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# BEST PRACTICES IN TRAFFIC INCIDENT MANAGEMENT

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16. Abstract Traffic incident management (TIM) is a planned and coordinated program to detect and remove incidents and restore traffic capacity as safely and quickly as possible. Over time, various tools and strategies have been developed and implemented in an effort to improve overall TIM efforts. 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. The National Traffic Incident Management Coalition (NTIMC), in cooperation with FHWA, provides a unique forum for not only disseminating the information presented here but also for standardizing practices to consistently maximize the effectiveness of TIM efforts.					
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SI* (MODERN METRIC) CONVERSION FACTORS				
APPROXIMATE CONVERSIONS TO SI UNITS				
SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
<b>LENGTH</b>				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
<b>AREA</b>				
in <sup>2</sup>	square inches	645.2	square millimeters	mm <sup>2</sup>
ft <sup>2</sup>	square feet	0.093	square meters	m <sup>2</sup>
yd <sup>2</sup>	square yard	0.836	square meters	m <sup>2</sup>
ac	acres	0.405	hectares	ha
mi <sup>2</sup>	square miles	2.59	square kilometers	km <sup>2</sup>
<b>VOLUME</b>				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft <sup>3</sup>	cubic feet	0.028	cubic meters	m <sup>3</sup>
yd <sup>3</sup>	cubic yards	0.765	cubic meters	m <sup>3</sup>
NOTE: volumes greater than 1000 L shall be shown in m <sup>3</sup>				
<b>MASS</b>				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
<b>TEMPERATURE (exact degrees)</b>				
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
<b>ILLUMINATION</b>				
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m <sup>2</sup>	cd/m <sup>2</sup>
<b>FORCE and PRESSURE or STRESS</b>				
lbf	poundforce	4.45	newtons	N
lbf/in <sup>2</sup>	poundforce per square inch	6.89	kilopascals	kPa

  

APPROXIMATE CONVERSIONS FROM SI UNITS				
SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
<b>LENGTH</b>				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
<b>AREA</b>				
mm <sup>2</sup>	square millimeters	0.0016	square inches	in <sup>2</sup>
m <sup>2</sup>	square meters	10.764	square feet	ft <sup>2</sup>
m <sup>2</sup>	square meters	1.195	square yards	yd <sup>2</sup>
ha	hectares	2.47	acres	ac
km <sup>2</sup>	square kilometers	0.386	square miles	mi <sup>2</sup>
<b>VOLUME</b>				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m <sup>3</sup>	cubic meters	35.314	cubic feet	ft <sup>3</sup>
m <sup>3</sup>	cubic meters	1.307	cubic yards	yd <sup>3</sup>
NOTE: volumes greater than 1000 L shall be shown in m <sup>3</sup>				
<b>MASS</b>				
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
<b>TEMPERATURE (exact degrees)</b>				
°C	Celsius	1.8C+32	Fahrenheit	°F
<b>ILLUMINATION</b>				
lx	lux	0.0929	foot-candles	fc
cd/m <sup>2</sup>	candela/m <sup>2</sup>	0.2919	foot-Lamberts	fl
<b>FORCE and PRESSURE or STRESS</b>				
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in <sup>2</sup>

\*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)

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## LIST OF ABBREVIATIONS

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<b>AAA</b>	American Automobile Association
<b>AASHTO</b>	American Association of State and Highway Transportation Officials
<b>ACNS</b>	Automated Collision Notification Systems
<b>AEGIS</b>	Advanced Emergency Geographic Information System
<b>AFD</b>	Austin Fire Department
<b>AIMHigh</b>	Austin-Area Incident Management for Highways
<b>ALERT</b>	Arizona Local Emergency Response Team
<b>AMPO</b>	Association of Metropolitan Planning Organizations
<b>ANSI</b>	American National Standards Institute
<b>APD</b>	Austin Police Department
<b>AR</b>	Arkansas
<b>ATIS</b>	Advanced Traveler Information System
<b>ATMS</b>	Advanced Traffic Management Systems
<b>ATSSA</b>	American Traffic Safety Services Association
<b>AVL</b>	Automatic Vehicle Location
<b>AZ</b>	Arizona
<b>CA</b>	California
<b>CAD</b>	Computer-Aided Dispatch
<b>CAMPO</b>	Capital Area Metropolitan Planning Organization
<b>CapWIN</b>	Capital Wireless Information Net
<b>CARS</b>	Condition Acquisition and Reporting System
<b>CCTV</b>	Closed-Circuit Television
<b>CFR</b>	Code of Federal Regulations
<b>CHART</b>	Coordinated Highways Action Response Team
<b>CITE</b>	Consortium for ITS Training and Education
<b>CJSTC</b>	Criminal Justice Standards and Training Commission
<b>CMAQ</b>	Congestion Mitigation And Air Quality
<b>CO</b>	Carbon Monoxide or Colorado
<b>COP</b>	Community of Practice
<b>CT</b>	Connecticut
<b>CTECC</b>	Combined Transportation, Emergency, and Communications Center
<b>DC</b>	District of Columbia
<b>DE</b>	Delaware

## Best Practices in Traffic Incident Management

<b>DHS</b>	Department of Homeland Security
<b>DMS</b>	Dynamic Message Sign
<b>DPS</b>	Department of Public Safety
<b>DVRPC</b>	Delaware Valley Regional Planning Commission
<b>E-CAD</b>	Enhanced Computer-Aided Dispatch
<b>EMS</b>	Emergency Medical Services
<b>EOC</b>	Emergency Operations Center
<b>ERSI</b>	Emergency Responder Safety Institute
<b>ETC</b>	Emergency Traffic Control
<b>ETP</b>	Emergency Traffic Patrol
<b>FEMA</b>	Federal Emergency Management Agency
<b>FHP</b>	Florida Highway Patrol
<b>FHWA</b>	Federal Highway Administration
<b>FIRST</b>	Freeway Incident Response Safety Team
<b>FL</b>	Florida
<b>FSI</b>	Focus State Initiative
<b>FSP</b>	Freeway Service Patrol
<b>GA</b>	Georgia
<b>GEMA</b>	Georgia Emergency Management Agency
<b>GIS</b>	Geographic Information Systems
<b>GJXDM</b>	Global Justice Xml Data Model
<b>GPS</b>	Global Positioning System
<b>HAR</b>	Highway Advisory Radio
<b>HC</b>	Hydrocarbon
<b>HELP</b>	Highway Emergency Local Patrol
<b>HERO</b>	Highway Emergency Response Operators
<b>IA</b>	Iowa
<b>IACP</b>	International Association of Chiefs Of Police
<b>IAFC</b>	International Association of Fire Chiefs
<b>ICS</b>	Incident Command System
<b>IDRuM</b>	Interactive Detour Route Mapping
<b>IEEE</b>	Institute of Electrical And Electronics Engineers, Inc.
<b>IL</b>	Illinois
<b>IMAP</b>	Incident Management Assistance Patrol
<b>IMCC</b>	Incident Management Coordinating Committee



## Best Practices in Traffic Incident Management

<b>IMRT</b>	Incident Management Response Team
<b>IN</b>	Indiana
<b>IN-TIME</b>	Indiana Traffic Incident Management Effort
<b>ISEA</b>	International Safety Equipment Association
<b>ITS</b>	Intelligent Transportation Systems
<b>JOPS</b>	Joint Operations Policy Statement
<b>KY</b>	Kentucky
<b>LA</b>	Louisiana
<b>M&amp;O</b>	Management and Operations
<b>MA</b>	Massachusetts
<b>MCCV</b>	Mobile Command/Communications Vehicle
<b>MD</b>	Maryland
<b>ME</b>	Maine
<b>MI</b>	Michigan
<b>MN</b>	Minnesota
<b>MO</b>	Missouri
<b>MOT</b>	Maintenance of Traffic
<b>MPO</b>	Metropolitan Planning Organization
<b>MS</b>	Mississippi
<b>MUTCD</b>	Manual of Uniform Traffic Control Devices for Streets and Highways
<b>NC</b>	North Carolina
<b>NCHRP</b>	National Cooperative Highway Research Program
<b>NCTCOG</b>	North Central Texas Council of Governments
<b>NEMA</b>	National Electrical Manufacturers Association
<b>NFPA</b>	National Fire Protection Association
<b>NG 9-1-1</b>	Next Generation 9-1-1
<b>NH</b>	New Hampshire
<b>NHI</b>	National Highway Institute
<b>NHTSA</b>	National Highway Traffic Safety Administration
<b>NIJ</b>	National Institute of Justice
<b>NIMS</b>	National Incident Management System
<b>NJ</b>	New Jersey
<b>NM</b>	New Mexico
<b>NOx</b>	Nitrous Oxide
<b>NTIMC</b>	National Traffic Incident Management Coalition

## Best Practices in Traffic Incident Management

<b>NUG</b>	National Unified Goal
<b>NV</b>	Nevada
<b>NVFC</b>	National Volunteer Fire Council
<b>NY</b>	New York
<b>NYSP</b>	New York State Police
<b>OEMC</b>	Office of Emergency Management and Communications
<b>OH</b>	Ohio
<b>OR</b>	Oregon
<b>OSHA</b>	Occupation Safety and Health Administration
<b>PA</b>	Pennsylvania
<b>POST</b>	Police Officers Standards and Training
<b>PSAP</b>	Public Safety Answering Point
<b>REACT</b>	Regional Emergency Action Coordinating Team
<b>RI</b>	Rhode Island
<b>RISC</b>	Roadway Incident Scene Clearance
<b>RoIP</b>	Radio-Over-Internet Protocol
<b>RTSC</b>	Responsive Traffic Signal Control Systems
<b>SC</b>	South Carolina
<b>SEWCRSG</b>	Southeast Wisconsin Communications Resource/Support Group
<b>SHRP</b>	Strategic Highway Research Program
<b>SIRV</b>	Severe Incident Response Vehicle
<b>SMRPC</b>	Southern Maine Regional Planning Commission
<b>SOPs</b>	Standard Operating Procedures
<b>SQC</b>	Safe, Quick Clearance
<b>TCLEOSE</b>	Texas Commission on Law Enforcement Officer Standards and Education
<b>TCME</b>	Travis County Office of the Medical Examiner
<b>TERI</b>	Transportation Emergency Response Institute
<b>TIM</b>	Traffic Incident Management
<b>TIME</b>	Traffic Incident Management Enhancement
<b>TIMSA</b>	Traffic Incident Management Self-Assessment
<b>TMC</b>	Traffic Management Center
<b>TN</b>	Tennessee
<b>TRAA</b>	Towing and Recovery Association of America
<b>TSSE</b>	Total Station Surveying Equipment
<b>TTY</b>	Text Telephone

## Best Practices in Traffic Incident Management

<b>TX</b>	Texas
<b>U.S.</b>	United States
<b>UDOT</b>	Utah Department of Transportation
<b>URM</b>	Unified Response Manual
<b>USDOJ</b>	U.S. Department of Justice
<b>USDOT</b>	U.S. Department of Transportation
<b>UT</b>	Utah
<b>VA</b>	Virginia
<b>VDOT</b>	Virginia Department of Transportation
<b>WA</b>	Washington
<b>WaTIMCo</b>	Washington's Traffic Incident Management Coalition
<b>WI</b>	Wisconsin
<b>WSDOT</b>	Washington Department of Transportation
<b>WSP</b>	Washington State Patrol

## INTRODUCTION

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Traffic incident management (TIM) is a planned and coordinated program to detect and remove incidents and restore traffic capacity as safely and as quickly as possible. Over time, various tools and strategies have been developed and implemented in an effort to improve overall TIM efforts. The nature and extent of tools and strategies in use are highly variable across the Nation, reflecting different priorities, congestion effects, levels of program maturity, and investment. As a direct result, the observed or reported effectiveness of individual or combined strategies is inconsistent.

As part of a continuing effort to improve TIM in the United States, an international scan tour was conducted in April 2005 under the sponsorship of the Federal Highway Administration (FHWA), the American Association of State and Highway Transportation Officials (AASHTO), and the National Cooperative Highway Research Program (NCHRP). TIM experts, representing law enforcement, fire and rescue, emergency medical services (EMS), transportation, and other perspectives, visited four European countries to assess various procedures, practices, and technologies that might improve the effectiveness of U.S. incident management. Major issues of interest included TIM planning and training, on-scene operations, technology use, and program management and administration.

From the information obtained during the scan, the team formulated several recommendations to improve the effectiveness of TIM in the United States. One such recommendation led to the development of a National Unified Goal (NUG) for Traffic Incident Management by the National Traffic Incident Management Coalition (NTIMC). Developed through a consensus process, the NUG consists of three major goals and 18 associated strategies related to responder safety; safe, quick incident clearance; and prompt, reliable, interoperable communications. NTIMC and its partners at the national level are working to provide tools and guidance to assist State, regional, and local TIM partners in implementing NUG strategies. A full description of the NUG, as well as supporting NTIMC initiatives, is available at the NTIMC website, accessible at <http://timcoalition.org/?siteid=41>.<sup>(1)</sup>

### Report Purpose and Contents

Consistent with NTIMC's efforts to assist TIM partners in implementing NUG strategies, the objectives of this investigation were to:

- Review and assess various TIM policies, procedures, and technologies to identify current "best practices" in the United States.
- Seek a synergistic partnership with NTIMC to support identification of U.S. best practices and accelerated implementation of these practices by State, regional, and local TIM partners.

Information to support this investigation was obtained through:

- A review of various published and electronic information sources.
- Input from TIM practitioners from law enforcement, fire and rescue, EMS, transportation and towing and recovery agencies in Arizona, California, Florida, Maryland, Michigan, Nevada, New Jersey, New York, Ohio, Pennsylvania, Tennessee, Texas, Utah, and Washington.

Following this introductory material, this report describes task-specific and cross-cutting challenges commonly encountered by TIM practitioners in the performance of their duties, and novel or effective strategies for overcoming these 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. Information sought included common challenges and impediments to TIM efforts in the United States, as well as potential tools and strategies for improving TIM efforts. Information pertaining to relative effectiveness or measurable benefits tied to each tool or strategy was also of interest. Because information was gathered from TIM programs at various stages of development, the reported strategies for improving TIM range from sophisticated, high-technology strategies to simple, procedural strategies. This report concludes with an identification of those TIM tools and strategies observed to be most successful and recommendations for NTIMC's role in supporting implementation of these practices by State, regional, and local TIM partners.

When considering the myriad of task-specific and cross-cutting tools and strategies identified in this document, note that select TIM tools and strategies must operate concurrently to fully realize operational benefits. For example, benefits resulting from the use of standardized message sets/use protocol will only be realized if dynamic message signs (DMSs) are concurrently used for traveler information. Similarly, the benefits resulting from the use of electronic loop detectors and closed-circuit television (CCTV) cameras in combination outweigh the benefits of either used singularly. This investigation did not consider cost in relation to effectiveness. Low- or no-cost tools or strategies with moderate reported or observed effectiveness may prove to be better implementation options than higher-cost strategies with the same or potentially higher benefits. Consequently, additional information gathering is recommended prior to implementation.

Published and electronic information sources are listed in "References" to support additional information gathering on particular topics of interest. In addition, contact information for the TIM practitioners providing information to support this investigation is provided in appendix A to allow follow-up regarding the application of a particular tool or strategy.

For many of the individual tools and strategies, a wide range of effectiveness was observed or reported by locale, suggesting that local conditions related to the nature and extent of operation, maintenance, marketing, etc. have a significant impact on their perceived or measured success. Because of their potential to be effective under certain implementation scenarios, these additional tools and strategies, infrequently or inconsistently observed to be effective, are included in "Appendix B: Additional Task-Specific Strategies" and "Appendix C: Additional Cross-Cutting Strategies" for supplemental reference. The tools and strategies described in the main body of the report are those that are most commonly and consistently reported to be effective.

## Target Audience

The target audience for this document includes the following:

- **Public agency/private industry operations personnel.** Personnel responsible for effecting efficient and effective TIM on a per-incident basis will benefit from this information through specific examples of successful TIM strategies that could be adopted.
- **Public agency/private industry management or administrative personnel.** Personnel will benefit from this information by identifying, implementing, and promoting successful TIM strategies to encourage future program growth.
- **State and local political officials.** Officials will benefit from an abbreviated form of this information by identifying and supporting successful TIM strategies that provide significant safety- and delay-related benefits to their constituents.

## TASK-SPECIFIC CHALLENGES AND STRATEGIES

---

TIM activities are typically categorized into five overlapping functional areas:

- Detection and verification.
- Traveler information.
- Response.
- Scene management and traffic control.
- Quick clearance and recovery.

Actions taken in any one of the five functional areas may be concurrent with actions taken in a different functional area. For example, public information officers may be continuously giving out traveler information while scene management and clearance actions are being taken at the incident scene.

Responders may encounter various challenges in the conduct of these TIM functions. Over time, various tools and strategies have been developed and implemented in an effort to overcome the most common impediments and improve overall TIM efforts. The remainder of this chapter describes common challenges and potential strategies for improvement for each of the five TIM functional areas. Whenever possible, the reader is directed to example applications, reported either in the published and electronic information sources or by participating TIM practitioners, to support additional information gathering regarding a particular tool or strategy of interest.

### Detection and Verification

Detection and verification are the first steps in the TIM process. Detection is the determination that an incident of some type has occurred. Incidents may be detected in person by motorists or response personnel or automatically using electronic loop detectors and associated incident detection algorithms. Verification is the determination of the precise location and nature of the incident. Accurate and detailed information about the incident can help to ensure that the most appropriate personnel and resources are dispatched to the scene. Verification can be accomplished in the field utilizing on-site response personnel or remotely using CCTV.

