 allow all TOCs to collect secondary crash data. The agency's TIM unit is currently determining how to best leverage these enhancements to measure and report on the performance measure statewide.

**Other**

- *Minnesota*: The respondent noted that reporting secondary crash data is labor-intensive and the subjective decision is limited to only one or two staff members.
- *Wyoming*: There is a lack of information about the original crash that caused the queue resulting in the secondary crash.

## Supplemental Information

Nevada

In a follow-up email, the respondent from Nevada DOT noted that TIM performance measures were added to the statewide crash form in April 2018. Statewide, roadway clearance, incident clearance and secondary crash data is collected by law enforcement on the standard crash form. This form is supplemented in urban areas with TMCs that collect data on clearances through Waycare. This product does not collect secondary crash data, but the agency is exploring the possibilities.

Additionally, the respondent provided two screenshots from the TIM dashboard along with an explanation of the data:

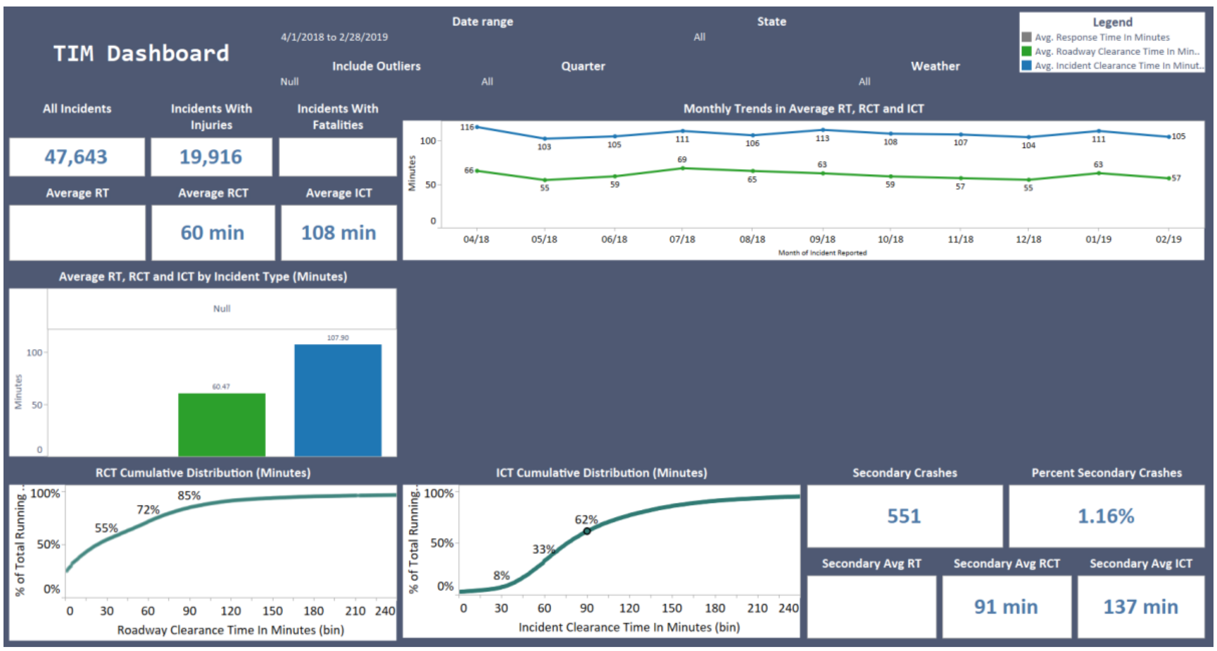


**Figure 1. Nevada DOT TIM Dashboard Output: Road Clearance Time and Incident Clearance Time, April 2018 Through February 2019**

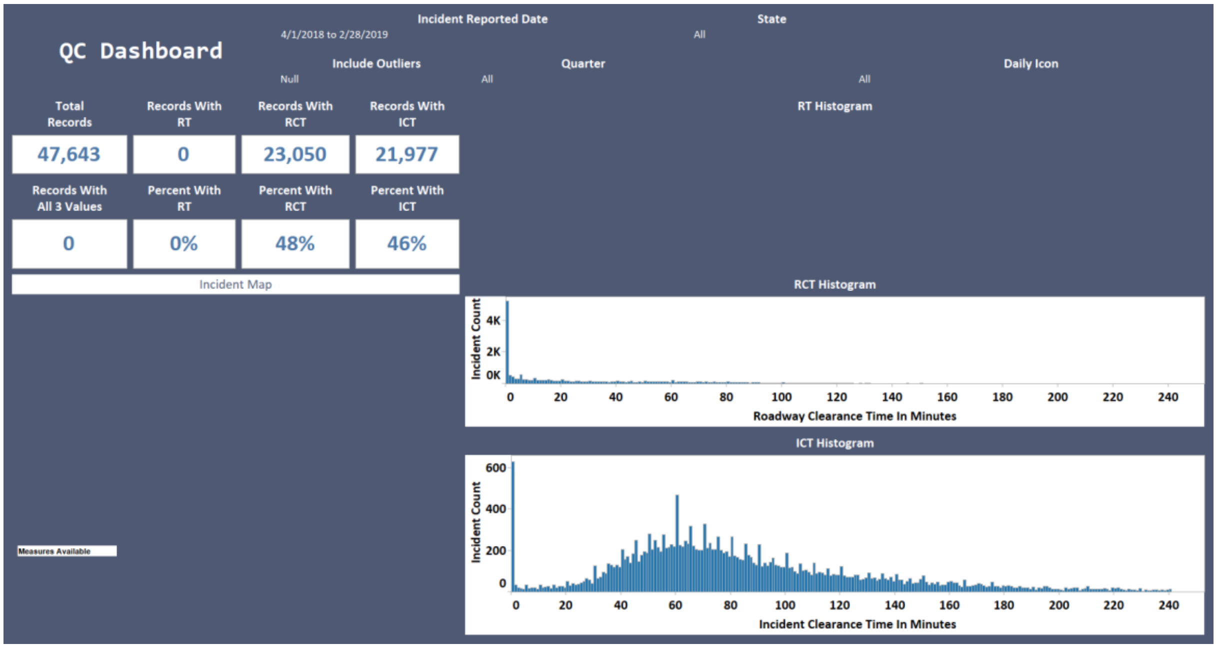


**Figure 2. Quality Control Analysis of the Nevada DOT TIM Dashboard Output**

- Out of the 53,959 records provided, 47,643 records (88.3 percent) had high enough data quality to use for analysis (the remaining 11.7 percent had too many missing or erroneous values).

**Roadway Clearance Time and Incident Clearance Time**

- 46 percent of the usable records allowed for the calculation of incident clearance time.
- 48 percent of usable records allowed for the calculation of roadway clearance time.
- Roadway clearance time distribution shape is flat because 47.3 percent of calculated roadway clearance times are 0. This may happen when officers put 0 as roadway clearance time when the crash is a non-lane blocking crash, which skews the roadway clearance time distribution and average measure.
- Incident clearance time T distribution shape is as expected except for the spikes, which are evidence that the incident clearance time is being rounded (usually to the nearest five minutes—30, 40, 45, 55, etc.) arbitrarily by some officers. There is an unusually high spike at 60 minutes, showing the excessive recording of 60-minute incident clearance time (and probably roadway clearance time) by many officers.
- If the 0 roadway clearance times for the non-lane blocking crashes are removed (there should be no roadway clearance time for a non-lane blocking crash), the average roadway clearance time will go up.
- Both roadway clearance time and incident clearance time are showing a decreasing trend over the last 12 months.

**Secondary Crashes**

- Total secondary crashes were 551 (1.16 percent), which correlates with what is seen in other states.
- Average roadway clearance time and incident clearance time for secondary crashes are 91 minutes and 137 minutes, respectively.

Utah

Utah DOT is currently collecting some of the performance data. The respondent noted that the agency is forming a statewide TIM coalition and developing a dashboard to facilitate data gathering and analysis, and report in real time. The agency expects to accomplish these tasks by the end of this year and at that time, will have "a greatly improved program."

## Related Resources

Below are sample reports, documents and other resources provided by survey respondents that are related to their agencies' TIM data system and data collection practices. Supplementing these materials are citations describing agency systems and tools. The Nebraska DOT respondent reported that while no documentation is currently available, software for crash reports and other incident data is estimated to be completed by 2021.

Georgia

**Highway Emergency Response Operations (HERO)**, Georgia Department of Transportation, undated.
http://www.dot.ga.gov/DS/Travel/HEROs
*From the web site*:

> Highway Emergency Response Operators (HEROs) are dispatched to traffic-related incidents in metropolitan Atlanta with the primary duty to clear roads so that normal traffic flow is restored. HEROs also assist stranded motorists with flat tires, dead batteries or in need of fuel or coolant.

Sample weekly and monthly HERO reports are provided as supplements to this report.

**Towing and Recovery Incentive Program (TRIP)**, Traffic Incident Management Enhancement (TIME) Task Force of Georgia, undated.
http://timetaskforce.com/time-initiatives/trip/
*From the web site*: Georgia's Towing and Recovery Incentive Program (TRIP) was implemented in metro Atlanta to facilitate improved management of large-scale commercial vehicle incidents. These large-scale incidents can significantly affect traffic in the region, causing long motorist delays, polluting the air, and creating safety hazards. TRIP encourages the quick, safe clearance of these incidents by paying performance incentives to highly-skilled, TRIP-certified towing and recovery companies for clearing wrecks within established clearance goals.

Kansas

**WICHway**, Kansas Department of Transportation, undated.
http://wichway.org/wichway
Monthly incident reports: http://wichway.org/wichway/Reports
*From the web site*:

> WICHway provides the latest traffic information on Wichita's highways. It is part of the statewide Intelligent Transportation System (ITS) designed to help travelers, commuters, commercial transport and other drivers make informed decisions as they travel Kansas highways. … It is owned and operated by the Kansas Department of Transportation in cooperation with many partners including Sedgwick County, City of Wichita, Kansas Highway Patrol, Kansas Turnpike Authority, Wichita Area Metropolitan Planning Organization, and Federal Highway Administration.

> The WICHway network has 68 closed circuit cameras, 75 traffic sensors and 25 dynamic message signs. A Traffic Management Center at the Sedgwick County Public Safety Building is operated Monday – Friday, 6 a.m. – 7 p.m. with 911 operators at the control console.

Links at this web site direct users to a map of Wichita that indicates travel speeds, road conditions, construction, and cameras and signs. An additional feature shows incidents on the map.

Links to annual and monthly incident reports dating back to June 2013 are also available at the web site. Current monthly reports include crash clearance time by highway, average incident clearance time by month and year, total incidents, incident breakdown by type and severity levels.

**KC Scout**, Kansas Department of Transportation, Missouri Department of Transportation, undated.
http://kcscout.net/About.aspx
Monthly incident reports: http://kcscout.net/ReportsMonthly.aspx
*From the web site*:

> KC Scout is Kansas City's bi-state traffic management system, designed to lessen traffic jams by improving rush-hour speeds, increasing safety by decreasing the number of rush-hour accidents and improving emergency response to traffic situations by clearing incidents quickly and safely. Scout manages traffic on more than 300 miles of continuous freeways in the greater Kansas City metropolitan area.

Links to fiscal year 2014 and 2015 annual reports and to monthly incident reports from September 2018 through February 2019 are also available at the web site. Current monthly reports provide an incident summary that includes total incidents, incidents with lane blockages, total minutes of blocked lanes and average time to clear lanes. Links to the complete report are also available.

Louisiana

**Intelligent NETworks**, Parsons Corporation, 2016.
https://www.parsons.com/wp-content/uploads/2017/08/iNET-Brochure.pdf
*From the brochure*:

> The Intelligent NETworks (iNET) Advanced Transportation Management System (ATMS) is Parsons' industry-leading software used to improve the management, efficiency, effectiveness, and safety of your transportation network. Whether it's a freeway, highway, toll road, transit route, tunnel, arterial road, or other transportation system, iNET applies state-of-the-art operational solutions to improve these facilities.

System capabilities and benefits are featured in the brochure along with base, device, intelligent management and external modules that are available.

Maryland

**ATMS System Architecture**, CHART Program, Version 27.0, General Dynamics, August 2018.
See Attachment A
This document presents the architecture of Maryland DOT SHA's CHART ATMS and details every feature currently included for recording data. Traffic event data is discussed in

Section 3.38.4 (page 78 of the report); performance monitoring is discussed in Section 7.6.3 (page 126 of the report).

**CHART Data Export Guide**, CHART Program, Version 7.0, General Dynamics, August 2018.
See Attachment B
This guide shows the available fields that are exported to the external systems of authorized agencies through a secure token. (Maryland DOT SHA's public Really Simple Syndication (RSS) feed does not contain all the information contained in the Interface Control Document.) Traffic event data is discussed in Section 2.3.1 (beginning on page 11 of the report).

**Maryland State Highway Mobility Report**, Maryland Department of Transportation State Highway Administration, 2018.
https://chart.maryland.gov/downloads/readingroom/tsmo/2018MobilityReportLowRes05072019.pdf
A summary of CHART practices begins on page 102 of the PDF.

**CHART Traffic Management Center Operations: Standard Operating Procedures**, Maryland Department of Transportation State Highway Administration, September 2016.
https://transportationops.org/publications/chart-traffic-management-center-operations-standard-operating-procedures (click on "Skip to content")
*From Chapter 1*:

> This document is the Standard Operating Procedures (SOP) manual that provides guidance to CHART TMC HOTs [highway operations technicians] (i.e., HOTs, Operators) in performing traffic management center operational duties at the SOC and TOCs. It outlines policies and procedures for conducting daily technical and administrative activities.

Section 1.5 (page 23 of the PDF) provides an overview of incident management. Policies and procedures related to traffic events are provided in Section 3.2 (page 115 of the PDF).

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**CHART Traffic Incident Management**, Coordinated Highways Action Response Team (CHART) Statewide Operations Center, undated.
https://chart.maryland.gov/about/incident_management.asp
This web page summarizes the CHART TIM program and provides access to other CHART program information.

Minnesota

**Computer-Aided Dispatch**, Intergraph Corporation, undated.
http://www.intergraph.com/global/it/publicsafety/cad.aspx
*From the web site*: Intergraph's Computer-Aided Dispatch (CAD) system provides call-center and communications center operators with the tools they need to field calls, create and update incidents, and manage an organization's critical resources by providing real-time interaction of crucial data. Combined with historical and local searches, operators are ensured they have the right information available to them when making urgent decisions.

Our Web-based solutions provide occasional or remote access to the CAD system, providing first responders and security personnel with secure Web access to live operational information and the ability to search for historical data on incidents and resources. For optimal communications, our solution smoothly integrates voice and data and includes built-in interfaces to radio and telecommunications systems, allowing fast, efficient radio messaging and data distribution.

….

This “intelligent” mapping and data entry system seamlessly integrates an interactive, real-time map display with call handling, dispatching, records and information management, remote access, and mobile data. The application enables precise and exceptionally fast response, while conveniently generating a full incident record for downstream use.

Nevada

**Waycare Solutions**, Waycare, undated.
http://waycaretech.com/
Waycare uses predictive analytics to optimize transportation systems. *From the web site*:

> By integrating disparate systems and multiple sources of data into a GIS [geographic information system]-based interface, the operator platform offers AI [artificial intelligence] driven incident identification, dynamic congestion, travel analysis and predictive analytics to identify near-term dangerous roads. … The platform includes a back office function with data visualization tools and automated reporting capabilities. An integrated interface provides accessibility to the data layers and allows PDF exports for building external reports.