Effective incident detection and verification can improve access to the scene for incident responders, support appropriate personnel and equipment dispatch to the scene, improve responder safety by alerting them to potentially dangerous conditions at the scene (i.e., fire or hazardous materials), reduce secondary incidents, and save lives by ensuring that vehicle crashes are detected on low-traffic roadways.

Common challenges to effective incident detection and verification include the following:

- **Inconsistent notification of incident responders.** Typically, public safety agencies, including law enforcement, fire and rescue, and EMS agencies, are the first to be notified of an incident through 9-1-1 dispatch. Notification of support incident responders, particularly transportation agencies, can be less consistent. If transportation agencies do not support 24-h operations or promote an active role in TIM, public safety personnel may overlook their notification. In addition, if no formal guidelines are in place for notifying support responders, or if recently instituted guidelines are not being followed, support personnel notification may vary depending on the particular public safety personnel managing the incident.

- **Inaccurate incident reports.** Motorists who carry cellular telephones are commonly the first to detect an incident and provide notification. While the speed with which the incident is reported is beneficial, motorists may not provide accurate location information and may exaggerate incident severity. Motorists may use landmarks to describe the incident location rather than roadway identifiers and may confuse directional information. As a result, unnecessary, inadequate, or insufficient response resources may be dispatched to the incident scene.
- **Dispatcher overload.** Often, especially after the occurrence of a major incident, dispatchers receive multiple calls from motorists reporting the incident. These multiple calls can overload dispatchers and limit their attention to other emergencies.
- **Slow detection.** In urban areas, higher traffic volumes and a prevalence of cellular-telephone users in the traffic stream generally result in quick and reliable incident detection times. In nonurban or remote areas, where passing vehicles are less frequent, incidents may go undetected for some time. Early detection helps to ensure prompt medical attention and a reduction in secondary incidents.

Table 1 identifies the various tools and strategies that have proven effective in overcoming these challenges and identifies select locations where these tools and strategies are in use. Note that select detection and verification strategies may be most appropriate for distinct implementation in rural or urban environments. For example, motorist aid call boxes and automated collision notification systems (ACNSs) may result in greater benefit when implemented in rural areas, while CCTV cameras are best suited to urban environments. Additional tools and strategies that were more variable in their reported effectiveness—such as electronic loop detectors and probe vehicles to improve slow incident detection or incident notification protocol to lend consistency to incident notification—are included in appendix B.

Table 1. Detection and verification challenges, strategies, and select implementation locations.

DETECTION AND VERIFICATION STRATEGIES					EXAMPLE APPLICATIONS
	Inconsistent Notification	Inaccurate Incident Reports	Dispatcher Overload	Slow Detection	
Field Verification by On-Site Responders		●			NY (Hudson Valley Region)
Closed-Circuit Television Cameras		●			76+ U.S. Metropolitan Areas, MD
Frequent/Enhanced Roadway Reference Markers		●			FL, NJ/PA (Delaware Valley Region), OH, TN
Enhanced 9-1-1/Automated Positioning Systems		●	●		TX (San Antonio)
Motorist Aid Call Boxes				●	27+ U.S. Metropolitan Areas, GA
Automated Collision Notification Systems				●	16+ U.S. Metropolitan Areas, NY (Erie Co.)

Additional descriptive information regarding the various tools and strategies and select locations where these tools and strategies are in use is provided below.

- **Field verification by on-site responders.** A common means of incident verification is through the initial dispatch of law enforcement personnel to the incident scene. Once on-scene, the officer assesses the incident, determines response needs, and requests appropriate response through dispatch. This method is particularly effective where traffic congestion does not unduly restrict travel time to the detected incident. Service patrols, described later in this document, can provide similar incident verification capabilities. Under congested conditions, roving service patrols may be quicker to arrive at an incident scene due to their closer proximity. The effectiveness of field verification by on-site responders under either scenario can be improved with a high degree of interagency cooperation and coordination.

In the Hudson Valley region in New York, Highway Emergency Local Patrol (HELP) service patrol vehicles are equipped with a live video stream back to the traffic management center (TMC) housing the New York State Department of Transportation and State Patrol. Onboard dash cameras relay real-time incident information to dispatchers ensuring the proper and expedited dispatch of equipment. The use of streaming video was found to be extremely helpful for remote transportation and law enforcement personnel in determining the incident characteristics and subsequent response needs. <sup>(6)</sup>

- **Closed-circuit television cameras.** CCTV cameras provide limited-access video images for traffic-monitoring purposes. Improvements in picture quality, pan and zoom capabilities, and video data transmission rates have made CCTV a very useful incident verification tool. Whereas electronic loop detectors (described in appendix B) provide detection capabilities but no verification, CCTV cameras provide verification capabilities but only limited incident detection functions. Experience has shown that manual monitoring of CCTV images leads to a “blank stare”; even if an incident is visible on the screen, the viewer may not register it. The two technologies may best be used in combination. Evaluating the combined use of electronic loop detectors and CCTV cameras, a study conducted in Maryland reported a benefit-to-cost ratio of 5.6:1, including a 5 percent (2 million vehicle-hours per year) decrease in delay associated with nonrecurrent congestion. <sup>(7)</sup>

The effectiveness of CCTV cameras is dependent upon the extent and adequacy of camera coverage. In 2007, the ITS Deployment Survey estimated that approximately 36 percent of all freeway miles across 76 U.S. metropolitan areas were equipped with CCTV cameras. <sup>(2)</sup>

- **Frequent/enhanced roadway reference markers.** Installing more frequent roadway reference markers can help to ensure that motorists accurately report incident location. Additional directional and route information can also be included on the markers.

A number of urban areas across the Nation rely upon frequent/enhanced roadway reference markers to accurately locate incidents:

- Roadway reference markers, provided every 0.2 mi along urban freeways in Ohio, help motorists quickly and accurately identify the location of an incident. Dispatchers are trained to direct motorists to look for and report these roadway identifiers. <sup>(8)</sup>
- Similarly spaced roadway reference markers along urban freeways in Chattanooga, Knoxville, Memphis, and Nashville, TN, have proven additionally beneficial to HELP



service patrol operators, law enforcement personnel, fire and rescue personnel, and other TIM personnel in accurately communicating incident location. <sup>(9)</sup>

- In the Delaware Valley region in New Jersey and Pennsylvania, TIM personnel rely on ramp reference markers at complex intersections for accurate identification of incident locations. A corresponding map is provided to dispatchers for reference.

Supporting more widespread implementation, a recent study conducted by the statewide TIM team in Florida concluded that frequent/enhanced roadway reference markers were beneficial to TIM operations. <sup>(10)</sup>

- **Enhanced 9-1-1/automated positioning systems.** Enhanced 9-1-1 systems—that automatically associate a physical address or location with the caller’s telephone number, display the caller’s location information to the dispatcher, and route the call to the most appropriate PSAP—can improve both the accuracy of incident reports and help to alleviate dispatcher overload. For incoming calls made from cellular telephones, a variety of automated positioning techniques are used. Cellular geolocation relies on the time difference of cellular signal arrival and the angle of arrival to determine incident location. The cellular tower location or the latitude/longitude of the caller may be displayed. GPS utilizes a chip installed in each cellular telephone to locate the originating call.

The next generation of 9-1-1 (NG 9-1-1) systems, whose development is currently being guided by a National Next Generation 9-1-1 Initiative, will be designed to better respond to text, data, images, and video, which are increasingly common in wireless personal communications. <sup>(11,12)</sup> Moving forward with implementation, Bexar, Comal, and Guadalupe Counties near San Antonio, TX, are implementing an NG 9-1-1 system to manage text messaging, voice-over-Internet protocol, and cellular telephone camera images and video. The upgrade will be accomplished over a 5-yr period at a cost of \$24 million, provided largely through telephone customer fees of \$0.22 per month for landline telephone accounts and \$0.50 per month for cellular telephone accounts. <sup>(13)</sup>

- **Motorist aid call boxes.** In 2007, the Intelligent Transportation Systems (ITS) Deployment Survey estimated that approximately 10 percent of all freeway miles in the United States across 27 metropolitan areas were equipped with motorist aid call boxes. <sup>(2)</sup> Motorist aid call boxes are permanently mounted roadside communications devices that allow motorists to request assistance or report an incident. Typically, call boxes are installed at bridge or tunnel locations where incident impacts are significant or in remote areas where alternative communications services (e.g., cellular service or pay phones) are limited. Contemporary motorist aid call box systems support two-way voice communication that allows the exchange of additional information about the incident. Safety concerns have been expressed regarding the need for motorists to exit their vehicles and walk to use the call box, exposing them to passing traffic.

Assuming a reduction of one injury per year and one fatality every 5 yr, motorist aid call boxes installed along 39 mi of rural I-85 in Georgia were estimated to yield a benefit-to-cost ratio of 2.76:1, with an associated cost savings of \$329,820. <sup>(3)</sup> In a public opinion survey conducted 1 yr later, 97 percent of respondents felt that call boxes on rural interstates in Georgia were a good idea even though 64 percent of them owned cellular telephones. Also, 78 percent of respondents indicated a willingness to pay a fee as part of their annual vehicle registration to fund the installation and maintenance of additional call boxes. <sup>(4)</sup>

- **Automated collision notification systems.** More than a dozen commercial ACNSs are currently on the market, available either as factory-installed options on high-end luxury vehicles or as after-market products. ACNSs serve to improve detection of incidents in remote areas through either the automatic or motorist-initiated activation of an alarm and verification of a vehicle's location through the automatic transmission of location data. The most popular position location technologies include global positioning system (GPS) and cellular geolocation techniques that rely on the time difference of cellular signal arrival and the angle of arrival.

ACNSs typically utilize wireless communication and a third-party response center to notify the closest public safety answering point (PSAP) for emergency response. In anticipation of ACNS proliferation and subsequent increases in call volumes, emerging strategies are currently under investigation that would allow for direct communications between ACNSs and PSAPs, eliminating the need for a third-party response center. Proposed strategies may utilize existing PSAP infrastructure, such as text telephone (TTY) systems required at all PSAPs under Federal law, or require various infrastructure upgrades depending on the nature of communications. In 2007, the ITS Deployment Survey reported that law enforcement agencies in 16 U.S. metropolitan areas and fire and rescue agencies in 6 U.S. metropolitan areas had access to data from ACNSs to speed incident detection. <sup>(2)</sup>

In Erie County, NY, a field operational test found that ACNS reduced incident detection time from an average of 3 min to less than 1 min. Maximum detection times for vehicles equipped with ACNS was 2 min, while the maximum detection times for unequipped vehicles was as high as 46 min. <sup>(5)</sup>

## Traveler Information

Traveler information is the communication of incident-related information to motorists who are at the scene of the incident, approaching the scene of the incident, or not yet departed from work, home, or other location. This information serves to reduce traffic demand and improve responder safety at the incident scene, reduce the potential for secondary incidents for motorists approaching the scene, and allow motorists to alter their travel plans on the basis of current traffic conditions. To ensure motorist cooperation, traveler information tools or strategies should:

- Advise motorists of the nature and extent of the problem so that they may make intelligent choices about alternative routes or delayed trip departures.
- Provide information on possible courses of action such as alternative routes.
- When motorists are required to take certain actions (e.g., change lanes, reduce speed, or divert), describe those actions clearly.

Traveler information should be provided as early in the TIM process as possible and should continue until the incident has been cleared and the traffic backup has dissipated. Common traveler information challenges relate to the following:

- **Inaccurate traveler information.** The lack of a sophisticated surveillance system is often blamed for poor traveler information. Miscommunication and a lack of communication among various responding agency personnel, dispatchers, and the media are more often the reasons. The accuracy or detail of information that is passed from responding personnel to the dispatcher is not always maintained when the information is passed to a third party. In

addition, dispatchers and the media must try to assimilate sometimes conflicting information from a variety of sources.

- Inconsistent dynamic message sign use.** Two different schools of thought exist regarding the use of DMSs during non-incident times. The first suggests that only emergency or incident-related messages should be displayed so that when it is necessary for motorists to be alert or take action, they will pay attention to the sign. Repetitious, nonemergency messages are thought to dull motorists’ sensitivity to the message. The second school of thought views repetitious observance of the sign as a benefit. Non-incident-related information, such as carpool information or safety reminders (e.g., “Buckle Up”), accustoms motorists to observing the signs for traffic-related information. During an incident, it is likely that they will turn to DMSs for information out of habit. In addition, leaving the sign blank may lead drivers to believe that it is not working.

Table 2 identifies the various tools and strategies that have proven effective in overcoming each of these challenges and identifies select locations where these tools and strategies are in use. Note that additional tools and strategies that were more variable in their reported effectiveness—including incident update protocols and highway advisory radio (HAR)—are included in appendix B.

Table 2. Traveler information challenges, strategies, and select implementation locations.

TRAVELER INFORMATION STRATEGIES	Inaccurate Traveler Information	Inconsistent DMS Use	EXAMPLE APPLICATIONS
5-1-1 Systems	●		33+ States
Traveler Information Websites	●		39+ States
Media Partnerships	●		53+ U.S. Metropolitan Areas
Dynamic Message Signs	●		81+ U.S. Metropolitan Areas, CA (Stockton)
Standardized DMS Message Sets/Use Protocol		●	73+ U.S. Metropolitan Areas, TX (Austin, San Antonio)

Additional descriptive information regarding the various tools and strategies and select locations where these tools and strategies are in use is provided below.

- 5-1-1 systems.** Similar to the national telephone numbers for information (4-1-1) and emergencies (9-1-1), 5-1-1 was recently established as the national telephone number for traffic and travel information. Travelers can dial 5-1-1 to access current information for specific routes and roadways, including traffic incidents, roadway blockages, lane closures, weather events, and, in some instances, transit and tourism information. State-level systems vary widely in functionality and may be managed by State departments of transportation, local transportation agencies, or local transit agencies. Some States have incorporated companion web services (described below) that provide more extensive traffic and travel information. The effectiveness of the 5-1-1 system is dependent upon the maturity of the available system and the nature and extent of concurrent marketing to inform the public of this traveler information resource.

To date, 5-1-1 services are available in 33 States. Since its inception in 1999, more than 112 million calls to 5-1-1 have been registered nationwide. <sup>(14)</sup>

- **Traveler information websites.** The Internet has allowed transportation agencies to widely disseminate traveler information such as real-time traffic congestion, incidents, updates on construction activities, and other transportation-related information to the public. Traveler information websites can also be combined with in-field technologies such as DMS (described below) and HAR (described in appendix B) as part of a broader advanced traveler information system (ATIS). The information is available 24 h a day at a relatively low cost to the provider, and it can be accessed by users from home, from work, or en route if Internet access is available. The effectiveness of traveler information websites is dependent upon the nature and extent of, and level of effort expended to maintain, the traveler information provided on the website.

In 2007, the ITS Deployment Survey reported that at least 39 States utilize websites to provide traveler information. <sup>(2)</sup> Approximately one-third of these websites are operated in conjunction with 5-1-1 telephone services described above.

- **Media partnerships.** Most traveler information is broadcast over commercial AM and FM radio or television. As an indication of the importance of providing traffic-related information, private traffic-reporting firms that collect, package, and “sell” traffic information to the broadcast media have developed in many urban areas. Cooperative media partnerships help to ensure that public-sector agencies are fully utilizing resource opportunities that exist. Effective media relationships require an understanding of media perspectives, needs, and limitations, as well as a media education effort to stress the importance of accurate and timely information. Multidisciplinary training may provide convenient forums for improving media relations.

In 2004, the ITS Deployment Survey reported 59, 54, and 15 metropolitan areas in the United States distributing TIM information, providing CCTV camera images, and providing a direct video feed of traffic conditions to the media, respectively. By 2006, the number of U.S. metropolitan areas providing a direct video feed of traffic conditions to the media increased to 53. <sup>(2)</sup>

- **Dynamic message signs.** DMSs—also known as changeable or variable message signs—are useful for providing dynamic information regarding unusual conditions, guidance information regarding diversion, and advance warning of conditions ahead. DMSs can be combined with HAR, websites, and other technologies as part of a broader ATIS. To ensure maximum effectiveness when communicating with the motoring public, the information should be accurate and timely, and the signs should be located carefully to support appropriate diversionary action. Signs can be permanently installed at fixed locations, or portable and mounted on a truck or trailer. Portable DMSs must be able to be quickly mobilized and deployed to be effective.

In 2006, the ITS Deployment Survey reported at least 3,398 permanently installed and 1,362 portable DMSs used in 81 metropolitan areas in the United States. <sup>(2)</sup>

As a quality assurance measure for DMS use, TIM personnel in Stockton, CA, reported using on-site responders to verify the appropriateness of posted DMS messages and to provide requests for updated messages as the TIM process evolves. These DMS message

verification procedures by on-site responders were reported to be very effective in enhancing the accuracy of traveler information.

- **Standardized DMS message sets/use protocol.** Standard message sets help to ensure the posting of appropriate DMS messages and reduce the need for TIM personnel to redraft unique messages for each incident. Standard DMS message sets that attempt to reflect every possible incident scenario, however, can become large and cumbersome to use and, hence, lose effectiveness.