North Carolina

**Incident Clearance Goal**, North Carolina Department of Transportation, undated.
See Attachment C
This document briefly describes North Carolina DOT’s proposed incident clearance goals and measures to achieve these goals.

Wisconsin

**Incident Response**, MAPSS Performance Improvement Program, Wisconsin Department of Transportation, undated.
https://wisconsindot.gov/Pages/about-wisdot/performance/mapss/measures/mobility/incident.aspx
Mobility: https://wisconsindot.gov/Pages/about-wisdot/performance/mapss/goalmobility.aspx
The MAPSS [Mobility, Accountability, Preservation, Safety and Service] Performance Improvement Program includes the agency’s five core goals for developing and operating a safe, efficient transportation system. Performance for each goal is assessed in a MAPSS Performance Scorecard, which includes performance measures, how the agency measures performance, performance for the current report period, the performance goal and comments about the performance.

Mobility is one of the agency’s five core goals. The Mobility web page summarizes performance data for July 2019, including incident response for calendar year 2018, which provides statistics about the percent of incidents cleared within a specific time frame.

# Consultation With the Center for Advanced Transportation Technology Laboratory

The Regional Integrated Transportation Information System (RITIS) is a data aggregation, dissemination and analytics platform that uses transportation data from public and private sector agencies and systems for incident response and planning.

We contacted Michael Pack, director of the Center for Advanced Transportation Technology (CATT) Laboratory at the University of Maryland, to learn about the California data residing in RITIS and other details about the platform's capabilities and potential applications. Below is a summary of phone and email conversations with Pack. He also provided a document that includes additional resources and tools illustrating the RITIS platform using real-time data from California and other agencies; the document is available as a supplement to this report. Following this discussion are publications and other relevant research about RITIS.

### Type of Data Gathered

Currently, RITIS has access to the following data from California:

- Caltrans incident data (primarily from the CHP CAD system).
- Crowdsourced event data from Waze, the GPS navigation app.
- Caltrans sensor data (inductive loop and other spot sensor data) that collects volume and speed data at specific locations.
- Probe-based speed data from INRIX, a private company providing location-based data and analytics.
- Probe-based speed data from FHWA's National Performance Management Research Data Set.
- National Weather Service (NWS) radar predictions.
- NWS real-time radar (precipitation rates on roads).
- Road weather information system (RWIS) data, such as surface temperatures, visibility, wind speed and direction.
- First responder radio communications.
- CCTV (streams and snapshots, depending on the location).
- Dynamic message signs (DMS).

The data is gathered and displayed in real time within RITIS and archived indefinitely. The CATT Lab has created a series of data visualizations and analytics tools that make it easier to compute TIM performance measures as defined by FHWA in its EDC program. (*Note*: FHWA contracted with the CATT Lab to build EDC TIM performance measures for event and roadway clearance times into these tools.) Caltrans events are standardized to the performance measures and then computed. (See *Related Resource* below for a link to a short video demonstrating the analytics.)

*Related Resource*:

> **EDC-Caltrans**, Center for Advanced Transportation Technology Laboratory, July 2019.
> https://vimeo.com/350489604
> This two-minute video demonstrates TIM performance measures analytics in RITIS.

## Data Sources

While the CATT Lab is not under contract with Caltrans to collect, manage and archive data, it is still archiving Caltrans data feeds from an expired contract with FHWA (2010-2014) when the lab was evaluating Integrated Corridor Management deployment in San Diego. Currently data is obtained electronically from multiple sources, including CHP and 911 dispatch calls, DOT operations staff, field units and third parties such as INRIX and NWS.

## Data Credibility

Some of the data sources are easily validated (for example, probe, speed sensor and weather data). Incident or event data is much more difficult to validate. To determine the credibility of these types of data, researchers use the following:

- *Timeliness indicators*: Has the data (or data feed) been updated when expected?
- *Quantity and location*: Is the number of incidents what is typically expected? How far out of the norm is the pattern—both spatially and temporally?
- *Agreement*: If incident data is coming from multiple sources, do the sources agree? Is one source timelier than another source?
- *Impactful*: Is the incident or event impacting traffic? Researchers can use probe data and/or sensor data to understand the impacts, determine if incidents are really happening on the roadway, and if so, estimate when they began and/or ended.
- *Complete*: Law enforcement doesn't complete a collision report for every incident on the roadway (for example, a debris event or disabled vehicle). DOTs are more likely to log these smaller events in their ATMS platforms. To have complete data, researchers merge these two data sets, remove the duplicates and use a combination of them to validate each other and fill in the gaps. Comparing police, DOT and Waze data is a useful way to understand how complete the data may or may not be.

Other RITIS analytics help to analyze and validate the data. For example, looking at trends in events over time (such as time of day or day of the week) can indicate any temporal gaps in the data. Mapping the data will show where spatial gaps may exist.

## Data Collection Challenges

The CATT Lab isn't computing roadway clearance data for California because the data is not machine-readable. CAD messages are input by operators in a nonstandard format with many variations. Caltrans data needs to be standardized and machine-readable for analysis.

*Contact*: Michael Pack, Director, Center for Advanced Transportation Technology Laboratory, University of Maryland, 240-676-4060, packml@umd.edu.

## Related Resources

**Usage of the Regional Integrated Transportation Information System (RITIS)**, Andrew Meese, Metropolitan Washington Council of Governments, March 2018.
https://www.mwcog.org/assets/1/28/03082018_-_Item_9_-_Usage_of_the_Regional_Integrated_Transportation_Information_System.pdf
This presentation describes RITIS, including system features and case studies, in the National Capital Region.

**"USA's Political Mosaic Makes Transport Agency Data Sharing Critically Important,"** Keith Nuthall, *Traffic Engineering and Control*, Vol. 54, No. 4, September 2013.
Citation at https://trid.trb.org/view/1264654
*From the abstract*: This article discusses the Regional Integrated Transportation Information System (RITIS), an automated transport data sharing, dissemination, and archiving system designed to improve communication between government and the traveling public. The system, which originally was developed to unit[e] the transport data systems of Maryland, Virginia and [Washington, D.C.], has now been adopted by about 100 transport management agencies across the country, including the U.S. Secret Service and Department of Homeland Security. The author also highlights a research project on improvements to information sharing systems being conducted by the National Cooperative Highway Research System. The project will identify successful multi-agency data sharing practices, including [t]he types of data being shared, how it is transmitted, how it impacts decision making and how to form data sharing agreements.

**Regional Integrated Transportation Information System**, Center for Advanced Transportation Technology Laboratory (CATT Lab), University of Maryland, undated.
https://ritis.org/intro
*From the web site*:

> RITIS is the leading big data aggregation and dissemination platform for solving challenging and complex transportation problems. Its broad spectrum of advanced analytics—from comprehensive situational awareness to in-depth archived data evaluation—provides enhanced, multi-faceted insight of the transportation system across geographic and agency boundaries. RITIS is used nationwide by thousands of decision-makers in planning, operations, research, the military and Homeland Security for developing smart, cost-effective mobility, safety and security solutions.
>
> ….
>
> RITIS is a situational awareness, data archiving, and analytics platform used by transportation officials, first responders, planners, researchers, and more. RITIS fuses data from many agencies, many systems, and even the private sector—enabling effective decision making for incident response and planning. Within RITIS are a broad portfolio of analytical tools and features. Ultimately, RITIS enables a wide range of capabilities and insights, reduces the cost of planning activities and conducting research, and breaks down the barriers within and between agencies for information sharing, collaboration, and coordination.

An extensive catalog of available tools and case studies are also included on the web site.

*Related Resource:*

> **CATT Lab (Center for Advanced Transportation Technology Laboratory)**, University of Maryland, undated.
> https://www.cattlab.umd.edu/
> *From the web site*: The CATT Lab develops real-time systems that fuse and integrate hundreds of [g]igabytes of data per day in real-time from emergency operations centers, transportation management centers, thousands of sensors, CCTV cameras and subsystems throughout the country.

**Regional Integrated Transportation Information System (RITIS)**, I-95 Corridor Coalition, undated.
https://i95coalition.org/projects/regional-integrated-transportation-information-system-ritis/
The I-95 Corridor Coalition is a partnership of transportation agencies, toll authorities, public safety and related organizations from the eastern United States and Canada. This web page describes the coalition's use of RITIS and provides access to its RITIS user group.

# Related Research and Resources

A literature search of recent publicly available resources identified publications and other resources that are organized into four topic areas:

- National resources.
- State practices.
- International resources.
- Related resources.

## National Resources

**Every Day Counts: An Innovation Partnership With States**, EDC-4 Final Report, Federal Highway Administration, April 2019.
https://www.njdottechtransfer.net/wp-content/uploads/2019/05/edc4_finalreport.pdf
Pages 41 through 44 of the report (pages 43 through 46 of the PDF) provide a summary of state activities related to using data to improve traffic incident management.

**Traffic Incident Management Knowledgebase**, Federal Highway Administration, 2019.
https://ops.fhwa.dot.gov/eto_tim_pse/preparedness/tim/knowledgebase/
*From the web site*: This Knowledgebase began as a tool to house online reference materials that furnished transportation and public safety professionals with knowledge and tools they need to conduct TIM incident-specific performance measurements. However, FHWA captured so much great information while meeting with jurisdictions' transportation and public safety mid-level managers, decision makers and practitioners during its TIM Workshops and SHRP2 [Strategic Highway Research Program Second Round] TIM Responder Train-the-Trainer initiatives, that the Knowledgebase necessarily expanded to accommodate great tools and information. As a result, the TI&EM [Traffic Incident and Events Management] team expanded this KMS [Knowledge Management System], building upon the performance measurement foundation to include other documents and models graciously provided by other [s]tates, local and regional jurisdictions and functional disciplines. The visitor will find documents and tools that range from policy, safe/quick clearance legislation, training, traffic management center operations and TIM, TIM Committee formation and operations, TIM resources, Public Outreach and other TIM functions.

**Collection, Analysis and Use of Data to Improve Traffic Incident Management (TIM): Innovative Examples from Successful States**, National Operations Center of Excellence, September 2018.
https://transportationops.org/ondemand-learning/collection-analysis-and-use-data-improve-traffic-incident-management-tim
*From the web site*: During this webinar, you will hear firsthand from three agencies that actively collect, analyze and use TIM data. These speakers will share the ways in which they use this information and the value they have derived from it to improve TIM and responder safety. This interactive webinar will allow participants an opportunity to ask questions of the presenters and participate in relevant polling questions.

**State of the Practice on Data Access, Sharing and Integration**, Anita Vandervalk, Krista Jeanotte, Dena Snyder and Jocelyn Bauer, Federal Highway Administration, December 2016.
Full report: https://www.hsdl.org/?view&did=798282
Chapter 3: https://www.fhwa.dot.gov/publications/research/operations/15072/003.cfm
*From the abstract*:

> The purpose of this state-of-the-practice review was to lay both technical and institutional foundation for all aspects of the development of the Virtual Data Access Framework. The review focused on current data sharing and integration practices among [s]tate and local agencies, example data environments, technical integration formats, and business rules for integration and sharing. State, local and regional transportation operators, planners and data professionals can use this report to enhance their data sharing and integration efforts by building on the experiences and effective practices of other agencies documented in this report.

RITIS and other data environments are summarized in Chapter 3 of this report.

**Best Practices Supporting Traffic Incident Management (TIM) Through Integrated Communication Between Traffic Management Center and Law Enforcement and Effective Performance-Measurement Data Collection**, NCHRP Project 20 68A, Scan 10-04, September 2013.
http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-68A_10-04.pdf
*From the executive summary*: This scan focused on examining the TIM practices in regions that have enhanced TIM performance through integrated communication between traffic management centers (TMCs) and law enforcement (LE) and effective performance-measurement data collection. The scan team selected and subsequently interviewed scan participants to learn about their best practices and the important features of those practices in each region. The team placed additional focus on collecting the lessons learned and insights gained through the participants' adoption of their particular practices, with particular regard for adoption of CAD and related technologies. The scan explicitly considered the perspectives of transportation, LE, and other incident-response agencies. The scan team was particularly interested in having discussions with state departments of transportation (DOTs) and other agencies that perform traditional traffic operations, specifically related to TIM, in collaboration with LE or emergency management and their respective CAD technologies. Furthermore, of those entities that have developed processes and procedures for collaboration, the team wanted to learn what performance measures they regularly monitor and track to ensure that their program is delivering the desired results. Additionally, the team searched for those entities that perform the above-mentioned collaboration in a collocated facility or TMC.

**Analysis, Modeling, and Simulation for Traffic Incident Management Applications**, Richard Margiotta, Rick Dowling and Jawad Paracha, Federal Highway Administration, July 2012.
https://ops.fhwa.dot.gov/publications/fhwahop12045/fhwahop12045.pdf
*From the abstract*: To support modeling and evaluation of TIM strategies, this document provides a synthesis of analysis, modeling, and simulation (AMS) methods for incident impacts. The focus is on incidents effects on congestion and reliability as well as secondary incidents, for the purpose of estimating benefits and evaluating programs and proposed strategies. This document covers several specific topics including a synthesis of AMS methods for incidents, TIM AMS application areas, data required to undertake modeling and evaluations of TIM strategies, and identification of future improvements to TIM AMS applications.

**Improved DOT Collaboration and Communication Could Enhance the Use of Technology to Manage Congestion**, Report to the Committee on Science, Space and Technology, U.S. House of Representatives, March 2012.
https://www.gao.gov/assets/590/589430.pdf
*From the abstract*:

> Since 1994, [the U.S.] DOT has overseen the allocation and expenditure of more than $3 billion for deploying and researching ITS [intelligent transportation systems]. GAO [Government Accountability Office] was asked to address (1) the current and emerging uses of ITS technologies by state and local governments, (2) the challenges these governments face in using ITS, and (3) the extent to which DOT's efforts to promote and support ITS address these challenges and follow leading practices. To conduct this work GAO visited four sites, and interviewed and analyzed documents and data from DOT and state and local transportation officials, ITS experts, and other stakeholders.

A discussion of RITIS begins on page 17 of the report (page 21 of the PDF).

**Recommendations for Improving the Use of Traffic Incident Management Performance Measures When Comparing Operations Performance Between State DOTs**, Thomas H. Jacobs, Nikola Ivanov and Michael L. Pack, NCHRP Project 20-24(37)D, January 2011.
http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-24(37)D_FR.pdf
*From the abstract*: The initial premise behind the project was to use available state [d]epartments of [t]ransportation (DOTs) data on traffic incident response performance to provide a time series/cross section-sectional analysis of incident response performance, which could be measured based on average, median, or maximum incident response time, total incident duration or incident clearance time. The idea was that a cross-state comparison and examination of changes in performance over time might identify best practices that could be instrumental in reducing incident duration with associated benefits to travelers. For reasons explained in this research report, the primary emphasis of this project shifted to one of developing specific recommendations that could improve TIM performance measurement. While this research did result in a cross-state comparison for some of the participating agencies, the lack of standardization in collection and use of nationally adopted TIM performance measures made it difficult to draw definitive conclusions as to how the agencies are performing with respect to one another. What the research did yield is a set of recommendations that will be useful in enhancing existing agency TIM data collection and reporting efforts and the possible development of a standard approach to TIM performance data collection that will allow future efforts at cross-comparison to yield results that are consistent and more readily comparable.