To elicit the proper response from motorists, DMS messages must be short enough to be read and understood by a passing motorist. At typical highway speeds, the message posted on a DMS must be presented to motorists in about 8 s or less. This translates to eight words at 55 mi/h, seven words at 65 mi/h, and six words at 70 mi/h. Motorist comprehension can be improved if messages contain the same elements and presentation order. Recommended message elements include a brief description of the situation, the location of the situation, the effect on travel (i.e., delays, lanes blocked, etc.), and the action that the motorist should take. <sup>(15)</sup>

Although no national agreement exists on the use of DMSs during non-incident times (i.e., left blank or used to provide nonemergency messages), regional or State-level consistency in DMS use will improve their effectiveness in eliciting motorist compliance. If a situation arises that requires the usage of a specific DMS for more than one ongoing condition, message priority criteria should be used for displaying messages. For example, as part of a recently developed multi-agency incident response plan for the I-35 corridor between Austin, TX, and San Antonio, TX, a hierarchy of DMS use was defined to reflect the following priority: safety, roadway closures, delay information, emergency messages (including AMBER alerts), test messages, and public service announcements. <sup>(16)</sup> In 2004, at least 73 major metropolitan areas in the United States reported having policies or procedures in place that govern the display of messages on DMSs. <sup>(2)</sup>

## Response

Incident response is the activation of a “planned” strategy for the safe and rapid deployment of the most appropriate personnel and resources to the incident scene. Information management plays an important role in response; providing the necessary information to the appropriate personnel is critical in achieving optimum response. Accurate information about an incident—such as its location, traffic impacts, vehicle types involved, presence of an injury or a fatality, and other special conditions (e.g., presence of a hazardous material)—is essential in determining the proper response. The level of required response is typically determined by an on-scene responder or by a dispatcher at a communications or traffic management center.

The objectives of improved response are to save lives through more rapid EMS response, ensure that responders reach the scene before the traffic backup becomes lengthy, make more efficient use of personnel and resources through “appropriate” response, and achieve a state of continued readiness for the rapid deployment of the appropriate resources to the incident scene and the area affected by it.

Common response challenges relate to the following:

- **Achieving optimum response.** Two common, yet undesirable, situations often result when incident response is initiated: under-response and over-response. Under-response results

when too few resources or inappropriate resources are dispatched to the scene (e.g., dispatching a light-duty wrecker to an incident involving an overturned semi-truck). Typically, the inadequacy of the personnel or resources first dispatched is not realized until after they have arrived at the incident scene. When additional personnel or equipment is requested to the scene, the subsequent response usually takes much longer because traffic congestion from the incident reduces accessibility. Under-response more than doubles necessary incident response times. An inappropriate solution to the problem of under-response is to dispatch excess personnel or equipment to the scene. Equipment and personnel that are not needed at the scene can cause a bigger congestion and accessibility problem than the incident itself. In addition, over-response greatly reduces an agency's efficiency by committing personnel and resources unnecessarily. Agencies should instead strive for optimum response, with the correct equipment and appropriate number of personnel dispatched to the incident scene. Optimum response can be attained through improved incident verification techniques and better awareness among responders of the different information needs and capabilities of each agency.

- Difficult scene access.** Traffic congestion and roadway design are the primary reasons for limited access to the scene for incident responders. Traffic congestion complicates access to the scene for responders. Flashing lights, especially amber-colored flashing lights, seem to have little effect on traffic movement (i.e., few people move to the right when a vehicle with flashing lights approaches from the rear). Historically, wide roadway shoulders have supported emergency access when travel lanes are congested. In many urban areas, however, efforts to ease traffic congestion have resulted in wide shoulders being converted to general-purpose or special-use lanes.

Table 3 identifies the various tools and strategies that have proven effective in overcoming each of these challenges and identifies select locations where these tools and strategies are in use. Note that additional tools and strategies that were more variable in their reported effectiveness—including median crossovers and traffic signal pre-emption—are included in appendix B.

Table 3. Response challenges, strategies, and select implementation locations.

RESPONSE STRATEGIES	Achieving Optimum Response	Difficult Scene Access	EXAMPLE APPLICATIONS
Personnel/Equipment Resource Lists	●		75+ U.S. Metropolitan Areas
Towing and Recovery <i>Vehicle Identification Guide</i>	●		NJ/PA (Delaware Valley Region), TX (Austin)
Instant Tow Dispatch Procedures		●	WA (Seattle)
Towing and Recovery Zone-Based Contracts		●	TX (Houston)
Enhanced Computer-Aided Dispatch		●	43+ Agencies in U.S. Metropolitan Areas, CA (Los Angeles), NM (Albuquerque), TN (Sequatchie Co.)
Dual/Optimized Dispatch Procedures		●	NJ
Motorcycle Patrols		●	All or Nearly U.S. Metropolitan Areas
Equipment Staging Areas/Pre-positioned		●	TN, WI

Equipment		
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Additional descriptive information regarding the various tools and strategies and select locations where these tools and strategies are in use is provided below.

- **Personnel/equipment resource lists.** Problems with indirect communication and unnecessary calls to request personnel or equipment can be minimized through the use of personnel or equipment resource lists. Significant resource information may have already been compiled by local emergency management agencies that perform emergency response planning for hurricanes, tornadoes, earthquakes, chemical disasters, etc. Information compiled in the resource lists should include geographic or jurisdictional response areas, telephone numbers, fax numbers, pager numbers, procedures for radio contact, alternative contacts, available equipment, available supplies or materials, and anticipated response times. This information should be provided for both daytime and nighttime conditions, particularly for nonemergency, support agencies (e.g., transportation departments) that do not operate 24 h a day. Resource lists should be regularly updated to ensure continued benefit.

In 2004, the ITS Deployment Survey reported at least 75 major metropolitan areas in the United States using personnel/equipment resource lists. <sup>(2)</sup>

- **Towing and recovery *Vehicle Identification Guide*.** Available as 8.5-inch by 11-inch laminated cards, the Towing and Recovery Association of America (TRAA) *Vehicle Identification Guide* can be carried in appropriate response vehicles to ensure that responders who are requesting towing and recovery services provide the necessary information to tow operators prior to dispatch. Key information includes the year, make, and model of the vehicle to be towed or recovered; the vehicle's classification under the U.S. Department of Transportation's (USDOT's) classification scheme (examples of vehicle types in each class are depicted); the type of services required (i.e., impound, accident, recovery, or motorist assist); and other pertinent vehicle information (i.e., tire condition, cargo contents, load status, etc.). Use of this guide helps to prevent inappropriate equipment/personnel dispatch, which in turn reduces overall incident duration resulting from sequential, redundant response.

In Austin, TX, the Texas Department of Transportation and the Austin Towing Association jointly sponsored provision of the TRAA *Vehicle Identification Guide* for law enforcement, fire and rescue, and transportation agency response vehicles in the metropolitan area. Similarly, the Delaware Valley Regional Planning Commission (DVRPC) in New Jersey and Pennsylvania sponsored provision of the TRAA *Vehicle Identification Guide* to all TIM personnel.

- **Instant tow dispatch procedures.** To expedite response and removal of blocking disabled vehicles, instant tow dispatch procedures initiate response from towing and recovery personnel and law enforcement at the same time, essentially eliminating the on-site verification process. In urban areas, the need for towing and recovery response may still be verified remotely using CCTV cameras.

In Washington, instant tow dispatch procedures are credited with saving an average of 15 min of lane-blocking congestion each time it is used, with an associated cost savings for each instant tow deployment of approximately \$20,000 to \$35,000, depending on the location and traffic conditions. Eliminating the verification process may result in "dry runs" for towing and recovery companies. With a dry run fee of \$25 per trip, the Washington State

Department of Transportation (WSDOT) reports paying under \$100 per month for coverage along all State and interstate highways in the Seattle metropolitan area. <sup>(17)</sup>

- **Towing and recovery zone-based contracts.** The two most common contracting mechanisms for providing towing and recovery services include rotational lists or zone-based licensing. Based on responses from 29 U.S. jurisdictions, 55 and 21 percent utilized rotational lists and zone-based licensing, respectively. <sup>(18)</sup> The latter approach—under which a single private towing agency is assigned to respond to incidents occurring in a predefined geographic area or zone—offers the greatest potential for enhancing incident response. Under zone-based contracts, geographic coverage areas are generally defined to support reasonable physical driving distances and associated response times. In addition, towing and recovery operators develop a high level of familiarity with traffic and incident characteristics (i.e., congested or high-incident locations) in their area and potential alternate routes for quickly accessing the incident scene. Responders, too, develop a familiarity with the personnel and equipment capabilities of the designated towing and recovery company.

Irrespective of type, contracts may specify acceptable response times to incident scenes. Input from towing and recovery personnel is important in establishing reasonable response times that can then be strictly enforced. In Houston, TX, qualified contracted towing and recovery companies are responsible for responding within an average of 6 min to incidents on a designated section of State-owned freeways as part of their SafeClear program. During the first year of the program, tow operators responded to more than 60,000 stalls and collisions, response times were under 6 min more than 87 percent of the time, and incidents were cleared in less than 20 min 72 percent of the time. An overall 10 percent reduction in the number of collisions on the freeways was also observed. <sup>(19)</sup> In 2008, response times by SafeClear program tow operators were under 6 min 89.8 percent of the time, and incidents were cleared in less than 20 min 90.5 percent of the time, frequently without any need for additional responder support. A reduction of approximately 1,440 incidents per year is attributed to the SafeClear program's expedited response and clearance times, resulting in an economic savings of nearly \$49 million per year. <sup>(20)</sup> The Texas Department of Transportation has similarly worked with various heavy-duty tow operators in Houston, TX, to define an acceptable 50-min response time to incident scenes involving large trucks.

- **Enhanced computer-aided dispatch.** Enhanced computer-aided dispatch (E-CAD) systems—more commonly used by law enforcement, fire and rescue, and EMS—utilize automatic vehicle location (AVL) technologies to locate, dispatch, and route emergency vehicles closest to the incident scene to minimize response time. E-CAD systems continuously update all information so that current field conditions can be viewed at any time.

In 2004, the ITS Deployment Survey reported at least 43 public safety agencies in major metropolitan areas in the United States using E-CAD systems. <sup>(2)</sup> Examples of E-CAD systems in use across the Nation include the following:

- On a small scale and utilizing a \$25,000 grant to buy four new laptop systems, Sequatchie County, TN, equipped its ambulances with technology that combines digital information from 9-1-1 dispatch centers, utility authorities, and the county property assessor's office with real-time incident information updated every 2 s. <sup>(21)</sup>
- Similarly, Albuquerque Ambulance in New Mexico uses a map-based E-CAD system that allows the dispatcher to provide en-route ambulance drivers with the exact location of an emergency and guidance on appropriate routes. The company's efficiency has reportedly increased by 10 to 15 percent. <sup>(22)</sup>



- On a larger scale, the Loma Linda University Medical Center east of Los Angeles—a regional trauma center for four counties—began developing its Advanced Emergency Geographic Information System (AEGIS) using a \$500,000 Department of Defense grant. Air ambulances were already equipped with GPS. Agreements were established to patch streaming data feeds from area police and fire and rescue agencies, patient-capacity information from other area hospitals, and weather data and traffic images from the California Department of Transportation. In its current form, the system effectively supports crucial routing and staff decisions. An outstanding goal is to provide first responders with the capability to upload incident images prior to departing or en route to the scene. <sup>(23)</sup>
- **Dual/optimized dispatch procedures.** In areas where traffic volumes are high, the distance between interchanges or crossovers is unusually long, or the exact location or direction of an incident has not been verified, dual dispatch procedures may be used to ensure the quickest response to an incident. Under this approach, response units are dispatched in both directions—the first unit to locate the incident provides response, and the other units return to their stations. Dual dispatch has proven to be successful in improving response times to incidents; however, the benefits of dual dispatch procedures may not be fully realized if traffic volumes are high along all routes leading to the incident or if travel distances for supplemental responders are lengthy.

To minimize the crossovers required under dual dispatch procedures, TIM personnel in New Jersey dispatch according to predetermined, mutually agreed-upon “response box” areas for limited access highways based on the agency’s proximity to an incident rather than its jurisdictional boundaries. Dispatchers have copies of these response box area diagrams and use them to dispatch the closest available resources to the scene.

- **Motorcycle patrols.** Motorcycle patrols, which can more easily maneuver in congested areas than larger response vehicles, allow trained personnel to reach and assess the incident scene more quickly. Motorcycle patrols can provide limited initial traffic control and scene protection prior to the arrival of additional resources. The effectiveness of motorcycle patrols is dependent upon the actions taken by law enforcement officers once on-scene; motorcycle patrol officers who administer first aid, secure the scene, and actively manage traffic may be perceived as most beneficial.

Motorcycle patrols are widely used to support TIM operations, predominantly by law enforcement agencies across the Nation.

- **Equipment staging areas/pre-positioned equipment.** For major incidents, significant and varied equipment may be required to clear the incident. Certain pieces of equipment that may be slow to mobilize—such as a front-end loader that needs to be loaded onto a flatbed trailer for transport—should be requested early in the TIM process to minimize lost time waiting for its arrival. Conversely, the early and intermittent arrival of equipment may compromise scene access and maneuverability. To enhance operations, a temporary staging area can be created to organize the equipment and designate its use. The staging area should be near the incident scene and easily accessible to responders.

Equipment and materials can also be pre-positioned and stored long term at key locations near areas that suffer from high incident rates. Pre-positioned TIM equipment, easily accessible by appropriate responding agencies, speeds the deployment of necessary

resources to an incident scene. Tennessee and Wisconsin provide examples of pre-positioned equipment to support TIM operations:

- Beginning in 2002, the Tennessee Department of Transportation deployed “Ready Response Trailers” stocked with traffic control devices at 15 strategic locations in suburban and rural areas. The intent was to assist with TIM operations outside of the normal HELP service patrol areas. <sup>(9)</sup>
- The Wisconsin Department of Transportation stages portable roadway barriers near key freeway access ramps to expedite necessary road closures during major incidents or weather events.

Cooperative agreements may be required to describe the equipment that would be stored and the responsibilities for keeping the facility stocked and paying initial and ongoing facility costs.

## Scene Management and Traffic Control

Scene management is the coordination and management of resources and activities at or near the incident scene, including personnel, equipment, and communication links. The scene management and traffic control phase of TIM occurs after responding agencies have arrived at the scene. Injured persons are immediately attended to, the incident scene is protected, and plans are formulated for scene documentation and wreckage or debris clearance. Successful scene management relies heavily on interagency cooperation and traffic control strategies. For minor incidents, scene management is relatively simple, usually involving just a single agency (e.g., a transportation agency) or a single agency and a company (e.g., a police agency and a wrecker company). Scene management becomes much more complicated as the severity of the incident increases. The number of responding agencies and companies and the number and complexity of individual tasks consequently increase.

The objectives of improved scene management and traffic control are to effectively coordinate the activities of multiple agencies, improve interagency and intra-agency communications, maximize the use of personnel and resources, and improve the safety of motorists and responders through traffic control. Because much of scene management deals with personnel coordination, measured benefits of improved site management efforts are seldom available.

Common challenges to effective scene management and traffic control include the following:

- **Confusion over authority/roles.** Response personnel at the scene of an incident are often required to make quick decisions that may have serious or even life-threatening implications. Disagreement among response personnel regarding the proper actions to take can lead to additional stress at the incident scene and can have a lasting, damaging effect on long-term interagency relationships. The question of who is “in charge” often arises when disagreement exists. One of the more common disagreements involves when to close a roadway to traffic. The disagreement over this issue stems from differing agency priorities. Transportation personnel traditionally have pressed to keep the roadway open to alleviate traffic congestion and prevent secondary incidents. Police and fire and rescue agencies have traditionally encouraged road closure to protect response personnel from passing traffic and to maintain the integrity of evidence at the scene.

- **Difficult on-scene maneuverability.** Accessibility to and maneuverability at the incident scene can be complicated by the incident response or emergency vehicles already at the scene. Traditionally, response vehicles have been parked where convenient without thought to access or roadway blockage. When a response vehicle must be moved, often the driver of the vehicle is not nearby, resulting in unnecessary delays at the scene.
- **Responder safety.** Since 2003, more than 59 law enforcement, 12 fire and rescue, and 54 highway maintenance personnel have been killed after being struck by vehicles along the highway, according to the Bureau of Labor Statistics.<sup>(24)</sup> Data on towing and recovery industry occupational fatalities are not well tracked. However, TRAA anecdotally reports a loss of about 100 towing operators in the line of service annually.<sup>(25)</sup> The occurrence of responder injury or “near misses” is much higher.
- **Secondary incidents.** Secondary incidents caused by unsuspecting approaching motorists may increase both the number and severity of injuries attributable to incidents and compound the impact of congestion and time taken to clear the roads. Minor incidents, if not cleared quickly, can result in more serious, major incidents. A passing vehicle may strike a disabled vehicle on the shoulder, seriously injuring the vehicle occupants or a pedestrian changing a flat tire on the side of the road. Major incidents can also lead to multiple minor incidents. If a traffic queue forms behind a major incident, minor incidents such as fender bender crashes are likely to occur. Each of these minor incidents, in turn, needs attention from response agencies. Incidents can be considered secondary to a primary incident if the time and location of the incident can be correlated with the primary incident, including the queue dissipation times. Accurately quantifying the number of secondary incidents is challenging; a high proportion of secondary incidents is likely minor and may never be formally reported to police agencies. Although no standard measure has been historically defined to identify secondary incidents, most estimates suggest that between 14 to 18 percent of the total incidents are secondary in nature.<sup>(26)</sup>
- **Excess delay.** The *2007 Urban Mobility Report* states that motorists in 437 U.S. urban areas incurred \$78.2 billion in congestion costs in 2005, with 52 to 58 percent of the total motorist delay attributed to crashes and vehicle breakdowns.<sup>(27)</sup> Roadway capacity reductions exceed the physical blockage resulting from an incident, exacerbating congestion and delay levels. The temporary obstruction of one and two travel lanes along a three-lane freeway is estimated to reduce the available capacity of the facility by 63 and 77 percent, respectively.<sup>(28)</sup> Incidents located wholly on the shoulder of a roadway are estimated to reduce the available capacity of the facility by up to 17 percent, depending on the nature of the incident.<sup>(29)</sup> Current TIM efforts are credited with reducing annual delay by 129.5 million h with an associated cost savings of approximately \$2.5 billion.<sup>(27)</sup> Cost savings attributable to reduced fuel consumption and harmful emissions are included in these estimates.

Table 4 identifies the various tools and strategies that have proven effective in overcoming each of these challenges and identifies select locations where these tools and strategies are in use. Note that additional tools and strategies that were more variable in their reported effectiveness—such as intrusion detection/warning systems, secondary and responder-involved incident tracking, responsive traffic signal control systems, alternative traffic signal timing plans, active lane/ramp controls, and reserved/special-use lane temporary use policies—are included in appendix B.

An additional challenge that is not listed here relates to limited on-scene communications. When agencies from different or multiple jurisdictions need to coordinate response actions on-scene, direct communications may be prevented by incompatible radio systems. Consequently, when responding

to a major incident, agencies must cope with other, inefficient means of communications. For example, law enforcement personnel may want to inform transportation personnel of the need to close a lane temporarily to remove the wreckage from the scene. The transportation personnel may be a significant distance upstream of the incident performing traffic control. Incompatible radio systems prevent the request from being made directly. The various tools and strategies that have been developed and implemented in an effort to overcome challenges related to on-scene communications are described later in this document under “Cross-Cutting Challenges and Strategies.”

Table 4. Scene management and traffic control challenges, strategies, and select implementation locations.

SCENE MANAGEMENT AND TRAFFIC CONTROL STRATEGIES	Confusion over Authority/Roles	Difficult On-Scene Maneuverability	Responder Safety	Secondary Incidents	Excess Delay	EXAMPLE APPLICATIONS
Incident Command System	●					58+ U.S. Metropolitan Areas, WA
Response Vehicle Parking Plans		●				AZ (Phoenix), CO (Lakewood), IA, MI (Farmington), TX (Lancaster)
High-Visibility Safety Apparel/Vehicle Markings			●			CO (Eagle)
On-scene Emergency Lighting Procedures			●			TX (Austin, San Antonio)
Safe, Quick Clearance Laws—Move Over			●			47 States, including CA, FL, GA, IN, TN
Effective Traffic Control Through On-Site Traffic Management Teams			●	●		CA (Stockton), FL (Southeast), NJ
End-of-Queue Advance Warning Systems				●		CA (Bishop, Los Angeles, Redding, Stockton), NJ (Camden), TN (Chattanooga), UT (Salt Lake City)
Alternate Route Plans					●	62+ U.S. Metropolitan Areas, CA (Anaheim), FL (Northeast), ME/NH, NJ/PA (Delaware Valley Region), WI

Additional descriptive information regarding the various tools and strategies and select locations where these tools and strategies are in use is provided below.

- Incident Command System.** The Incident Command System (ICS) is a federally adopted, on-scene command and control protocol that lends consistency to TIM actions, clearly defines command, improves interdisciplinary communication, and more fully utilizes resources. The ICS relies upon a unified command concept whereby management responsibility is shared for the incident. All agencies that have a responsibility at an incident cooperatively determine the overall incident objectives, strategies, planning efforts, integrated activities or actions to take place, and maximum use of resources. Transportation personnel, traditionally untrained in ICS principles, can refer to the *Simplified Guide to the ICS for Transportation Professionals*, accessible at [http://ops.fhwa.dot.gov/publications/ics\\_guide/ics\\_guide.pdf](http://ops.fhwa.dot.gov/publications/ics_guide/ics_guide.pdf), to learn more. <sup>(30)</sup>

In 2004, the ITS Deployment Survey reported at least 65 agencies in 58 major U.S. metropolitan areas operating under ICS principles; 26 were required to do so by law. <sup>(2)</sup> For example, in Washington, the following legislation exists related to the ICS:

§70.136.030 Incident Command Agencies—Designation by Political Subdivisions. The governing body of each applicable political subdivision of this state shall designate a hazardous materials incident command agency within its respective boundaries, and file this designation with the director of community development. In designating the incident command agency, the political subdivision shall consider the training, manpower, expertise, and equipment of various available agencies as well as the Uniform Fire Code and other existing codes and regulations. Along state and interstate highway corridors, the Washington State Patrol shall be the designated incident command agency unless by mutual agreement the role has been assumed by another designated incident command agency. If a political subdivision has not designated an incident command agency within 6 months after July 26, 1987, the Washington State Patrol shall then assume the role of incident command agency by action of the chief until a designation has been made.

§70.136.035 Incident Command Agencies—Assistance from State Patrol. In political subdivisions where an incident command agency has been designated, the Washington State Patrol shall continue to respond with a supervisor to provide assistance to the incident command agency.

- **Response vehicle parking plans.** Response vehicle parking plans serve to preserve maneuverability at the scene, ensure response personnel safety, protect response personnel at the incident scene, and maintain traffic flow past the incident. While it is not possible to develop parking plans to fit all incident scenarios, it is possible to develop guidelines or policies about how and where response vehicles should be parked so that travel lanes can be opened when they are no longer needed by responders. For example, all responding vehicles should be parked on the same side of the roadway on which the incident occurred. With the exception of vehicles parked to secure the incident scene, response vehicles should be parked on the shoulder to keep from blocking any additional lanes of traffic. Fire personnel are usually directed to park their vehicles directly behind or in front of the cars involved in the emergency, to minimize the disruption of traffic and to reduce the exposure of personnel and apparatus to danger. On-scene tow trucks, sand trucks, and other vehicles should be parked where they can be accessed and moved while not blocking lane-opening activities.

The International Association of Fire Chiefs' (IAFC's) Vehicle Safety Resources website, accessible at <http://www.iafc.org/displaycommon.cfm?an=1&subarticlenbr=413>, includes links to various standard operating procedures in use by fire and rescue agencies across the Nation that detail appropriate on-scene vehicle parking. Select examples are listed below:

- In Phoenix, AZ, standard operating procedures (SOPs) for freeways, accessible at <http://www.iafc.org/associations/4685/files/AZ%20-%20Freeway%20SOP.pdf>, direct fire and rescue personnel to position apparatus between oncoming traffic and response personnel to protect the scene, but to avoid unnecessarily blocking traffic lanes to permit law enforcement to move traffic and relieve congestion. <sup>(31)</sup>
- In Lakewood, CO, SOPs developed by West Metro Fire and Rescue related to vehicle placement on highways, accessible at

- <http://www.iafc.org/associations/4685/files/CO%20-%20Highway%20Placement%20SOP.pdf>, note that reducing and/or shutting down traffic lanes can create other problems and safety concerns. Unnecessarily closing or keeping traffic lanes closed greatly increases the risk of a secondary incident occurring in the resulting backup. <sup>(32)</sup>
- In Iowa, Urbandale fire and rescue personnel utilize a Roadway Incident “Cue Card,” accessible at <http://www.iafc.org/associations/4685/files/IA%20-%20Roadway%20Incident%20Cue%20Card.doc>, that reminds response personnel of proper vehicle placement and encourages aggressive termination of incidents, noting that a faster return to normal traffic flow reduces the potential risk of secondary incident and response personnel exposure. <sup>(33)</sup>
  - Similarly, the City of Lancaster Fire Department in Texas promotes aggressive incident termination in their SOPs, accessible at <http://www.iafc.org/associations/4685/files/safetyWkResVehSOP%5FTX%2DSOG%2DF%2D05TrafficAndHighwaySafety%2Epdf>, to reduce exposure of crews, apparatus, and equipment to moving traffic. <sup>(34)</sup>
  - In Michigan, the Farmington Hills Fire Department follows SOPs specific to operations that take place on or near roadways with moving vehicular traffic. These SOPs, accessible at <http://www.iafc.org/associations/4685/files/MI%20-%20Emergency%20Scene%20Traffic%20Management.pdf>, identify specific apparatus placement practices and are intended to work in conjunction with law enforcement traffic control measures. <sup>(35)</sup>

The effectiveness of response vehicle parking plans is more likely dependent upon TIM practitioner adherence to the response vehicle parking plan rather than the design of the underlying plans. Unless response vehicle parking plans are integrated into TIM intra- and interagency training, consistent adherence to the plan among all incident response personnel will be challenged.

- **High-visibility safety apparel/vehicle markings.** The visibility and conspicuity of emergency vehicles have been the subject of significant historic investigation. Most recently the U.S. Fire Administration and the International Fire Service Training Association published the *Emergency Vehicle Visibility and Conspicuity Study*, intended to improve on-scene safety for all incident responders with a focus on passive visibility/conspicuity treatments. <sup>(36)</sup> In brief, the study identified several opportunities for improving the visibility and conspicuity of emergency vehicles through the proper placement of retroreflective materials to optimize interaction with approaching vehicle headlamps and the use of contour markings, fluorescent and/or high-efficiency retroreflective materials, and distinctive logos or emblems made with retroreflective material.

High-visibility safety apparel plays an important concurrent role in ensuring scene safety. High-visibility safety apparel is defined as personal protective safety clothing that is intended to provide conspicuity during both daytime and nighttime usage. In November 2008, 23 Code of Federal Regulations (CFR) 634 was enacted to mandate the use of high-visibility clothing meeting American National Standards Institute (ANSI)/International Safety Equipment Association (ISEA) 107 Class 2 or 3 requirements by anyone working in the right-of-way of a Federal-aid highway. In December 2009, Section 6D.03 of the *Manual of Uniform Traffic Control Devices for Streets and Highways* (MUTCD) introduced related standards for high-visibility safety apparel:

Standard: All workers, including emergency responders, within the right-of-way who are exposed either to traffic (vehicles using the highway for purposes of travel) or to work vehicles and construction equipment within the TTC zone shall wear high-visibility safety apparel that meets the Performance Class 2 or 3 requirements of the ANSI/ISEA 107–2004 publication entitled “American National Standard for High-Visibility Safety Apparel and Headwear” (see Section 1A.11), or equivalent revisions, and labeled as meeting the ANSI 107-2004 standard performance for Class 2 or 3 risk exposure, except as provided in Paragraph 5. A person designated by the employer to be responsible for worker safety shall make the selection of the appropriate class of garment.

Option: Emergency and incident responders and law enforcement personnel within the TTC zone may wear high-visibility safety apparel that meets the performance requirements of the ANSI/ISEA 207-2006 publication entitled “American National Standard for High-Visibility Public Safety Vests” (see Section 1A.11), or equivalent revisions, and labeled as ANSI 207-2006, in lieu of ANSI/ISEA 107-2004 apparel. <sup>(37)</sup>

Instituting many of the recommended principles for high-visibility vehicles and safety apparel, the Western Eagle County Ambulance District in Eagle, CO, has instituted a new visibility safety program for vehicles and personnel. Based on European models, three of the district’s vehicles feature distinctive reflective yellow and blue chevron stripes across the back, yellow and blue horizontal stripes along each side, and white contour lines outlining the profile of the vehicle. Ambulance doors are additionally equipped with blinking lights. Ambulance personnel wear the same reflective colors on their windbreaker coats and fleece jackets. <sup>(38)</sup>

- **On-scene emergency lighting procedures.** In the initial stages of an incident, the appropriate use of emergency lights is essential for responder and motorist safety. Emergency lights help speed the response of emergency personnel to the incident and serve as a warning to approaching traffic of the presence of stopped or slowed vehicles in the area. However, the prolonged use of emergency lights at the scene of an incident can have detrimental effects. Emergency lights are often distracting and confusing to motorists, especially at night and for major incidents that involve a number of emergency vehicles. Emergency lights also contribute to congestion as motorists slow down to observe the cause of the flashing lights. Consequently, the use of emergency lights should be reduced as soon as sufficient traffic control (i.e., advance warning signs and traffic control devices) has been established at the incident scene. Specific guidelines can be developed that include general emergency-light use procedures (i.e., turn off forward-facing emergency lights once on-scene; avoid using red or white flashing, strobing, or oscillating lights of any kind around merging lanes to avoid masking the directional arrow lights) and a phased approach for reducing emergency-light use concurrent with the deployment of traffic control devices for scene protection.

Section 6I.05 Use of Emergency-Vehicle Lighting in the MUTCD, 2009 edition, provides the following guidance related to emergency-light use:

Public safety agencies should examine their policies on the use of emergency-vehicle lighting, especially after a traffic incident scene is secured, with the intent of reducing the use of this lighting as much as possible while not endangering those at the scene. Special consideration should be given to reducing or extinguishing forward facing emergency-vehicle lighting,

especially on divided roadways, to reduce distractions to oncoming road users.

Because the glare from floodlights or vehicle headlights can impair the nighttime vision of approaching road users, any floodlights or vehicle headlights that are not needed for illumination, or to provide notice to other road users of an incident response vehicle being in an unexpected location, should be turned off at night. <sup>(37)</sup>

Consistent with this guidance, on-scene emergency lighting procedures were recently developed as part of a multi-agency incident response plan for the I-35 corridor between Austin and San Antonio, TX, to promote the phased use of emergency lighting on-scene (i.e., use emergency lighting in the initial stages of an incident but reduce emergency lighting as soon as sufficient traffic control is in place), the preferred types of lighting, and the appropriate times and circumstances for use (e.g., when en route to a confirmed incident with injuries or incident that is blocking a travel lane). <sup>(16)</sup> In addition, the IAFC Vehicle Safety Resources website, identified previously and accessible at <http://www.iafc.org/displaycommon.cfm?an=1&subarticlenbr=413>, includes links to various standard operating procedures in use by fire and rescue agencies across the Nation that detail appropriate emergency-light use.

- **Safe, quick clearance laws—*Move Over*.** *Move Over* laws require drivers approaching a scene where emergency responders are present to either change lanes when possible and/or reduce speed with the intent of enhancing responder safety. *Move Over* laws are commonly included as extensions to pre-existing laws directing a driver to slow and pull to the side of the road to allow emergency vehicles with warning devices activated to pass. These laws have been modified to include driver guidance when approaching and passing stationary emergency vehicles along the roadside. Anecdotally, responders have expressed concern over the lack of *Move Over* law awareness among drivers and the challenges faced by law enforcement personnel tasked with performing incident management duties and concurrently enforcing *Move Over* laws.

At the time of this investigation, all but two States—Hawaii and New York—have enacted *Move Over* laws. Significant national initiatives, led by the *Move Over, America* partnership and the American Automobile Association (AAA), have contributed to the proliferation of these laws among States. The AAA initiative encourages enactment of *Move Over* laws that cover tow trucks and other roadside assistance vehicles in addition to law enforcement vehicles, fire trucks, and ambulances.

Because the effectiveness of *Move Over* laws relies heavily upon driver cooperation, the *Move Over, America* partnership and AAA initiated concurrent national public information campaigns comprised of public safety announcements and other publicity efforts in an effort to raise awareness of driver responsibilities under these laws. Select States, such as Florida, have also included State-mandated driver education initiatives and enforcement directives as part of their legislation:

§316.126. 2 (c) The Department of Highway Safety and Motor Vehicles shall provide an educational awareness campaign informing the motoring public about the *Move Over* Act. The department shall provide information about the *Move Over* Act in all newly printed driver's license educational materials after July 1, 2002.



More information regarding *Move Over* laws, including recommendations for model language, can be found in FHWA's *Traffic Incident Management Quick Clearance Laws: A National Review of Best Practices*, accessible at <http://ops.fhwa.dot.gov/publications/fhwahop09005/index.htm>.<sup>(39)</sup> In addition, a recent FHWA educational outreach initiative aimed at encouraging the adoption and effective implementation of safe, quick clearance laws, including *Move Over* laws, is described in *Educational Outreach for Safe, Quick Clearance (SQC) Laws and Policies*, accessible at [http://ops.fhwa.dot.gov/publications/fhwahop10012/tim\\_sqc.pdf](http://ops.fhwa.dot.gov/publications/fhwahop10012/tim_sqc.pdf).<sup>(40)</sup>

- **Effective traffic control through on-site traffic management teams.** The rapid deployment of traffic control devices at the scene of an incident not only improves access to the scene for responders but also provides a safe on-scene environment for responders performing TIM duties and minimizes the potential for secondary incidents involving approaching motorists.

A number of urban areas across the Nation rely upon on-site traffic management teams to ensure the rapid and appropriate deployment of traffic control devices at an incident scene:

- To ensure adequate scene protection for incident responders, TIM personnel in Stockton, CA, reported using on-site traffic management teams to quickly and effectively establish proper traffic control.
  - Similarly, in New Jersey, an Incident Management Response Team (IMRT) responds to major highway incidents or planned events and directs the proper response and use of transportation-related resources in the most efficient fashion. These specially trained teams provide technical, logistical, and incident management support to the incident commander by establishing necessary traffic control and diversion routes, serving as the liaison for the New Jersey Department of Transportation to mobilize resources, safely and quickly restoring lanes of traffic, facilitating necessary repairs, and reopening the roadway. In addition, IMRT members work with other in-state and out-of-state agencies in planning, coordinating, and implementing traffic remediation efforts for special events such as major sporting and entertainment events.
  - In southeast Florida, the Severe Incident Response Vehicle (SIRV) program is dedicated to keeping motorists and emergency responders safe during traffic incidents while working to quickly clear the roadways. Program personnel respond to severe traffic incidents such as full highway closures, fatalities, overturned commercial trucks, and any other event that may last longer than 2 h.<sup>(6)</sup> The SIRV vehicles carry additional equipment and supplies to provide a higher level of traffic maintenance than that supported by the Road Ranger service patrol vehicles.
- **End-of-queue advance warning systems.** Static, arrow board, or dynamic message signs are commonly utilized to warn approaching motorists of a downstream traffic queue. Arrow boards and DMSs used for this purpose are commonly portable, and mounted on trailers or installed on appropriate response vehicles. End-of-queue advance warning should occur far enough upstream to provide motorists with sufficient notice to slow and stop their vehicle, as necessary. The appropriate location varies depending on the speed limit, extent of congestion, and roadway geometrics that affect driver sight distance. Warning devices should be moved as needed to remain well in advance of the queue. The effectiveness of end-of-queue advance warning systems is dependent upon the nature and extent of traffic control devices available as part of the end-of-queue advance warning system, and the expediency with which these devices are mobilized and deployed.