**Best Practices in Traffic Incident Management**, Federal Highway Administration, September 2010.
https://ops.fhwa.dot.gov/publications/fhwahop10050/fhwahop10050.pdf
*From the abstract*: This report describes task-specific and cross-cutting issues or challenges commonly encountered by TIM responders in the performance of their duties, and novel and/or effective strategies for overcoming these issues and challenges (i.e., best practices). Task-specific challenges may include obtaining accurate information from motorists, accessing the scene, and condemning a spilled load. Cross-cutting challenges may include interagency coordination and communication, technology procurement and deployment, and performance measurement. The reported tools and strategies for improving TIM range from sophisticated, high-technology strategies to simple, procedural strategies. Information to support this investigation was obtained through (1) a review of published and electronic information sources and (2) input from TIM personnel in Arizona, California, Florida, Maryland, Michigan, Nevada, New Jersey, New York, Ohio, Pennsylvania, Tennessee, Texas, Utah, and Washington representing law enforcement, fire and rescue, emergency medical services, transportation, and towing and recovery agencies. For many of the individual tools and strategies, a wide range of effectiveness was reported by locale, challenging the explicit identification of best practices and suggesting that local conditions related to the nature and extent of operation, maintenance, marketing, etc., have a significant impact on the perceived or measured success of specific TIM efforts.

**Federal Highway Administration Focus States Initiative: Traffic Incident Management Performance Measures Final Report**, Nicholas D. Owens, April H. Armstrong, Carol Mitchell and Rebecca Brewster, Federal Highway Administration, December 2009.
https://ops.fhwa.dot.gov/publications/fhwahop10010/fhwahop10010.pdf
*From the abstract*: The Traffic Incident Management Performance Measures Focus States Initiative (TIM PM FSI) involves 11 [s]tates that have defined three traffic incident performance measures (PM) and conducted field tests of two of these measures. The following measures were defined in December 2005 and field tested for 18 months: 1. Reduce “roadway clearance” time (defined as the time between awareness of an incident and restoration of lanes to full operational status); and 2. Reduce “incident clearance” time (defined as the time between awareness of an incident and removal of all evidence of the incident, including debris or remaining assets, from shoulders). A third measure was defined at the final project workshop in October 2007 but has not yet been field tested; 3. Reduce the number of secondary incidents—specifically unplanned incidents for which a response or intervention is taken, where a collision occurs either a) within the incident scene or b) within the queue (which could include opposite direction) resulting from the original incident. The FSI represents the first effort by multiple [s]tates to measure TIM performance using common performance metrics. The results of the FSI demonstrated that TIM performance measurement is institutionally and technically viable. The participating [s]tates also demonstrated that integrating and coordinating TIM operations between multiple agencies can be done seamlessly. The final products of the FSI are an outreach plan and outreach products that can be used by [s]tates to promote TIM PM and integrated TIM programs.

## Data Collection and Reporting Practices

The citations below provide information about data collection and reporting practices.

**Guidance for Implementation of Traffic Incident Management Performance Measurement**, National Cooperative Highway Research Program, undated.
http://nchrptimpm.timnetwork.org/
This web site provides "concise guidance on the consistent use and application of TIM performance measures in support of the overall efforts of TIM program assessment." The web site also includes information on performance measurement for TIM programs, including agency case studies, as well as information on creating a model database.

*Related Resource:*

> **Agency Case Studies**, Performance Measurement for Traffic Incident Management Programs, Applied Engineering Management Corp. and Texas A&M Transportation Institute, undated.
> http://nchrptimpm.timnetwork.org/?page_id=69
> An evaluation of TIM performance measurement practices in several states was conducted as part of the NCHRP 07-20 project and presented as case studies. *From the web site*:
>
> > The case studies encompassed a range of TIM capabilities and program maturity, with some at the start of performance measurement and others that have institutionalized TIM program assessment. The case studies focus on four core areas:
> >
> > - TIM program description,
> > - Data collection and management practices,
> > - Performance analysis and reporting practices, and
> > - Notable benefits from TIM performance measurement.

**Using Data to Improve Traffic Incident Management**, Federal Highway Administration, April 2018.
https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/timdata.cfm
This web site includes resources, webinars/videos and tools associated with TIM data collection and performance measures.

*Related Resource:*

> **Using Data to Improve Traffic Incident Management (TIM)**, Federal Highway Administration, 2016.
> https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/factsheet/traffic_incident_management.pdf
> This two-page fact sheet summarizes the state of the practice of data collection and performance measurement reporting.

**Using Data to Improve Traffic Incident Management**, Paul Jodoin, Federal Highway Administration, April 2018.
https://i95coalition.org/wp-content/uploads/2018/06/2-I95CC-CAD-Workshop-EDC4-TIM-FHWA-Presentation-Apr2018.pdf?x70560
This presentation to the I-95 Corridor Coalition includes data analysis examples from multiple states.

**Using Data to Improve Traffic Incident Management: Next Generation TIM**, Paul Jodoin, Federal Highway Administration, October 2016.
http://txstic.org/1.TXSTIC.Traffic%20Incident%20Management.pdf
This presentation to the Texas State Transportation Innovation Council addresses the Every Day Counts initiative and the "process of coordinating resources of many agencies and companies to detect, respond to, and clear traffic incidents as quickly as possible." The presentation includes data collection examples from Arizona and Michigan DOTs.

## State Practices

### Arizona

**Traffic Incident Management and Reducing Secondary Crashes in Arizona**, Eric Rensel, Peter Rafferty and Charles Yorks, Arizona Department of Transportation, November 2018.
https://apps.azdot.gov/files/ADOTLibrary/publications/project_reports/pdf/spr740.pdf
*From the abstract*: This study concentrated on identification of the benefits of effective Traffic Incident Management (TIM) practices on secondary crashes in terms of improved safety for motorists and first responders. The study begins the process of developing an assessment model that examines a well-defined situation and a known threat and estimates the relative risk. Based on the findings, recommendations were made to establish several action items for statewide TIM implementation and relationship building. The study resulted in identification of opportunities to collect additional data that will help better understand the time and spatial relationships of secondary crashes, linked to the time and spatial relationships of TIM tactics engaged in primary crashes. This has the potential for enhancing the recommended risk model that considers a number of factors and necessary data that would become available.

**"TraCS and ACIS,"** Transportation Systems Management and Operations, Arizona Department of Transportation, *20th Annual Arizona Rural Transportation Summit*, October 2018.
https://www.azrts.org/2018-docs/04-Presentation-PPT-ADOT.pdf
This presentation describes the agency's traffic data collection and reporting systems: Traffic and Criminal Software (TraCS) and Arizona Crash Information System (ACIS).

### Florida

**Traffic Incident Management**, Florida Department of Transportation, undated.
http://www.floridatim.com/
This web site summarizes Florida DOT's TIM program, including links to documents and publications, meetings, events, programs and services.