End-of-queue advance warning systems are widely used to support TIM operations, predominantly by transportation agencies across the Nation. Of the participants in this investigation, end-of-queue advance warning systems are reported to be in use in Bishop, CA, Los Angeles, CA, Redding, CA, Stockton, CA, Camden, NJ, Chattanooga, TN, and Salt Lake City, UT.

- **Alternate route plans.** Alternate routes have the potential to reduce traffic demand at the scene and reduce delay and frustration for the motoring public. Appropriate alternate routes intended for public use are often difficult to identify and require associated diversion plans to be effective. During an incident, motorists may self-route or be directed to an alternate route by response personnel. Not all routes may be able to accommodate all traffic types. Truck traffic requires sufficient infrastructure that can support heavy loads and accommodate larger vehicle dimensions. Bridge and overpass structures are commonly limiting factors along potential alternate routes. In such instances, distinct alternate routes may be identified for passenger car and truck traffic. The designation of alternate routes can be politically charged; buy-in from all affected jurisdictions is required. When county or city roadways are utilized as alternate routes, appropriate jurisdictions should be notified immediately so that they may adjust to accommodate the additional traffic flow. Despite these challenges, the 2004 ITS Deployment Survey reported at least 62 major metropolitan areas in the United States with pre-planned alternate route plans serving certain sections of the freeway system. <sup>(2)</sup> Select examples include the following:
  - In northeast Florida, TIM practitioners developed alternate route plans and distributed these plans, in electronic format, to all TIM agencies. <sup>(6)</sup>
  - Working closely with local law enforcement agencies, TIM practitioners in Maine and New Hampshire developed a series of alternate route maps that include local routing scenarios with officer locations, barricades, bridge closures, and detour signs for all major highways within their jurisdictions. <sup>(6)</sup>
  - In New Jersey, personnel from the New Jersey Department of Transportation and State Police act as facilitators for multi-agency groups tasked with developing alternate route plans for all State highways and interstates. To date, plans have been established for 19 of the 21 counties. In a recent related initiative, the DVRPC developed the web-based Interactive Detour Route Mapping (IDRuM) application, accessible at [www.idrum.us](http://www.idrum.us), which currently includes existing regional emergency route plans for New Jersey and Pennsylvania. The IDRuM application is available both online and offline, with the offline version designed to give TIM personnel access to the alternate routes where Internet access is limited or nonexistent. The ultimate goal is to integrate New Jersey's alternate route plans into IDRuM for statewide application.
  - In Wisconsin, a statewide template was developed to lend consistency when establishing and signing for emergency alternate routes. <sup>(6)</sup>
  - To lend consistency to operations when implementing alternate route plans, a real-time, knowledge-based decision support tool—Traffic Control Manager—was used to assist TMC personnel in Anaheim, CA, with selection of alternate route plans and associated traffic signal control timing plans after the occurrence of an incident. Simulations indicated that the plans chosen by the decision support tool reduced average travel time 1.9 to 29 percent and reduced stop time 14.8 to 55.9 percent, compared to scenarios without the tool. <sup>(41)</sup>

Common criteria for initiating traffic diversion to alternate routes are based on the type of incident (reported by 56 metropolitan areas), incident duration (reported by 59 metropolitan areas), incident location (reported by 53 metropolitan areas), number of freeway lanes blocked (reported by 55 metropolitan areas), and time of day (reported by 36 metropolitan areas).<sup>(2)</sup>

Sufficient personnel, traffic control devices, and signing are required to adequately convey diversion direction to the motoring public who are being asked or required to divert. More information on developing and implementing alternate route plans is available in FHWA's *Alternate Route Handbook*, accessible at <http://www.ops.fhwa.dot.gov/publications/ar%5Fhandbook/>.<sup>(42)</sup>

## Quick Clearance and Recovery

Clearance and recovery are the final steps in the TIM process. Clearance refers to the safe and timely removal of any wreckage, debris, or spilled material from the roadway. Recovery refers to the restoration of the roadway to its full capacity. It is important to recognize that when providing information to the motoring public, motorists are most interested in their chances of encountering delay—an incident should not be publicly reported as “cleared” until the traffic backup has fully cleared. If an incident has been reported cleared because the blockage has been removed but motorists encounter significant delay in the traffic backup, an agency may lose credibility and the public's trust and respect.

The objectives of improved incident clearance and recovery are to restore full roadway capacity as quickly and safely as possible; enhance the safety of responders and motorists; make the most efficient use of resources, including equipment and personnel; and minimize delay and ease frustration for motorists. Effective incident clearance relies on effective equipment utilization (i.e., appropriate towing and recovery vehicles, push bumpers, etc.) and an awareness of legal authority to speed clearance.

Common challenges to effective quick clearance and recovery relate to the following:

- **Abandoned vehicle hazards.** When a vehicle becomes disabled because of a mechanical failure, gasoline depletion, flat tire, or some other reason, motorists seldom stay in their vehicle and wait for help. Many walk along the roadway shoulder or are transported by another passing vehicle to reach services. When responders stop to offer assistance and a motorist is not with a vehicle, their action is commonly limited to “tagging” the vehicle as abandoned (if the responder has that authority). Once a vehicle has been tagged as abandoned, motorists are allowed to leave a vehicle in its location often in excess of 24 h and up to 72 h. Results of the 2004 ITS Deployment Survey indicated that 47 percent of participating metropolitan areas allow abandoned vehicles to remain in the right-of-way for more than 24 h.<sup>(2)</sup> Sometimes vehicles remain on the shoulder of the roadway longer than the allowable time either because they were not detected and reported immediately by law enforcement personnel, or law enforcement personnel did not specifically check for the vehicle at the end of the allowable time period. Accurately enforcing the “time clock” requires vehicles to be tagged at the time of detection and shoulders to be actively patrolled to assure that vehicles are not left long beyond the time allowed.

Law enforcement personnel can typically expedite removal of abandoned vehicles that are deemed a hazard; negative public reaction to this action and competing law enforcement duties may limit this practice despite the safety risk. In 2005, North Carolina completed a 5-

yr study of abandoned vehicle crash involvement and found that a total of 1,300 abandoned vehicles were struck, resulting in 47 fatality crashes and over 500 injuries. <sup>(43)</sup>

- **Lengthy minor incident clearance.** Minor incidents, the most frequently occurring type of incident, typically affect only the roadway shoulder, result in local traffic impacts, require response from a single agency or company, and require informal actions to be taken to clear the incident. Some minor incidents may be cleared by the party involved before a responder even arrives at the scene. These self-helped incidents are seldom reported to law enforcement agencies.

Few direct operational challenges exist when clearing minor incidents. Instead, the factors challenging the quick clearance of minor incidents tend to be institutional in nature. For example, response to minor incidents may be low in priority relative to other competing duties that must be performed by law enforcement or transportation agency personnel. Consequently, response times to minor incidents may be lengthy, particularly in areas where dedicated service patrol programs are not offered. Secondly, quick clearance of minor incidents may be restricted by current legislation or policy that prevents an unattended or abandoned vehicle from being immediately removed from the roadway. Minor incidents can also be perceived to be major incidents if responders lack adequate training. For example, incidents involving hazardous materials are often classified as major incidents because they require response from specially trained fire or hazardous material response personnel. Minor petroleum, antifreeze, or other noncargo fluids spilled from the vehicle do not constitute a hazard; unnecessary clearance delay often results because responders incorrectly classify them as hazardous materials. <sup>(19)</sup> Delayed clearance of minor incidents increases the amount of time that response personnel are exposed to danger; the potential for secondary incidents; and motorist delay, associated fuel consumption, and harmful emissions.

- **Lengthy major incident clearance.** Major incidents typically affect one or more of the travel lanes, result in area-wide or corridor-wide traffic impacts, require response from multiple agencies or companies, require a more formal response plan, may involve fatalities or hazardous materials, and may require investigation. Major incidents occur less frequently but produce more severe impacts.

A myriad of factors may challenge the quick clearance of major incidents. Response personnel from multiple agencies or companies must not only perform the duties for which they were trained quickly and effectively, but must also coordinate these activities among all responders in the context of the broader incident management process. Oftentimes, this coordination suffers because of technical and institutional inefficiencies in communications. Major incidents also often require response from specially trained responders (i.e., responders capable of performing accident investigation or hazardous material response and cleanup) and specialty equipment (i.e., rotating crane, front-end loader, etc.) that may be slow to mobilize. In either case, a lack of consensus regarding the importance of quick clearance among all response agencies will exacerbate the detrimental incident impacts.

- **Liability concerns.** Perhaps the most common issue that arises when attempts are made to speed incident clearance is the fear of liability resulting from additional damage to a vehicle or its cargo because of clearance actions taken. Important points to realize, however, are that:

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- The vehicle and cargo are already damaged as a result of the incident and are already, in many instances, unusable.
- Damage costs are most often covered by insurers, not the party involved.
- Liability costs attributable to extra damage are negligible in comparison to the liability costs associated with an unnecessary fatality or serious injury as a result of a secondary incident.

Table 5 identifies the various tools and strategies that have proven effective in overcoming each of these challenges and identifies select locations where these tools and strategies are in use.

Table 5. Quick clearance and recovery challenges, strategies, and select implementation locations.

QUICK CLEARANCE AND RECOVERY STRATEGIES	Abandoned Vehicle Hazards	Lengthy Minor Incident Clearance	Lengthy Major Incident Clearance	Liability Concerns	EXAMPLE APPLICATIONS
Abandoned Vehicle Legislation/Policy	●				21+ U.S. Metropolitan Areas, IN, NC
Safe, Quick Clearance Laws— <i>Driver Removal</i>		●			~25 States, including FL, GA, MD, NC, OH, SC, TN, TX, VA, WI
Service Patrols		●			130+ U.S. Metropolitan Areas, AZ (Phoenix), CA, FL, GA (Atlanta), IN, MD, MN, NM (Albuquerque), OR, TN, UT (Salt Lake City)
Vehicle-Mounted Push Bumpers		●			CA (Redding, Stockton), MD (Baltimore), NJ/PA (Delaware Valley Region), OH (Cincinnati), TN (Chattanooga), TX (Austin), UT (Salt Lake City)
Incident Investigation Sites		●			16+ U.S. Metropolitan Areas, TX (Houston)
Safe, Quick Clearance Laws— <i>Authority Removal</i>		●	●	●	AZ, CA, CO, FL, GA, IL, IN, KY, MO, NM, NC, OH, OR, SC, TN, TX, VA, WA
Quick Clearance/Open Roads Policy		●	●		35+ U.S. Metropolitan Areas, CA, FL, GA, ID, IN, LA, MD, NV, NH, TN, UT, WA, WI
Non-cargo Vehicle Fluid Discharge Policy		●	●		FL, MN
Fatality Certification/Removal Policy			●		PA, TN, TX (Austin), WA
Expedited Crash Investigation			●		93+ U.S. Metropolitan Areas, FL, IN, TX (North Central Region), UT
Quick Clearance Using Fire Apparatus			●		TX (Austin)
Towing and Recovery Quick Clearance Incentives			●		FL, GA, WA
Major Incident Response Teams			●		DE, FL, IL (Chicago), LA, MD, NJ, OH (Cincinnati, Columbus), NY, TX (Dallas Co.), WA

Additional descriptive information regarding the various tools and strategies and select locations where these tools and strategies are in use is provided below.

- **Abandoned vehicle legislation/policy.** Given the similar risk for being struck by passing motorists, supporting legislation that does not distinguish response personnel removal actions for attended or unattended/abandoned vehicles is most advantageous for speeding

the clearance of minor incidents. For example, North Carolina law supports the immediate clearance of any abandoned vehicle on the paved roadway or shoulder on any State-maintained roadway. In addition, through a memorandum of understanding between the North Carolina Department of Transportation and the City of Greensboro, Incident Management Assistance Patrols (IMAPs) are allowed to impound or tow any abandoned vehicles off the roadway shoulders using the city's towing rotation procedures. <sup>(6)</sup>

As an alternative, States can modify existing legislation specific to unattended/abandoned vehicles to reduce the amount of time that motorists are allowed to leave a vehicle in its location. Indiana recently passed a law that reduced the amount of time that an abandoned vehicle is able to remain in the right-of-way from 72 h to 24 h. <sup>(6)</sup> Comparatively, the 2004 ITS Deployment Survey reported at least 21 major metropolitan areas in the United States having associated State laws that limit the amount of time unattended/abandoned vehicles are allowed to remain within the State right-of-way to between 0 and 4 h. <sup>(2)</sup>

More information regarding supporting legislation for abandoned vehicles can be found in FHWA's *Traffic Incident Management Quick Clearance Laws: A National Review of Best Practices*, accessible at <http://ops.fhwa.dot.gov/publications/fhwahop09005/index.htm>. <sup>(39)</sup>

A third strategy that may not require a change in existing legislation is to expand the definition of "hazard" to include unattended/abandoned vehicles on the roadway shoulder or median. In most areas, responders can legally remove any parked vehicle that is considered hazardous. Because the perception of a "hazard" varies widely among responders, removal of unattended/abandoned vehicles on the shoulder or median may not be consistently performed. Agreement between law enforcement, transportation, and other response personnel regarding what constitutes a hazard can encourage improvements in quick clearance in the absence or interim of legislation change.

Driver education can encourage motorist compliance with laws and/or policies related to abandoned vehicles. When a vehicle becomes disabled, motorists frequently leave their vehicle unattended to obtain services. In the absence of or in conjunction with legislation that requires motorists to remain with their vehicle, driver education efforts can encourage motorists to stay with their vehicles to hasten vehicle repair, accommodate towing, and minimize traffic impacts. With extensive use of service patrols, law enforcement patrols, cellular telephones, and traffic-reporting services in most major metropolitan areas, quick and efficient notice of incapacitated vehicles is enhanced. A significant incentive for motorists is that, by staying with their vehicle and receiving help from law enforcement, transportation, or publicly or privately sponsored service patrol programs, they may save money. Many motorist assistance services are free or require a nominal charge.

- **Safe, quick clearance laws—Driver Removal.** *Driver Removal* laws—also referred to as *Fender Bender, Move It, or Steer It/Clear It* laws—are considered key strategies for speeding clearance of noninjury, property-damage-only crashes, which account for the majority of all crashes on U.S. roadways. These laws, currently enacted in approximately half of all States, encourage or require drivers involved in incidents to move their vehicle out of the travel lanes if they can do so safely. In the case of an immobilized vehicle, *Driver Removal* laws commonly mandate that drivers immediately seek assistance to remove their vehicle from the travel lanes. Concurrent legislation or language that protects drivers from liability resulting from their actions (in the absence of gross negligence) or waives at-fault determination regarding the cause of the incident as a result of moving their vehicle is often included to encourage drivers to expeditiously move their vehicle.

*Driver Removal* laws are becoming more important over time. As the levels of congestion build on U.S. roadways, transportation and law enforcement personnel meet increasing TIM demands, in the context of their other duties and responsibilities. Public agencies are challenged to function with ever-increasing constraints on personnel and resources. *Driver Removal* laws that require drivers to take response action not only enhance the safety of those involved and of approaching motorists, but also allow transportation and law enforcement personnel to focus on other duties. The effectiveness of *Driver Removal* laws is dependent upon motorist awareness of their responsibilities under this law and associated enforcement actions to ensure that the law functions as intended.

Several States have developed publicity materials to raise awareness of driver responsibilities under *Driver Removal* laws (see table 6). Using an alternate approach, the Tennessee Department of Transportation installed more than 100 signs at key locations along the State’s urban freeway system with the message “Move Damaged Vehicles to Shoulder If No Serious Injury.”<sup>(9)</sup>

Table 6. Example of *Driver Removal* law publicity materials.

<p><b>Florida</b></p>	<p><b><i>Move It—Yes You Can!</i></b> Brochure, Billboard, and Media Kit  <a href="http://www.metroplanorlando.com/site/partnerships/moveit.asp">http://www.metroplanorlando.com/site/partnerships/moveit.asp</a>  <b><i>Move It—It’s the Law</i></b> Website  <a href="http://www.fhp.state.fl.us/misc/News/Related/2006/FHPnews032006e1.htm">http://www.fhp.state.fl.us/misc/News/Related/2006/FHPnews032006e1.htm</a></p>
<p><b>Maryland</b></p>	<p><b><i>Move It—It’s the Law</i></b> Brochure  <a href="http://www.chart.state.md.us/downloads/readingroom/Move_It_Form.pdf">www.chart.state.md.us/downloads/readingroom/Move_It_Form.pdf</a></p>
<p><b>Ohio</b></p>	<p><b><i>QuickClear</i></b> Website  <a href="http://www.dot.state.oh.us/quickclear/quickclear.asp">http://www.dot.state.oh.us/quickclear/quickclear.asp</a></p>
<p><b>Texas</b></p>	<p><b><i>Steer It...Clear It</i></b> Website  <a href="http://www.houstontranstar.org/sici.aspx">http://www.houstontranstar.org/sici.aspx</a></p>
<p><b>Virginia</b></p>	<p><b><i>Move It—It’s the Law</i></b> Website  <a href="http://www.virginiadot.org/travel/move_it_move_over.asp">http://www.virginiadot.org/travel/move_it_move_over.asp</a></p>
<p><b>Wisconsin</b></p>	<p><b><i>Traffic Incident Management Enhancement (TIME) Program</i></b> Website  <a href="http://www.dot.wisconsin.gov/travel/stoc/time.htm">http://www.dot.wisconsin.gov/travel/stoc/time.htm</a></p>

Hamlin et al. considered the benefits attributable to a *Driver Removal* law enacted in South Carolina.<sup>(44)</sup> Microscopic simulation analysis estimated that implementation of the related legislation resulted in an 11 percent reduction in delay for minor incidents with one lane blocked. This reduced delay, in turn, resulted in an average cost savings of \$1,682 per incident, which is significant when considering the number of minor incidents occurring on a daily basis in large metropolitan areas. Besides the effect on congestion and its associated impacts, the authors cited benefits related to the safety of road users and incident response personnel.

More information regarding *Driver Removal* laws, including recommendations for model language, can be found in FHWA’s *Traffic Incident Management Quick Clearance Laws: A National Review of Best Practices*, accessible at <http://ops.fhwa.dot.gov/publications/fhwahop09005/index.htm>.<sup>(39)</sup> In addition, a recent FHWA educational outreach initiative aimed at encouraging the adoption and effective implementation of safe, quick clearance laws, including *Driver Removal* laws, is described in

*Educational Outreach for Safe, Quick Clearance (SQC) Laws and Policies*, accessible at [http://ops.fhwa.dot.gov/publications/fhwahop10012/tim\\_sqc.pdf](http://ops.fhwa.dot.gov/publications/fhwahop10012/tim_sqc.pdf).<sup>(40)</sup>

- **Service patrols.** Service patrols are universally accepted as the most effective tool for TIM.<sup>(26)</sup> The Federal Highway Administration is currently promoting use of full-function service patrols on all urban freeways on a 24/7 basis as full emergency response partners with law enforcement, fire and rescue, EMS, and towing responders, and is encouraging their sustainability by promoting public agency cost sharing and public/private partnerships.<sup>(45)</sup> One example of such a public/private partnership exists in Pennsylvania where the Pennsylvania Turnpike Commission has partnered with State Farm Insurance to provide service patrols along designated routes. A similar arrangement with State Farm Insurance exists in Atlanta, GA.

Service patrols are popular in urban areas across the United States largely because of the flexibility in services offered, hours of operation, cost, and other considerations. Service patrols can be publicly operated by transportation or police departments or privately operated; can operate 24 h a day or only in the peak period; and may rove highway corridors or be stationed at fixed points such as at tunnel entrances, bridge approaches, or elevated roadway sections. Service patrol vehicles commonly include vans or small pickups, but also include heavy-duty large trucks. An estimated 130 distinct service patrol programs operate along U.S. freeways.<sup>(46)</sup>

Examples of service patrol programs across the Nation include the following:

- The Arizona Local Emergency Response Team (ALERT), operated by the Arizona Department of Transportation, provides TIM on freeways in the Phoenix, AZ, metropolitan area, while the Maricopa County Regional Emergency Action Coordinating Team (REACT) provides TIM on arterial roadways.
- Both California and Florida operate extensive, statewide service patrol programs. In California, the Freeway Service Patrol (FSP) program is funded through combined State and local funds, with local funds originating from a \$1 annual vehicle registration fee in participating counties. In Florida, Road Rangers operate in each of the seven Florida Department of Transportation districts and along the turnpike to facilitate quick incident clearance.
- In Atlanta, GA, the Highway Emergency Response Operators (HERO) program is jointly supported through Federal Congestion Mitigation and Air Quality (CMAQ) funds and private sponsorship by State Farm Insurance.
- As part of the broader Coordinated Highways Action Response Team (CHART) program, the Maryland State Highway Administration operates an Emergency Traffic Patrol (ETP) program to provide emergency motorist assistance and relocate disabled vehicles out of travel lanes.
- In Minnesota, the Freeway Incident Response Safety Team (FIRST) has expanded over time to now include 11 routes and 220 mi of metropolitan area freeways.
- In Tennessee, the Tennessee Department of Transportation initiated the HELP program in 1999 in Knoxville and Nashville. Since that time, the program has expanded to Chattanooga and Memphis and covers more than 180 mi of highways in the four cities.<sup>(9)</sup>



Benefit-to-cost ratios for service patrol programs are variable, reflective of the range of reported operating conditions among programs. Consistently, however, the program benefits significantly outweigh the costs. Early benefit-to-cost ratios, reported between 1990 and 1996, range from 2:1 to 36.4:1. <sup>(47)</sup> More recent benefit-to-cost ratios range from 4.6:1 to 42:1, with a median benefit-to-cost ratio of 9.99:1 and an average benefit-to-cost ratio of 13.3:1. <sup>(46)</sup> Service patrol benefits most commonly include reductions in overall incident duration, secondary incidents, and delay, including associated fuel consumption and harmful emissions, attributable to their role in responding to and clearing minor incidents and providing scene protection during major incidents.

As a result of service patrols, overall incident duration has reportedly been reduced by:

- 28.6 percent in Maryland. <sup>(48)</sup>
- 12 to 36 percent in Salt Lake City, UT. <sup>(49)</sup>
- 8 min for disabled vehicles in Minneapolis, MN. <sup>(50)</sup>

Oregon reported a reduction in incident duration of 15 to 30 percent as a result of expanding its freeway service patrol program from part-time to full-time operations. <sup>(51)</sup> During the first year of operations at the “Big I” work zone in Albuquerque, NM, the use of on-site service patrols reduced the average incident response time to less than 8 min. <sup>(52)</sup>

Once on-scene, service patrol operators can quickly verify the incident, provide scene protection, request additional response that may be required, and establish traffic control as necessary, easing access to the scene for subsequent responders and enhancing on-scene safety:

- Atlanta, GA, reported a 69 percent reduction in secondary incidents and a related annual cost savings of \$1,611,054. <sup>(53)</sup>
- Maryland reported a 28.6 percent reduction in average incident duration, leading to an estimated 377 fewer secondary incidents. <sup>(48)</sup>
- Northwest Indiana reported an annual cost savings of \$618,200 attributable to a reduction in secondary incidents. <sup>(54)</sup>

Reported benefits related to delay, including associated fuel consumption and harmful emissions, are also substantial:

- Atlanta, GA, reported saving 7.25 million vehicle-hours of delay over 1 yr with an annual cost savings of \$152,053,180. An associated reduction in gasoline consumption of 5.17 million gallons and a reduction in diesel consumption of 1.66 million gallons was estimated to save an additional \$10,365,969 annually. Harmful-emission reductions of 2,457 tons of carbon monoxide (CO), 186 tons of hydrocarbons (HC), and 186 tons of nitrous oxide (NOx), with related annual cost savings of \$1,247,985, \$15,626,587, and \$3,368,436, respectively, were also reported. <sup>(53)</sup>
- Florida reported eliminating over 1 million vehicle-hours of delay with an associated fuel savings of 1.7 million gallons of fuel. <sup>(55)</sup>
- Maryland reported reduced delay of approximately 30 million vehicle-hours with an associated 5-million-gal reduction in consumed fuel. <sup>(48)</sup>
- Minneapolis, MN, reported an annual cost savings of \$1.4 million attributable to service patrols. <sup>(50)</sup>

- Northwest Indiana reported an annual cost savings of \$1,241,300 and \$78,300 attributable to delay and fuel consumption reductions, respectively. <sup>(54)</sup>

Customer satisfaction with service patrol programs is high. Of motorists surveyed, 99, 95, and 97 percent rated the service patrol program as “excellent” in Tennessee, Atlanta, GA, and Minneapolis, MN, respectively. <sup>(8,52,49)</sup>

High levels of satisfaction have also been reported by law enforcement agencies. In 2001, the Tennessee Department of Transportation surveyed officers who had firsthand experiences with the HELP service patrol program. Of the 121 officers who responded to the survey, 70 percent rated the overall HELP program as “excellent,” and 25 percent rated the program as “good.” Seventy percent of the officers also reported that they felt safer when a HELP vehicle is present at an incident scene and estimated that the HELP program has reduced the time required to investigate crashes by an average of 31 percent. <sup>(9)</sup>

Service patrols can support quick clearance of minor incidents or disablements by directly relocating the vehicle (i.e., using push bumpers or tow straps/chains) from the travel lane or shoulder to a safe refuge, eliminating the delay caused when a tow truck is needed. If a vehicle is simply disabled, service patrol operators may also provide gasoline, water, or minor mechanical repair services to quickly remedy the problem. During major incidents, service patrols provide an important traffic control and scene protection function (i.e., warning and guiding approaching motorists past the incident) that allows emergency and other response personnel to quickly access the scene, focus on performing duties for which they are specially trained without the distraction or concern for traffic control, and rapidly exit the scene to ensure speedy transport of victims to a medical center or to expedite the opening of blocked lanes.

Additional information regarding the development, implementation, and operation of effective safety service patrols can be found in FHWA’s *Service Patrol Handbook*, accessible at [http://ops.fhwa.dot.gov/publications/fhwahop08031/ffsp\\_handbook.pdf](http://ops.fhwa.dot.gov/publications/fhwahop08031/ffsp_handbook.pdf). <sup>(56)</sup>

- **Vehicle-mounted push bumpers.** Push bumpers, mounted on response vehicles, are used to quickly and safely remove disabled vehicles from the shoulder or travel lanes, reducing the likelihood of secondary incidents and improving the safety of both response personnel and motorists. Push bumpers are commonly mounted on law enforcement and transportation agency vehicles, particularly those used in a service patrol capacity. Vehicles equipped with push bumpers are used to relocate vehicles out of immediate danger; towing and recovery vehicles are used to transport the vehicle longer distances as required.

Vehicle-mounted push bumpers are widely used to support TIM operations across the Nation. Of the participants in this investigation, vehicle-mounted push bumpers are reported to be in use in Redding, CA, Stockton, CA, Baltimore, MD, the Delaware Valley region in New Jersey and Pennsylvania, Cincinnati, OH, Chattanooga, TN, Austin, TX, and Salt Lake City, UT.

- **Incident investigation sites.** Results of the 2004 ITS Deployment Survey indicated that 16 participating metropolitan areas in 12 States utilize incident investigation sites to support TIM operations. <sup>(2)</sup> Incident investigation sites provide a safe refuge off the main roadway where further investigation or documentation can take place. Sites should be easily accessible from the main roadway, yet sufficiently out of sight to prevent motorist delay caused by rubbernecking. In addition, sites should be adequately signed, be lit, and provide enough space to accommodate multiple vehicles or a large truck.

In Houston, TX, a brief public service awareness video describing the State's *Steer It, Clear It* law directs motorists to relocate their vehicle—if it can be normally and safely driven—to a designated incident investigation site or other safe location to minimize interference with existing freeway traffic. The video is available for viewing at the Houston TranStar website, accessible at <http://www.houstontranstar.org/sici.aspx>.<sup>(57)</sup>

- **Safe, quick clearance laws—*Authority Removal*.** *Authority Removal* laws provide authorization to a predesignated set of public agencies—generally including State, county, and local law enforcement or State departments of transportation—to remove damaged or disabled vehicles and/or spilled cargo determined to be a hazard from the roadway. Driver and authority removal responsibilities may be defined within the same statute: if the driver is unwilling or unable to remove the vehicle or cargo, designated authorities may require or perform removal without the consent of the owner. *Authority Removal* laws may also include immediate tow-away policies to ensure the timely removal of disabled vehicles from roadway shoulders in highly congested, metropolitan areas. More commonly, separate *Authority Tow* laws are in place to support removal of incident-involved vehicles and/or cargo on the shoulder or roadway right-of-way to an off-site location (e.g., storage area, service station).

Large-truck incidents can add a unique challenge to the clearance process. Often, cargo transported by truck is spilled across the roadway, requiring not only the righting and clearing of the involved vehicle but also the cleanup of associated cargo. If the cargo is hazardous, response from specially trained spill response personnel is required. In addition, certain types of nonhazardous cargo—such as agriculture or livestock, or certain other perishable products such as food—may require certification from the Department of Agriculture or Health Department to confirm that the load was damaged and is unusable. Personnel from these agencies are not common TIM participants and as such may be slow to arrive at the scene. Supporting legislation or language that allows for the rapid relocation of nonhazardous cargo out of the roadway prior to their arrival supports quick clearance ideals designed to enhance public and responder safety and reduce delay.

Further, the effectiveness of *Authority Removal* laws may be compromised if response personnel are reluctant to exercise their full authority under this law. Often, liability concerns are raised by responding agency personnel when they clear an incident because of additional damage the vehicle or cargo may incur during clearance procedures, even though the resulting additional vehicle damage is often minimal and covered by the causing party's insurer. Concurrent "hold harmless" legislation or language that protects responders from liability resulting from their actions (in the absence of gross negligence) is often included with *Authority Removal* laws to encourage responders to expeditiously move damaged or disabled vehicles and/or spilled cargo from the roadway. The same predesignated agencies authorized to remove damaged or disabled vehicles and/or spilled cargo from the roadway, as well as any qualified responder working under the direction of these agencies, are generally protected under these provisions.

Approximately half of all States have enacted *Authority Removal* laws, and approximately half of all States that have *Authority Removal* laws have concurrent hold harmless provisions. For example, Indiana recently passed a law that includes hold harmless language allowing enforcement personnel to safely and quickly remove vehicles or debris from the roadway and reopen the impacted traffic lanes.<sup>(6)</sup> Select States (Texas and Virginia) also include hold harmless clauses that protect against liability for responder actions *not* taken; authorities are not held responsible for any damages or claims that may result from the failure to exercise any authority granted, provided they are acting in good faith.

More information regarding *Authority Removal* laws and associated hold harmless language, including recommendations for model language, can be found in FHWA's *Traffic Incident Management Quick Clearance Laws: A National Review of Best Practices*, accessible at <http://ops.fhwa.dot.gov/publications/fhwahop09005/index.htm>.<sup>(39)</sup> In addition, a recent FHWA educational outreach initiative aimed at encouraging the adoption and effective implementation of safe, quick clearance laws, including *Authority Removal* laws, is described in *Educational Outreach for Safe, Quick Clearance (SQC) Laws and Policies*, accessible at [http://ops.fhwa.dot.gov/publications/fhwahop10012/tim\\_sqc.pdf](http://ops.fhwa.dot.gov/publications/fhwahop10012/tim_sqc.pdf).<sup>(40)</sup>

- **Quick clearance/open roads policy.** A key agreement supporting TIM efforts is a quick clearance or “open roads” policy that binds agencies to quick clearance consensus by setting implied or explicit goals for clearing traffic incidents from the roadway. Depending on how it is drafted, quick clearance policies can help to speed the clearance of both minor and major incidents, subsequently enhancing responder and public safety and reducing delay.

In 2004, the ITS Deployment Survey reported at least 35 major metropolitan areas in the United States having associated policies and procedures facilitating the quick removal of heavily damaged vehicles and nonhazardous cargoes.<sup>(2)</sup> For example, member agencies participating in Indiana's Traffic Incident Management Effort (IN-TIME) are required to sign a multilateral working agreement that establishes an “Open Roads Philosophy” to work together to “accomplish improved safety, clearance and communication during traffic incidents and/or obstructions on all public roadways in the State of Indiana.” Through a partnership between the Indiana Department of Transportation and the Indiana Law Enforcement Academy, an accompanying IN-TIME video was produced introducing TIM initiatives in Indiana and showing support for quick clearance. The video features an introduction by the Indiana State Police superintendent and can be viewed at the IN-TIME website, accessible at <http://www.indianaquickclearance.org/>.<sup>(58)</sup>

Other examples of quick clearance policies from across the Nation include the following:

- Florida's Open Roads Policy. Local open roads policies are signed by all agencies as an addendum to the statewide Open Roads Policy.
- Georgia's Open Roads Policy.
- Maryland's Removal of Vehicles from Roadway Interagency Agreement.
- New Hampshire's Quick Clearance for Safety and Mobility Interagency Memorandum of Understanding.
- Tennessee's Urgent Clearance of Highway Incidents and Safety at Incident Scenes Interagency Memorandum of Understanding.
- Wisconsin's Interagency Freeway Incident Clearance Policy Statement.

Louisiana passed the first-ever open roads law in the Nation that mandates keeping roads open whenever possible, requires TIM training for all law enforcement officers, establishes improved towing procedures, and requires open roads agreements between key agencies.<sup>(6)</sup>

The inclusion of explicit performance goals in quick clearance policies helps to ensure continued focus on quick clearance and improvement in operations. The most frequently used performance metric for TIM programs is average or maximum incident clearance time, defined as the time between the first recordable awareness and the time at which the last responder has left the scene.<sup>(59)</sup> California, Washington, and Florida have statewide 90-min incident clearance targets. Utah's performance goals are based on incident severity: 20 min for fender benders, 60 min for injury crashes, and 90 min for fatalities. Idaho and Nevada

take a similar approach, with a 30-, 60-, or 120-min maximum clearance time, based on incident severity. <sup>(59)</sup>

The effectiveness of quick clearance policies depends upon the perceived attainability of and focus placed on local clearance time goals and the extent of commitment among TIM agencies in pursuing these goals. The I-95 Corridor Coalition's *Traffic Incident Management Teams Best Practices Report* includes a comprehensive checklist in appendix D for drafting and implementing an effective quick clearance policy. <sup>(6)</sup>

- **Non-cargo vehicle fluid discharge policy.** While some materials pose a danger in any quantity, hazardous materials response procedures are frequently invoked when nonhazardous, non-cargo vehicle fluids are discharged during a minor incident, unnecessarily extending the clearance duration. Spilled vehicle fluids, including crank-case engine oil, diesel fuel, transmission or hydraulic fluids, etc., are generally not considered hazardous wastes.