### Illinois

**"Development of Incident Management Performance Measures for the Illinois State Toll Highway Authority,"** Jeff Hochmuth, John Benda, Jim Powell and Bill Hereth, *18th ITS World Congress*, ITS America, 2011.
https://ertico.assetbank-server.com/assetbank-ertico/action/viewAsset?id=8612&index=177&total=569&collection=2011+Orlando&categoryId=32&categoryTypeId=1&filterId=0&modal=true&sortAttributeId=0&sortDescending=false
*From the abstract*: The Illinois Tollway has operated ITS devices for several decades. In 2002 the Tollway opened their state of the art Traffic and Incident Management System (TIMS), which now manages all ITS devices including CCTV, DMS, and real time traffic information from two sources. By 2003, TIMS was integrated with the existing Tollway computer aided dispatch (CAD) system. This allowed incident information from the Illinois State Police and Tollway

Maintenance Forces to be directly input into the TIMS system. Vast amounts of data are produced by both the TIMS and CAD systems daily. This in turn has created an ever increasing number of inquiries from managers and executives. The industry was reviewed to understand how other agencies were successfully using similar data. Collectively, over 100 different performance measures were identified. Wilbur Smith identified 26 existing reports and 23 new reports that best matched the Tollway data and operational needs. Many of these reports required a baseline—a defined "normal" condition—for which to compare incident conditions, with a focus on actual conditions as opposed to modeled or daily speed profiles across the system. By comparing daily and average speed profiles near crashes, the Tollway can now directly and accurately determine the measured impact of incidents. With these new tools, the Illinois Tollway is able to make more informed operational and planning decisions on a variety of issues.

## Iowa

**Traffic Incident Management (TIM) Service Layer Plan**, Version 1.4, Iowa Transportation Systems Management and Operations (TSMO), Iowa Department of Transportation, January 2018.
https://iowadot.gov/TSMO/ServiceLayerPlan2.pdf
*From the goals and objectives*: The TIM Service Layer supports both the strategic and programmatic goals and objectives of the Iowa DOT. It establishes specific objectives to guide the day-to-day activities, prioritize projects and services, and establish performance-based management of TIM activities in Iowa. Table 1 shows the TSMO strategic goals and objectives for Iowa DOT. Table 2 shows the programmatic objectives identified for performance monitoring within the TIM Service Layer. Further consideration for the TIM Service Layer identifies more specific objectives to support the program objectives and the TSMO strategic objectives. Iowa DOT staff and key TIM partners identified service layer objectives, also shown in Table 2. These objectives reflect key components of successful TIM plans identified in Federal Highway Administration's (FHWA) Traffic Incident Management Gap Analysis Primer.

## Kentucky

**Improving the Quality of Traffic Records for Traffic Incident Management**, Reginald Souleyrette, Mei Chen, Xu Zang, Eric R. Green and Shraddha Sagar, Kentucky Transportation Cabinet, December 2018.
https://uknowledge.uky.edu/cgi/viewcontent.cgi?article=2630&context=ktc_researchreports
*From the abstract*: This project analyzes the three TIM performance measures: roadway clearance time, incident clearance time and secondary crashes of Kentucky to identify a baseline for performance which may indicate potential for improvement. The study pinpoints different data sources, tools and technologies that can be used to collect and analyze TIM performance measures. Kentucky State Police (KSP) Crash Database and TRIMARC Incident Records are the two principal data sources used. In addition, Waze and HERE speed data are also examined for potential use. Lastly, the three national performance measures are summarized and analyzed. They comprise a baseline for future performance assessment.

*Research in Progress:*

> **Traffic Incident Management (TIM) Dashboard**, Kentucky Transportation Cabinet; start date: July 1, 2019, expected completion date: June 30, 2020.
> Project description at https://trid.trb.org/view/1638639
> *From the project description*: The study will update methodologies for TIM performance measures and develop a dashboard to track the performance and evaluate the effectiveness

of TIM improvements. Researchers will conduct a literature review on practices used in other states, with a particular focus on the institutionalization of TIM. They will produce an expanded list of TIM performance measures for Kentucky: roadway clearance time (RCT), incident clearance time (ICT), secondary crashes (SC), and responders struck by (RSB) and develop a Kentucky TIM dashboard for periodically updating and tracking performance measures.

## Nevada

**Development of a Statewide Pilot Project for Standardized TIM Performance Measurement and Reporting**, Kelley Klaver Pecheux, Benjamin Pecheux and Cara O'Donnell, Nevada Department of Transportation, July 2016.
https://www.nevadadot.com/home/showdocument?id=9371
*From the abstract*: This report describes the approach and findings associated with the development of a statewide pilot project for standardized traffic incident management (TIM) performance measurement and reporting. The project included four primary objectives: (1) benchmark Nevada's practices against those of leading peer agencies, (2) assess the quantity and quality of incident data available in Nevada, (3) develop a prototype integrated TIM performance database using available data, and (4) develop a prototype interactive dashboard that displays TIM performance measures using the database. Five sources of incident data were assessed: the Nevada Department of Transportation's (NDOT) freeway service patrol program; NDOT's statewide crash database; the Nevada Highway Patrol's computer-aided dispatch system; the Northern Nevada Road Operation Center; and the Freeway and Arterial System of Traffic. A step-by-step process for integrating data from the various sources was developed and implemented. A number of challenges and limitations associated with the data were identified. Finally, a prototype dashboard was developed that displays a variety of aggregate and disaggregate TIM performance measures. Recommendations for filling some of the data gaps are provided.

## Texas

**"Every Day Counts–Round 4 (EDC4): Accelerated Traffic Incident Management (TIM) Data Collection to Improve Overall Traffic Incident Management,"** Jeff Kaufman, *TxSTIC Meeting*, November 2018.
http://www.txstic.org/docs/download/Nov%202018%20TxSTIC%20Presentation.pdf
This presentation summarizes the FHWA EDC4 Program including project background, project scope, Waze and CAD integration and performance measures. The presentation also addresses how the information collected can be used to report on incident management activities throughout Texas.

**Review of Literature and Practices for Incident Management Programs,** Tim Lomax and Lauren Simcic, Texas A&M Transportation Institute, June 2016.
https://static.tti.tamu.edu/tti.tamu.edu/documents/PRC-15-56-T.pdf
This report focuses on the review of literature and practices for incident management programs, the FHWA's analysis of the important elements of TIM programs and characteristics that are associated with a high-performing program, incident management key strategies, performance measures and targets, key rapid clearance strategy elements, and attributes and experiences from incident management programs.

**Evaluating and Improving Incident Management Using Historical Incident Data: Case Studies at Texas Transportation Management Centers**, Praprut Songchitruksa, Kevin Balke, Xiaosi Zeng, Chi-Leung Chu, Yunlong Zhang and Geza Pesti, Texas Department of Transportation, August 2009.
https://pdfs.semanticscholar.org/d68b/c06ffeb4596bab8194c7401550707e7413a5.pdf
*From the abstract*: The companion guidebook (0-5485-P2) developed as part of this study provides the procedures and methodologies for effective use of historical incident data at Texas Transportation Management Centers (TMCs). This research report documents the results from the case studies conducted using the procedures outlined in the guidebook. Researchers examined the data collected from three Texas TMCs, which are Houston's TranStar, Austin's Combined Transportation and Emergency Communications Center (CTECC), and Fort Worth's TransVISION. Researchers conducted six categories of analyses in this study – (a) analysis of incident characteristics, (b) hot spot analysis, (c) incident impact estimation, (d) analysis of incident management performance measures, (e) incident duration prediction, and (f) incident-induced congestion clearance time prediction.

Researchers found that historical incident data can be effectively used to support incident management and performance evaluation processes both reactively and proactively. Some procedures need to be automated to be used efficiently in day-to-day operations. As such, various prototype tools, such as the incident duration and incident-induced congestion clearance prediction tools, were developed during this study to facilitate and automate the proposed methodologies. These prototype tools provided a platform for TxDOT to deploy the research results in the future.