Some States have adopted procedures or policies that exempt non-cargo vehicle fluid spills from hazardous materials response procedures, providing the spill has been contained on the pavement. In direct support of their Open Roads Policy, Florida developed *Guidelines for the Mitigation of Accidental Discharges of Motor Vehicle Fluids (Non-cargo)* to encourage the mitigation of such spills and speed the clearance of minor incidents. <sup>(60)</sup> Under these guidelines, the Florida Department of Transportation and other incident response personnel may apply absorbents and sweep off travel lanes regardless of spill quantity. The absorbent materials are moved out of the travel lanes and stored at the roadside, or are containerized and placed in the damaged vehicle(s) for removal by the towing company. It is not necessary to await a licensed clean-up contractor.

Similarly, authority is defined in Minnesota's *Traffic Incident Management Recommended Operational Guidelines*. <sup>(61)</sup> Under these guidelines, Minnesota Department of Transportation personnel are allowed to help contain and clean up non-cargo vehicle fluid spills using absorbent products but must obtain annual "right-to-know" training regarding these materials. The effectiveness of non-cargo vehicle fluid discharge mitigation policies in enhancing the quick clearance of minor incidents was not found to be distinctly reported. Instead, the benefits of such a policy are often combined and reported jointly with benefits attributable to broader quick clearance policies and/or reported only for major incidents.

The effectiveness of non-cargo vehicle fluid discharge mitigation policies can be compromised if there is a lack of awareness among response personnel and/or reluctance to exercise their full authority under this policy.

- **Fatality certification/removal policy.** When responding to fatality traffic incidents, it is important to balance the need for thorough investigations into the cause of death, with the need to minimize responder exposure to danger, minimize risk of secondary incidents involving the motoring public, respect the dignity and privacy of the decedent and the decedent's family, and restore the flow of traffic.

In many cases, local policy or State law requires that death be certified by a coroner or medical examiner and that the victim not be moved until the coroner has done so. The result may be significant delays to traffic while the arrival of a coroner is awaited; because the coroner is not facing a life or death situation, he or she may not feel an urgent need to respond. In addition, the number of coroners available is generally limited in comparison to their geographic area of coverage. Alternative policies include allowing a designated EMS

unit to certify death. Accordingly, EMS units are typically among the first to arrive at an incident that may involve an injury or a fatality. Vital signs of fatalities can be telemetrically relayed to an off-site coroner for verification, eliminating the need for the coroner to travel to the site. Once death is certified, fatalities can be relocated to a better, safer refuge in the interest of public safety.

In select States (Pennsylvania, Tennessee, and Texas), *Fatality Certification* laws permit the removal of the victim before the arrival of the coroner when the incident poses a safety hazard. To expedite clearing the roadway and to prevent additional incidents, law enforcement marks the locations and removes the victims immediately, without waiting for the arrival of the coroner.

In the absence of or in addition to such legislation, interagency agreements can explicitly define or detail responder operations during fatality incidents. In Texas, for example, the Austin Police Department (APD), Austin Fire Department (AFD), Austin-Travis County EMS, and Travis County Office of the Medical Examiner (TCME) recently developed an agreement that outlines mutual operating procedures to expedite the removal of deceased persons from the scene of an incident when the incident restricts the free movement of traffic on the State and National Highway Systems. The agreement also addresses operating procedures related to the dispatch of and communications with TCME investigative personnel, the expedited transport of deceased persons, the relocation/removal of deceased persons in the absence of TCME investigative personnel, and the maintenance/capture of evidentiary information. Similar agreements are in place between the Washington State Patrol (WSP), WSDOT, and various county medical examiners throughout the State. Incident management personnel in Bellevue, WA, specifically noted the clearance benefits attributable to the removal of a significantly damaged vehicle with the entrapped decedent in the vehicle.

- **Expedited crash investigation.** Traditional methods of collecting physical evidence at an incident scene (i.e., the base-tape method, coordinate method, or triangulation method) can be time consuming and personnel intensive, resulting in unnecessary delay to the motoring public and responder risk. Total station surveying equipment (TSSE)—that electronically measures and records the locations of evidentiary items using horizontal distance, horizontal angle, and vertical rise captured simultaneously—was first introduced as a means to speed crash investigation.

While TSSE is still widely used to support TIM operations, photogrammetry is emerging as a preferred alternative:

- In a laudable public-public partnership, the Florida Department of Transportation recently procured photogrammetry systems for the Florida Highway Patrol (FHP) statewide. FHP is training two sets of troopers in the photography and software aspects of the systems, respectively, with the goal of converting to a complete photogrammetry-based investigatory process by the end of 2010. <sup>(6)</sup>
- Similarly, the Indiana Department of Transportation, Indiana Department of Revenue, Federal Highway Administration, and Indiana Toll Road have cooperatively funded 23 complete photogrammetry systems. Indiana currently has 22 officers and 6 trainers in the State trained in photogrammetry with an average scene-measuring time of 42 min. <sup>(6)</sup>
- In a unique application, the Utah Highway Patrol uses aerial photogrammetry to take crash scene photos with a camera mounted on a low-flying, remote-controlled helicopter. <sup>(6)</sup>

Photogrammetry captures the necessary data through the process of analyzing and interpreting photos taken at the incident scene. For either system, data captured in the field can be further analyzed off-site using specialized software, reducing the length of time the roadway or lanes need to be closed. Photogrammetry systems have been credited with significantly reducing the amount of time it takes to perform incident investigation while increasing the number of measurements able to be captured.

To support and encourage the use of photogrammetry, the North Central Texas Council of Governments (NCTCOG) offers a photogrammetry training course as a complement to the region's Freeway Incident Management series. Two course tracks are offered twice per year to regional law enforcement agencies. Basic training is 5 d in duration and includes a 3-d iWitness™ workshop and a 2-d crash zone workshop. Advanced photogrammetry training is offered over 2 d to students who complete the basic training. Additional information regarding NCTCOG's photogrammetry training is available through their website, accessible at <http://www.nctcog.org/trans/safety/PhotogramTrng.asp>.<sup>(62)</sup>

In 2007, the ITS Deployment Survey reported at least 93 major metropolitan areas in the United States using these technology-based strategies to expedite crash investigation procedures at major incidents.<sup>(2)</sup>

In the absence of technology-based tools, alternative means of marking evidence (i.e., using paint to mark the evidence, including vehicle positions and locations, and a camera to photograph the incident scene) can be used. Once marked and recorded, the incident scene can be cleared. Law enforcement personnel can later return to the incident scene at a time when traffic volumes are low, close the necessary portion of the roadway, and collect the information required as part of the crash investigation. The use of alternative means of marking evidence is also encouraged as a means to speed incident clearance prior to the arrival of technology-based incident investigation tools on-scene.

- **Quick clearance using fire apparatus.** Adopting a unique and progressive approach to quick clearance in Austin, TX, the Austin Fire Department recently issued a Special Order that allows AFD personnel to use their on-scene fire apparatus to assist in clearing the roadways. Utilizing tow straps provided by on-scene law enforcement officers, AFD may pull a disabled or blocking vehicle out of the travel lane to the side of the road. Fire and rescue personnel are authorized to act only at the request of a law enforcement officer.

During minor incidents, this capability is thought to be particularly beneficial when only law enforcement motorcycle units with limited vehicle removal abilities are available on-scene. To make full use of this new operating procedure, local law enforcement agencies are considering equipping all motorcycle units with tow straps. During major incidents, the larger size and towing capacity of the fire apparatus compared to on-scene law enforcement cruisers may prove beneficial in quickly removing larger vehicles involved in the incident from the travel lane. Although benefits attributable to this change in operation have not yet been quantified given its recent implementation, it is anticipated to be highly effective in enhancing the quick clearance of incidents since fire and rescue and law enforcement personnel are typically the first responders to the scene.

- **Towing and recovery quick clearance incentives.** A combination of financial incentives for quick clearance and pricing disincentives for slow performance has proven to successfully improve tower performance and reduce clearance times. For example, in 2004, the Florida Turnpike Enterprise implemented the Nation's first Roadway Incident Scene Clearance (RISC) program in an effort to meet Florida's open roads policy of clearing incidents from roadways

in 90 min or less. Under this program, contract towing and recovery operators are required to respond to major incidents with two certified heavy-duty wreckers and a support vehicle carrying cleanup and traffic control equipment. Contractors earn a \$2,500 bonus if they respond to the incident site within 60 min and clear the roadway to traffic within 90 min of the Florida Highway Patrol's notice to proceed. If the contractor fails to open the roadway within 3 h, the contractor is penalized \$10 for each minute over. In the first 9 months of operation, the average time to respond to an incident was 41 min (well under the required response time of 60 min), and the average clearance time was 55 min (well under the required 90 min to receive bonus incentives).<sup>(63)</sup>

Georgia and Washington recently initiated similar programs (the Towing and Recovery Incentive Program [TRIP] and the Blockage Buster Tow Incentive program, respectively) aimed at clearing commercial and other vehicle incidents within 90 min. In Georgia, average incident duration decreased from 314 min in 2007 to 131 min in 2008.<sup>(64)</sup>

All three programs include explicit equipment, training, and performance requirements for participating towing and recovery companies.

- **Major incident response teams.** In a national survey conducted as part of the *NCHRP Synthesis of Highway Practice 318: Safe and Quick Clearance of Traffic Incidents*, 15 agencies across 9 States reported participating in a major incident response team.<sup>(18)</sup>

Major incident response teams are typically comprised of high-ranking individuals from a variety of disciplines (e.g., law enforcement, fire and rescue, and transportation) who train for and respond to major incidents together and who are available 24/7. Major incident response teams not only improve response to an incident scene but also enhance personnel interaction at the scene and support quick incident clearance. Quick clearance efforts benefit from the high level of familiarity among the various team members and their authority to mobilize the necessary personnel and equipment to respond.

With the advent of the National Incident Management System (NIMS) in March 2004, major incident response teams now have a formalized framework for effective operation. Relying upon ICS principles, NIMS enables responders at all levels from various agencies and jurisdictions to work together more effectively and efficiently to manage major incidents. NIMS also promotes proven incident management practices, standardized personnel training and certification, communications interoperability, ongoing performance evaluation, and more to enhance overall TIM operations.

Providing a recent example, the New York State Police (NYSP) created a dedicated TIM Detail in 2008 to speed the clearance of major traffic crashes, reduce congestion and secondary collisions, provide more targeted enforcement in crash-prone areas, and fulfill the mandates of New York's Work Zone Safety Act of 2005. Approximately 100 TIM troopers are deployed statewide. Detail supervisors work with local law enforcement, fire and rescue, EMS, towing and recovery, and other TIM responders to improve the coordination of emergency responses and apply NIMS concepts to the traffic environment. The NYSP TIM Detail strives to achieve the three objectives set out in NTIMC's NUG: responder safety; safe, quick clearance; and prompt, reliable, interoperable communications. This dedicated-team approach is intended not only to improve the safety of the broader roadway system year-round but also to increase safety in New York's highway work zones.<sup>(65)</sup>





## CROSS-CUTTING CHALLENGES AND STRATEGIES

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Efforts to develop or improve TIM are often challenged by issues of an institutional rather than operational nature. Common impediments frequently relate to:

- Agency relations.
- Training.
- Communications.
- Technology.
- Performance measurement.
- Program resources and funding.

Institutional challenges are more difficult than operational challenges to characterize and address. Consequently, the effectiveness of various tools and strategies designed to overcome the most common impediments and improve overall TIM efforts is difficult to accurately determine.

The remainder of this chapter describes common institutional challenges and potential strategies for improvement for each of the six areas identified above. Whenever possible, the reader is directed to example applications, reported either in the published and electronic information sources or by participating TIM practitioners, to support additional information gathering regarding a particular tool or strategy of interest.

### Agency Relations

Strong agency relations are a basic underlying principle of effective TIM. Key relationships should exist among transportation, law enforcement, fire and rescue, and EMS agencies and the towing and recovery industry. Additional partners that should not be overlooked include the trucking industry, traffic control industry, insurance industry, and emergency management agencies. <sup>(66)</sup>

Common challenges to effective agency relations include the following:

- **Different agency priorities and cultures.** Although each TIM responder performs a valuable function at the scene of an incident, differing priorities and agency cultures often complicate and may delay the TIM process. For example, lengthy law enforcement investigation duties sometimes conflict with the objective of quickly restoring traffic flow under a multidisciplinary TIM approach. Fire and rescue personnel, with the intent of protecting the incident scene, may use fire equipment that can unnecessarily block traffic lanes and may not respond individually to requests from other response agencies unless their commanding officer directs them to do so. Transportation agencies are rarely connected directly to public safety emergency communications and dispatch systems, and not all operate 24 h a day, resulting in sometimes lengthy after-hours response. Compared to other TIM participants, towing and recovery service providers are unique because they are not public agencies; they must remain profitable to retain a skilled work force and purchase and maintain expensive and complex equipment. <sup>(66)</sup> Understanding these differences in priorities and operating protocols helps each participant appreciate another's expertise and helps agencies coordinate overall incident management efforts more effectively.
- **Informal TIM operations.** TIM efforts, as stand-alone activities, may be beneficial but are vulnerable to administrative personnel changes and annual budgetary fluctuations. Institutionalizing TIM efforts into formalized TIM programs can help to encourage

sustainability. Sustainable TIM programs may require legislative or administrative authorization, strategic missions and goals, written operational policies, and formal organizational structure. The latter can include trained and dedicated staff, assigned responsibilities, defined reporting channels, and steady dedicated funding. Most TIM programs at the State and regional levels have some of these institutional support elements in place, but none seem to have them all. <sup>(67)</sup>

Table 7 identifies the various tools and strategies that have proven effective in overcoming each of these challenges and identifies select locations where these tools and strategies are in use. Note that additional tools and strategies that were more variable in their reported effectiveness—including a viable career path for TIM—are included in appendix C.

Table 7. Agency relations challenges, strategies, and select implementation locations.

AGENCY RELATIONS STRATEGIES	Different Priorities/ Cultures	Informal TIM Operations	EXAMPLE APPLICATIONS
Routine, Periodic “TIM Team” Meetings	●		GA (Atlanta), MI (Detroit), NJ/PA (Delaware Valley Region), TX (Austin), WA, WI
Joint Agency/Jurisdictional Protocols	●		FL (Southeast), WA
Joint Traffic/Emergency Management Center		●	FL, GA (Atlanta), IL (Chicago), NY (Hudson Valley Region, New York), RI, TX (Austin), UT (Salt Lake City)

Additional descriptive information regarding the various tools and strategies and select locations where these tools and strategies are in use is provided below.

- Routine, periodic “TIM team” meetings.** To encourage ongoing dialogue among TIM responders, monthly or quarterly meetings may be held to bring forward and discuss TIM challenges, procedures, and resource needs related to operations or safety. These meetings are commonly organized and facilitated by a champion within one of the participating agencies but may also be arranged through an external contractor. Successful meetings include regular participants from law enforcement, fire and rescue, EMS, transportation, towing and recovery, and other agencies. Often, participating TIM responders are formalized into a “TIM team” to encourage individual commitment to TIM efforts and help ensure that all response agency and partner perspectives are represented in discussions.

For example, in the Delaware Valley region in New Jersey and Pennsylvania, the DVRPC facilitated development of five corridor-focused TIM task forces that meet on a quarterly basis. Task force members include State and local law enforcement, fire and rescue, EMS, transportation (including operations, maintenance, and project management divisions), towing and recovery, communications, and environmental protection agencies. In New Jersey, four subcommittees—focused on policy and procedures, response boxes, training, and feedback—meet as necessary outside of the quarterly meetings. The DVRPC staff provides administrative support for each of the task forces and facilitates agency coordination. As an “outside” agency that does not respond directly to incidents, DVRPC is

effective in promoting and organizing TIM activities among responders but cannot exercise authority over State or local transportation or public safety agencies.

Other examples of active TIM teams include the following:

- The Austin-Area Incident Management for Highways (AIMHigh) Team in Austin, TX—including representatives from Federal, State, and local transportation agencies; State and local law enforcement agencies; fire and rescue agencies; EMS; the local towing association; local watershed protection agencies; and the regional metropolitan planning organization (MPO)—meet bimonthly to discuss TIM challenges, accomplishments, and resource needs. Meetings are facilitated by an outside contractor.
- The TIME Task Force, Inc., in metropolitan Atlanta, GA, is comprised largely of representatives from State and local transportation agencies, State and local law enforcement agencies, fire and rescue agencies, EMS, and towing and recovery interests. Members generally meet quarterly and have recently begun to host an annual conference. Like the TIM teams in the Delaware Valley region in New Jersey and Pennsylvania, the TIME Task Force, Inc., supports four subcommittees focused on operations, programs, training, and communications. Additional information is available at the Metro Atlanta TIME Task Force, Inc., website, accessible at <http://timetaskforce.com/index.html>.<sup>(68)</sup>
- In Detroit, MI, the Incident Management Coordinating Committee (IMCC) began in 1992 as an ad-hoc advisory group made up of public agencies and private interests with the purpose of improving response to traffic incidents. Since its inception, the IMCC has facilitated major TIM improvements including the development of a combined Michigan Department of Transportation/State Police TMC, the expansion of CCTV camera and DMS coverage on the metropolitan freeways, the establishment of the Freeway Courtesy Patrol, and legislative changes that reduced the time that abandoned vehicles were allowed to remain on the freeway right-of-way from 48 to 18 h.<sup>(69)</sup> The IMCC includes subcommittees focused on freeway operations, planning, and short-term initiatives. Meetings are generally monthly and are facilitated by an outside contractor.
- In 2008, Washington's TIM Coalition (WaTIMCo) hosted the inaugural Washington State TIM Conference, intended to serve as the first formal WaTIMCo meeting, provide a forum for discussing NTIMC's NUG and how best to implement associated best practices in the State, and provide an opportunity to strengthen existing transportation–public safety partnerships. The conference received endorsements from the Washington State Department of Transportation, Washington State Patrol, Washington State Fire Fighters' Association, American Automobile Association, and governor. Additional information is available through the WaTIMCo website, accessible at <http://www.watimcoalition.org/>.<sup>(70)</sup>
- Wisconsin's statewide TIME team includes representatives from Federal, State, and local transportation agencies; State and local law enforcement agencies; fire and rescue agencies; EMS; the State towing association; the State motor carrier association; and various media outlets. A complete list of members is available at Wisconsin's TIME program website, accessible at <http://www.dot.wisconsin.gov/travel/stoc/time-partners.htm>.<sup>(71)</sup>

The effectiveness of TIM teams and associated TIM meetings is dependent upon the meeting frequency, participation, and content. In addition, members must feel that they have the

ability and/or authority to make change. Targeting fire and rescue agencies, Sullivan recently promoted the benefits of TIM teams and associated TIM meetings as a means to “preplan, train and coordinate the resources of a number of different agencies” and “develop a better understanding of the resources, staffing, response times and protocols for the other responders.”<sup>(72)</sup> Participation in such forums was encouraged to ensure that unique fire and rescue operational needs—such as access to water supplies, emergency turnarounds, pull-offs/exits, and any detours that can affect emergency response times—are considered.