*Related Resource*:

> **A Guidebook for Effective Use of Incident Data at Texas Transportation Management Centers**, Praprut Songchitruksa, Kevin Balke, Xiaosi Zeng, Chi-Leung Chu, Yunlong Zhang and Geza Pesti, Texas Department of Transportation, February 2009.
> Publication available at https://rosap.ntl.bts.gov/view/dot/37051
> *From the abstract*: This guidebook provides methodologies and procedures for using incident data collected at Texas transportation management centers (TMCs) to perform two types of analysis – evaluation/planning analysis and predictive analysis. For the evaluation/planning analysis, this guidebook provides (1) guidelines for reporting incident characteristics, (2) methods for analyzing hot spots, (3) methodologies for estimating incident impacts, and (4) guidelines and procedures for calculating performance measures. For predictive analysis, this guidebook describes (1) methodologies for predicting incident duration using incident characteristics and (2) methodologies for predicting incident-induced congestion clearance time using combined historical and real-time traffic data. Examples of applications and results from the methodologies and procedures described are provided throughout this guidebook.

## Utah

**Analysis of Performance Measures of Traffic Incident Management in Utah**, Grant G. Schultz, Mitsuru Saito, Mitchell G. Hadfield, Logan S. Bennett and Dennis L. Eggett, Utah Department of Transportation, April 2019.
https://www.udot.utah.gov/main/uconowner.gf?n=7287761759464127
*From the abstract*: In 2009 the Federal Highway Administration published a report regarding a Focus States Initiative that had been conducted with 11 states to discuss the development of national Traffic Incident Management (TIM) standards. Performance measures were defined, and a national TIM dashboard created, but very little data have been added to the dashboard

since. In this research study, performance measures of the Utah Department of Transportation (UDOT) TIM program were analyzed. Data availability was first assessed to determine whether these performance measures could be calculated. It was determined that crash response data available from the Utah Highway Patrol (UHP) could be used to calculate the performance measures of Incident Management Teams (IMT) and UHP units; however, roadway clearance data were missing. UHP personnel agreed to collect additional data regarding crash roadway clearance for six months of the study. Performance measures were calculated for responding units at 168 crashes. Using the crash response data from UHP and traffic speed, travel time, and volume data from UDOT databases, 83 crashes were evaluated to determine the volume of traffic affected by each incident and the associated user cost. Statistical analyses were conducted to assist UDOT in optimizing the allocation of their IMT resources.

### Virginia

**Highway Performance—Incident Duration**, Virginia Department of Transportation, September 2019.
http://dashboard.virginiadot.org/Pages/Performance/IncidentDuration.aspx
This web page provides incident duration data by district and date range, as well as a summary of the information based on percentages or numbers of incidents. The "Details" tab provides incident clearance data by date; the "Trends" tab charts the percent of incidents cleared by length of time (less than 30 minutes, 30 to 60 minutes, 60 to 90 minutes and greater than 90 minutes) and date.

**Primary and Secondary Incident Management: Predicting Durations in Real Time**, Asad J. Khattak, Xin Wang, Hongbing Zhang and Mecit Cetin, Virginia Center for Transportation Innovation and Research, April 2011.
http://www.virginiadot.org/vtrc/main/online_reports/pdf/11-r11.pdf
*From the abstract*: The main objectives of this study were to define secondary incidents, understand and analyze the occurrence and nature of such incidents, and develop tools that can comprehensively and continuously analyze primary and secondary incidents at the planning and operational levels, ultimately contributing to congestion management. The scope of the study is limited to freeway incidents in the Hampton Roads (HR) area.
….
This study developed and applied a dynamic queue-based tool (SiT) [Secondary Incident Identification Tool] to identify primary and secondary incidents from historical incident data and incorporated the models developed for incident duration, secondary incident occurrence and associated delays in an online prediction tool (iMiT) [Incident Management Integration Tool]. Although the tools developed in this study (SiT and iMiT) are currently calibrated using HR data, the methodology is transferable to other regions of Virginia.

## International Resources

**"Overview of Traffic Incident Duration Analysis and Prediction,"** Ruimin Li, Francisco C. Pereira and Moshe E. Ben-Akiva, *European Transport Research Review,* Vol. 10, Article 22, May 2018.
https://etrr.springeropen.com/articles/10.1186/s12544-018-0300-1
*From the introduction*: The objective of this study is to conduct a thorough review and discuss the research evolution, mainly including the different phases of incident duration, data resources, and the various methods that are applied in the traffic incident duration influence factor analysis and duration time prediction.

**"Traffic Incident Management: Framework and Contemporary Practices,"** Auttapone Karndacharuk and Asif Hassan, *Australasian Transport Research Forum*, November 2017. https://www.atrf.info/papers/2017/files/ATRF2017_108.pdf
*From the abstract*: A framework has been developed to present many aspects of traffic incident management (TIM) with an aim to harmonize incident management approaches in Australasia. By providing road network managers and incident management service providers with a guidance and common understanding of the ongoing process for integrating TIM practices and techniques, traffic disruption and road safety risk can be managed in a more coordinated and effective manner. Based on the Austroads research report (AP-R547-17), this paper presents the TIM framework and underlying principles for the various incident management phases from multi-agency collaboration and planning to performance evaluation and capability development. The outcome of identifying contemporary TIM practices from a review of jurisdictional policy and procedure documentation is discussed to support the overarching goal of the framework in maintaining mobility and improving safety during an incident.

*Related Resource*:

> **Techniques for Incident Management to Support Network Operations Planning**, Auttapone Karndacharuk and Asif Hassan, Austroads, July 2017.
> https://austroads.com.au/publications/traffic-management/ap-r547-17
> *From the abstract*: This report investigates current local and international incident management techniques and proposes an Australasian incident management framework that supports network operations planning. A literature review highlights the fact that traffic incident management (TIM) is not only a process of managing multi-agency, multi-jurisdictional response to road traffic incidents, but also a broader management program that involves an objective setup, stakeholder collaboration, option development and selection, implementation and performance evaluation. Baseline and emerging TIM techniques and practices for the collection of road and traffic data and the response to incident management needs were also reviewed and new and emerging techniques for traffic incident management identified. To assist in the establishment of a harmonised TIM methodology across Australasia, an incident management framework was developed based on the leading practices and techniques. The adoption of this integrated framework, which is underpinned by seven management principles, would improve the operation and safety of the road network by reducing the impact of planned and unplanned incidents. While the potential implications and benefits of the new technologies within the TIM framework have been briefly discussed in this report, quantifying the safety and efficiency impacts of different TIM techniques requires further investigation.

**"Best Practice in European Traffic Incident Management,"** John Steenbruggen, Michel Kusters and Gerrit Broekhuizen, *Procedia-Social and Behavioral Sciences*, Vol. 48, pages 297-310, 2012.
https://core.ac.uk/download/pdf/82224351.pdf
*From the abstract*: The Conference of European Directors of Roads (CEDR) investigates how countries can develop their IM [incident management] capabilities to support policy goals and the needs of road users. The purpose of this study is to facilitate the cooperation, on a European level, by exchanging experience and information. This will support countries across Europe to minimise the economic cost of incidents, improve road safety and, decrease mobility problems through the implementation of relatively low cost IM measures.

**"A Synthesis of Emerging Data Collection Technologies and Their Impact on Traffic Management Applications,"** Constantinos Antoniou, Ramachandran Balakrishna and Haris N. Koutsopoulos, *European Transport Research Review*, Vol. 3, Issue 3, pages 139-148, November 2011.
https://link.springer.com/article/10.1007/s12544-011-0058-1
*From the abstract*: The objective of this research is to provide an overview of emerging data collection technologies and their impact on traffic management applications. Several existing and emerging surveillance technologies are being used for traffic data collection. Each of these technologies has different technical characteristics and operating principles, which determine the types of data collected, accuracy of the measurements, levels of maturity, feasibility and cost, and network coverage. This paper reviews the different sources of traffic surveillance data currently employed, and the types of traffic management applications they may support. Automated Vehicle Identification data have several applications in traffic management and many more are certain to emerge as these data become more widely available, reliable, and accessible. Representative examples in this field are presented. Furthermore, the fusion of condition information with traffic data can result in better and more responsive dynamic traffic management applications with a richer data background**.**

**"Best Practice in European Traffic Incident Management,"** David Stones, *Conference of European Directors of Roads*, March 2011.
https://www.cedr.eu/download/Publications/2012/e_Incident_Management.pdf
*From the executive summary*: The first part of the report … outlines the motivation, composition, strategy, methodology and results of the task, as well as issues "for decision." This is followed by appendices devoted to best practice at operational, tactical and strategic levels. Appendix A is a framework guide that summarizes the essential components and factors in TIM including the cycle of phases which make up the critical timeline. Appendix B addresses wider concepts for effective TIM including international best practice. Appendix C highlights both the role of TIM in relation to the EC's ITS Action Plan and the EasyWay project and paths for development of TIM capability. Appendix D contains definitions and references.

## Related Resources

The citations below provide information about TIM modeling and metrics. Also included is a presentation about EventFlow, a potential system of interest.

**"Temporal Event Analytics With EventFlow: A Case Study of the Response to Fatal Incidents, Baltimore Region, 2014–2016**," Jason Dicembre, Michael VanDaniker, Catherine Plaisant, Fan Du and Eileen Singleton, *8th International Visualization in Transportation Symposium*, Baltimore Metropolitan Council, July 2017.
http://onlinepubs.trb.org/onlinepubs/Conferences/2017/visualization/Presentations_Viz/48.VanDaniker.pdf
This presentation describes the use of EventFlow for evaluating traffic incidents.

**"A Comprehensive Framework of Performance Measurement for Traffic Incident Management Programs,"** Md Sakoat Hossan, Xia Jin, Zhaohan Zhang, Albert Gan and Dong Chen, *Transportation Research Board 94th Annual Meeting*, Paper #15-0286, 2015.
Citation at https://trid.trb.org/view/1336582
*From the abstract*: This paper presents a comprehensive performance measurement framework that covers all aspects of TIM activities. This framework applies to all stages of TIM programming, from initiating a new program, to evaluating or improving an existing one. Specific, feasible and quantifiable indicators are developed that address all elements in a TIM

program, from strategic program planning and development, to tactical operations and tools, and supporting data and communication component. This performance measurement framework provides a guidance and serves a basic outline to facilitate any further customization for a TIM program. In addition, a brief overview of performance of TIM programs is provided based on a nationwide TMC survey. This benchmark analysis could provide some useful information for agencies who are interested to compare their performances.

**"Modeling Analysis of Incident and Roadway Clearance Time,"** Huaguo Zhou and Zhaofeng Tian, *Procedia-Social and Behavioral Sciences*, Vol. 43, pages 349-355, 2012.
https://cyberleninka.org/article/n/1168243.pdf
*From the abstract*: This research explored the relationship between incident clearance time and roadway clearance time using microsimulation VISSIM modelling to run different traffic incident scenarios. Approximately 50 traffic incident scenarios were developed to generate the data for different types of incidents under traffic conditions. Number of through lanes, number of blocked lanes, and traffic volumes were some of the variables being considered. Then, a mathematic model was developed to demonstrate the relationship between roadway clearance time and incident clearance time.

**Identifying Methods and Metrics for Evaluating Interagency Coordination in Traffic Incident Management**, Robert G. Feyen and Chinweike I. Eseonu, Intelligent Transportation Systems Institute, Center for Transportation Studies, University of Minnesota, May 2009.
Report available at
http://www.cts.umn.edu/Publications/ResearchReports/reportdetail.html?id=1764
*From the abstract*: This study found DOTs collect basic TIM performance measures (e.g., lane clearance times), but many do not record additional measures, consistently review the collected data or analyze it unless needed to answer specific questions. Since performance evaluation of interagency coordination is one area of TIM in which little success has been attained (FHWA, 2003), process improvement methods from operations management may prove useful. To illustrate, interagency incident response for a disabled vehicle (no injuries or property damage) is modeled as a process in which appropriate resources (e.g., state police, tow) must coordinate to safely remove the vehicle and restore normal traffic flow. Completing these events requires the resources to perform specific functions, each taking more or less time depending on various factors (e.g., weather, time of day). Response time data can highlight geographic areas or process segments with highly variable event times, leading to investigation and recommendations to reduce variability and, ultimately, traffic delays. Based on this approach, recommendations are made for data collection and analysis of appropriate TIM performance measures.

# Contacts

## State Agencies

CTC contacted the individuals below to gather information for this investigation.

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## Other Recommended Contacts

In addition to survey respondents, the individuals below were recommended as resources for information about their agencies' practices.

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### Maryland

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# Appendix A: Survey Questions

The following survey was distributed to members of the American Association of State Highway and Transportation Officials (AASHTO) Committee on Transportation System Operations who had experience with traffic incident management (TIM) data systems and practices.

## Traffic Incident Management Data Collection

*Note: Response to the question below determined how a respondent completed the survey:*

- *Respondents who answered "no" were directed to the* ***Agencies Not Gathering Data for Performance Measures*** *section in the survey.*
- *Respondents who answered "yes" were directed to the* ***Roadway Clearance Time*** *section in the survey.*

Is your agency using a system, process or database to collect traffic incident management (TIM) data to report on one or more of the three national performance measures listed below that are recommended under Federal Highway Administration's Every Day Counts (EDC-4) initiative?

- Roadway clearance time (time it takes to open the roadway due to an incident).
- Incident clearance time (time it takes to clear the incident; when the responders have left).
- Number of secondary crashes.
    - No.
    - Yes.

## Agencies Not Gathering Data for Performance Measures

*Note: After responding to the question below, this group of respondents is directed to the* ***Wrap-Up*** *section.*

Does your agency have an interest in or plans to use a system, process or database to collect data to report on TIM-related performance measures?

- Our agency has no interest in reporting on these performance measures.
- Our agency has an interest in reporting on these performance measures but lacks the resources to do so.
- Our agency plans to report on these performance measures. (Please describe your agency's plans below.)

## Roadway Clearance Time

Does your agency gather data to measure **roadway clearance time**?

- No (directs the respondent to **Incident Clearance Time**)
- Yes (directs the respondent to the questions below)

1. What roadway clearance time data does your agency gather?
2. What data sources does your agency use to gather this data (for example, traffic management centers, law enforcement, highway service patrols and freeway service patrols)?
3. When receiving data from these sources, what data format is used?
4. Please describe the challenges your agency has experienced when gathering data to measure and report on roadway clearance time.

### Incident Clearance Time

Does your agency gather data to measure **incident clearance time**?

- No (directs the respondent to **Number of Secondary Crashes**)
- Yes (directs the respondent to the questions below)

1. What incident clearance time data does your agency gather?
2. What data sources does your agency use to gather this data (for example, traffic management centers, law enforcement, highway service patrols and freeway service patrols)?
3. When receiving data from these sources, what data format is used?
4. Please describe the challenges your agency has experienced when gathering data to measure and report on incident clearance time.

### Number of Secondary Crashes

Does your agency gather data to measure the **number of secondary crashes**?

- No (directs the respondent to **Wrap-Up**)
- Yes (directs the respondent to the questions below)

1. What secondary crash data does your agency gather?
2. What data sources does your agency use to gather this data (for example, traffic management centers, law enforcement, highway service patrols and freeway service patrols)?
3. When receiving data from these sources, what data format is used?
4. Please describe the challenges your agency has experienced when gathering data to measure and report on secondary crashes.

### Wrap-Up

1. If available, please provide links to documentation related to your agency’s TIM data system and data collection practices. Send any files not available online to carol.rolland@ctcandassociates.com.
2. Please provide contact information for the staff member(s) we can contact to obtain more information about your agency's practices.
3. Please use this space to provide any comments or additional information about your previous responses.