- **Joint agency/jurisdictional protocols.** On a more formal basis, agencies or jurisdictions can develop joint operating protocols intended to recognize the shared responsibility for roadway safety between public safety and transportation agencies.

For example, the Washington State Patrol and Department of Transportation signed the first *Joint Operations Policy Statement (JOPS)* in the Nation to better coordinate efforts to clear traffic incidents. In addition to describing how each of the various TIM program components function under a multi-agency agreement, this document formalized the 90-min clearance goal for major traffic incidents that was initiated in 1997. The agreement, currently under revision and scheduled to be released in 2010, also addresses broader issues related to data sharing, communication, enforcement, work zone safety, commercial vehicle operations, safety rest areas, and more.<sup>(73)</sup>

In southeast Florida, a similar JOP, developed between the public safety community and the Florida Department of Transportation, is intended to identify existing related policies and to create a common guideline for effective TIM.

- **Joint traffic/emergency management center.** TMCs can be staffed by a single agency or multiple agencies. Facilities that house multiple agencies, including associated dispatch centers, under a single roof have the potential to enhance agency relations, as well as reduce overall facility development and operating costs (i.e., costs are shared across multiple agencies). Effective joint TMCs require a high level of information sharing and cooperation from all agency participants.

One example of a joint traffic/emergency management center is Chicago’s Office of Emergency Management and Communications (OEMC). Housed within a single building, the OEMC is comprised of four distinct but coordinated centers:

- The Operations Center, staffed by personnel from local law enforcement, fire and rescue, and transportation agencies tasked with managing traffic.
- The Joint Operations Center to support large-scale emergency management.
- The City Incident Center, responsible for reactive roadway maintenance (i.e., snow removal, broken water main/downed power wire repairs).
- The centralized 9-1-1/Dispatch Center for local police, fire and rescue, and EMS agencies.

Together, they form an integrated unit that directs all of Chicago’s resources during local emergencies or large-scale catastrophes that require participation from State and Federal agencies. For first responders, the result is more accurate and timely direction in the field, better preparation for receiving casualties at the city’s trauma centers, and enhanced safety and backup.<sup>(74)</sup>

Similarly, the Combined Transportation, Emergency, and Communications Center (CTECC) in Austin, TX, brings several State, county, and municipal government agencies together in a

single facility to share command-and-control resources in the area and strengthen the area's emergency communications and traffic management. Located at the CTECC facility are the City of Austin's 9-1-1 dispatch, police department, fire department, and EMS; Travis County's 9-1-1 dispatch and sheriff's department; the Capital Metropolitan Transportation Authority (the local transit system); and the Texas Department of Transportation.

Several additional examples of joint traffic/emergency management centers exist across the Nation:

- Throughout Florida, several of the TMCs operated by the Florida Department of Transportation are entirely or partially co-located with their counterpart State law enforcement dispatch centers, and sometimes in the Florida Highway Patrol District Headquarters. <sup>(6)</sup>
- To facilitate communications during large-scale incidents and emergencies impacting the highway network, the primary TMC in Atlanta, GA, is located in close proximity to the Georgia Emergency Management Agency's (GEMA's) Statewide Emergency Operations Center (EOC). In addition, GEMA representatives are active participants in the TIME Task Force. <sup>(6)</sup>
- Similarly, the TMC operated by the New York City Department of Transportation is located in the same facility with the New York Police Department, improving coordination for traffic incidents. More recently, the New York State Department of Transportation and State Police partnered to design, build, and operate a TMC in the Hudson Valley region to facilitate multi-agency TIM and disseminate traveler information. <sup>(6)</sup>
- The Rhode Island Department of Transportation's TMC and radio dispatch is co-located with the State Police, allowing for better, easier coordination. <sup>(6)</sup>
- Similarly, the Utah Department of Public Safety (DPS) Communications Bureau dispatch is co-located with the Utah Department of Transportation (UDOT) in Salt Lake City's TMC. The UDOT TMC operators and DPS dispatchers work together to identify incidents and get a response unit to the incident scene quicker.

## Training

TIM training efforts may focus on three general areas:

- Training specific to TIM within one's own agency or company.
- Training aimed at increasing awareness of other responders' roles or existence.
- Training aimed at improving specific procedural operations.

Efforts to improve TIM should consider training activities in each of these areas. Training efforts focused on a single agency or company's procedures or on procedural operations can be tailored based on specific needs. Training aimed at increasing awareness of other responders' roles or existence should involve response personnel from law enforcement, fire and rescue, EMS, transportation, towing and recovery, and other disciplines.

Common challenges to effective TIM operations stem from the following:

- **Inadequate joint training among responders.** TIM personnel receive extensive discipline-specific training but have fewer opportunities to train with responders from other disciplines. The NTIMC Training Task Force has identified essential TIM functions that can be commonly performed by various agency personnel in their document *Multidisciplinary Core Competencies*.<sup>(75)</sup> For example, NTIMC recommends that all responders, regardless of discipline, be trained to position vehicles to support scene safety and expeditious exit of EMS vehicles, establish temporary traffic control, provide basic first aid to victims until EMS arrives, and assume incident command until replaced. The NTIMC recommends cooperative roles for law enforcement and transportation personnel when establishing advance traffic control and detour routes, with fire and rescue personnel providing assistance as needed. Similarly, law enforcement personnel are primarily tasked with vehicle and debris removal, but transportation and fire and rescue personnel are urged to take an assistive role. Both fire and rescue and transportation personnel are presumed to competently perform functions associated with the cleanup of minor spills. Multidisciplinary training, particularly in these common functional areas, will encourage more efficient and effective TIM.
- **Responder competency/standardization.** Too often, TIM is learned on the job, with training deficiencies most commonly identified for transportation and towing and recovery personnel. Transportation agencies, in a formal capacity, are relatively new to TIM and, therefore, lack substantive training materials. Unlike public safety agencies, whose personnel devote much of their time to training for emergency or life-threatening situations, transportation personnel are typically not trained in such areas. One reason may be that the role of transportation agencies at an incident scene may be clear in the most general terms (i.e., to provide traffic control) but quickly becomes vague about specific duties such as response to hazardous material incidents. In addition, the roles and involvement of transportation agencies in TIM vary nationally (i.e., some transportation agencies are very proactive and would like to assume additional TIM responsibilities, whereas others are content to perform construction and maintenance functions).

Until recently, towing and recovery agencies also suffered from a lack of substantive training materials. The TRAA National Driver Certification program was developed to enhance TIM training for towing and recovery operators. Not all companies subscribe to the TRAA certification program, however, resulting in inconsistent operator competency at the scene of an incident. A request to a towing and recovery company may result in response by a well-qualified professional with years of expertise or a new employee whose skills are not up to the job.

- **Variable traffic control training among responders.** The use of traffic control standards meets driver expectations and reduces a public agency's potential for liability. Nontransportation personnel are often ill equipped and untrained to provide extensive traffic control at the scene of an incident. Because they are often first on the scene, however, enhancements to scene management could result if they are trained in MUTCD-compliant procedures, despite limitations in available traffic control devices.

Table 8 identifies the various tools and strategies that have proven effective in overcoming each of these challenges and identifies select locations where these tools and strategies are in use.

Table 8. Training challenges, strategies, and select implementation locations.

TRAINING STRATEGIES	Challenges			EXAMPLE APPLICATIONS
	Inadequate Joint Training	Responder Competency/Standards	Variable Traffic Control Training	
National TIM Training	●			National Highway Institute (NHI), Department of Homeland Security (DHS, NIMS), Consortium for ITS Training and Education (CITE), <i>Traffic Incident Management Systems</i>
Information Clearinghouses/Communities of Practice	●			NTIMC, ResponderSafety.com, I-95 Quick Clearance Toolkit, International Association of Chiefs of Police (IACP) Technology Clearinghouse, IAFC Vehicle Safety Resources, FL (Southwest), GA, IN, NV, NJ/PA (Delaware Valley Region), NY, WA, WI
Local Multidisciplinary TIM Training	●			AZ, FL, GA, IN, MD, MI, NC, NJ, NY, OR, TX (Dallas, Ft. Worth), VA, WA, WI
Tabletop Exercises/Scenarios	●			NJ/PA (Delaware Valley Region), MD
After-Action Reviews/Debriefings	●			FL, ME/NH, GA, NV, NJ/PA (Delaware Valley Region), TX (Austin), WI
Multidisciplinary TIM Response Plan/Operating Procedures	●	●	●	AZ, CT, ME/NH, MA, MN, NJ/PA (Delaware Valley Region), NY, NC, OH, TX (Austin, San Antonio), WI
TIM Personnel Certifications/Training Requirements		●	●	TRAA, GA, NJ/PA (Delaware Valley Region), NY (Hudson Valley Region), VA

Additional descriptive information regarding the various tools and strategies and select locations where these tools and strategies are in use is provided below.

- **National TIM training.** NHI offers a suite of courses that provides awareness-level training for personnel from law enforcement, fire and rescue, transportation, towing and recovery, communications, and other agencies or companies involved in responding to incidents or planning special events:
  - *Managing Traffic Incident and Roadway Emergencies* (FHWA-NHI-133048) addresses institutional and technical aspects of resolving traffic incidents and roadway emergencies safely and efficiently.
  - *Managing Travel for Planned Special Events* (FHWA-NHI-133099) guides practitioners through all phases of managing travel for planned events using a local event scenario.
  - *Using the Incident Command System (ICS) at Highway Incidents* (FHWA-NHI-133101) presents an overview of ICS, its structure, and how it expands/contracts to meet incident demands while maintaining a manageable span of control for on-scene personnel.

These courses may be taken individually or in succession.

In addition, DHS offers NIMS training. The NIMS provides a consistent nationwide template to enable Federal, State, tribal, and local governments; the private sector; and



nongovernmental organizations to work together to prepare for, prevent, respond to, recover from, and mitigate the effects of incidents, regardless of cause, size, location, or complexity, in order to reduce the loss of life and property and reduce harm to the environment. These courses are available online, accessible at <http://www.fema.gov/emergency/nims/NIMSTrainingCourses>, for all emergency-services-related disciplines such as law enforcement, fire and rescue, EMS, hospitals, public health, public works/utilities, skilled support personnel, and other emergency management response, support, and volunteer personnel. <sup>(76)</sup>

CITE also provides an online course related to TIM, accessible at <http://www.citeconsortium.org/courses/1mod8.html>. <sup>(77)</sup> This course, however, is intended for transportation professionals from State, regional, and local agencies and may lack a multidisciplinary focus.

Recently, the U.S. Fire Administration and the USDOT, working in partnership with the International Fire Service Training Association, published *Traffic Incident Management Systems*. <sup>(78)</sup> The report provides guidance to local-level fire and rescue agencies to encourage compliance with the MUTCD and the *Incident Command System Model Procedures Guide for Incidents Involving Structural Fire Fighting, High Rise, Multi Casualty, Highway, & Managing Large-Scale Incidents Using NIMS-ICS*. <sup>(79)</sup> The report includes case studies of roadway incidents that have resulted in firefighter fatalities, highway scene safety survival basics, incident command for roadway incidents, and examples of effective TIM programs.

- **Information clearinghouses/communities of practice.** Electronic information clearinghouses or communities of practice (COPs) focused on TIM can support local training efforts as well as achieve broader benefits related to targeted information exchange and expedited implementation of successful TIM tools and strategies.

A number of TIM-related information clearinghouses or COPs exist at the national level:

- The NTIMC website, accessible at <http://timcoalition.org/?siteid=41&pageid=590>, provides electronic access to information intended to promote State, regional, and local TIM programs; TIM-related standards, best practices, and performance measures; and TIM-related research. <sup>(1)</sup> The website provides an overview of the recently ratified NUG and includes links to various TIM-related publications and products, multidisciplinary and directed TIM training materials, quick clearance legislation and policies, standard operating procedures and guidelines, State and local TIM activities, and upcoming TIM-related meetings and events. The NTIMC also supports information exchange through a COP website, accessible at <http://timexchange.org/inc/inc.nsf/home>. <sup>(80)</sup> The NTIMC COP website offers a forum for TIM practitioners to post and respond to questions to encourage the direct exchange of experiences and knowledge within the TIM community.
- The FHWA's Emergency Transportation Operations Traffic Incident Management website, accessible at [http://ops.fhwa.dot.gov/eto\\_tim\\_pse/about/tim.htm](http://ops.fhwa.dot.gov/eto_tim_pse/about/tim.htm), provides descriptive information about TIM and TIM partners, as well as electronic access to various related publications (including a link to FHWA's Office of Operation's Publications website that includes more than 30 TIM related reports), regulations, and policies. <sup>(67)</sup> This information clearinghouse also provides a point of contact at FHWA if further information is required.

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- The ResponderSafety.com website, accessible at [www.respondersafety.com](http://www.respondersafety.com), provides similar opportunities for information exchange. <sup>(81)</sup> This website—created and maintained by the Cumberland Valley Volunteer Firemen’s Association Emergency Responder Safety Institute (ERSI), with recent support from the U.S. Fire Administration—includes timely news, downloadable training courses and information, product and equipment information, a photo gallery, model standard operating procedures and guidelines, information on quick clearance legislation, and more.
- The *Coordinated Incident Management Toolkit for Quick Clearance*, developed by the I-95 Corridor Coalition, serves as an additional resource to support information exchange. <sup>(43)</sup> The toolkit is designed for use by multiple disciplines and provides policy makers and TIM practitioners with ready-to-use tools to assist them in providing more effective TIM practices, with a primary emphasis on quick clearance. Information that is available electronically for download includes presentations, videos, and TIM scenarios, as well as supporting information such as sample policies, laws, memoranda of understanding, and incident response plans.
- Providing for more focused information exchange, a technology clearinghouse was established in 1997 through a cooperative agreement between the IACP, FHWA, and the National Highway Traffic Safety Administration (NHTSA). The IACP Technology Clearinghouse, accessible at <http://www.iacptechology.org/>, is a web-based information exchange forum focused on innovative law enforcement and transportation technologies. The website provides informational resources related to TIM technologies and resources, ITS, computer-aided dispatch (CAD) and records management systems, and law enforcement information management resources. The website receives over 3.6 million hits each year. <sup>(82)</sup>
- Intended primarily for fire and rescue personnel, the IAFC Vehicle Safety Resources website, accessible at <http://www.iafc.org/displaycommon.cfm?an=1&subarticlenbr=413>, provides unrestricted access to various standard operating procedures and guidelines that relate to positioning vehicles at the scene of an incident, the use of emergency lighting, and general TIM operations with a focus on safety. <sup>(83)</sup>

Similar resources have been developed at the State level. For example, the Delaware Valley region in New Jersey and Pennsylvania has developed a collection of resources or “toolbox” to support TIM task force development and ongoing efforts. A CD contains a series of ready-to-use TIM meeting facilitation materials, examples of local TIM products, a video, and various national resource documents. <sup>(6)</sup>

A number of States also host websites intended to share TIM-related information. Examples include:

- The Delaware Valley region’s (New Jersey and Pennsylvania) Incident Management website, accessible at <http://www.dvrpc.org/Operations/IncidentManagement.htm>. <sup>(84)</sup>
- Southwest Florida’s TIM website, accessible at <http://www.swftim.org/>. <sup>(85)</sup>
- Metro Atlanta’s (Georgia) TIME website, accessible at <http://www.timtaskforce.com/>. <sup>(68)</sup>
- Indiana’s IN-TIME website, accessible at <http://www.indianaquickclearance.org/index.php>. <sup>(58)</sup>
- New York’s Traffic Incident Management website, accessible at <https://www.nysdot.gov/tim>. <sup>(86)</sup>
- Washington’s WaTIMCo website, accessible at <http://www.watimcoalition.org/>. <sup>(70)</sup>

- Wisconsin's TIME program website, accessible at <http://www.dot.wisconsin.gov/travel/stoc/time.htm>.<sup>(71)</sup>

Select States routinely distribute supplemental newsletters to further enhance information sharing among TIM practitioners:

- In southwest Florida, a bimonthly newsletter is distributed in electronic format that includes information regarding State and local TIM team activities and national TIM initiatives.<sup>(6)</sup>
  - Similarly, Georgia distributes a quarterly newsletter to all participating agencies with updates on current accomplishments of the TIME Task Force.<sup>(6)</sup>
  - With a more specific focus, Nevada distributes an annual newsletter that updates members/stakeholders on current activities as they relate to the State's TIM strategic plan.<sup>(6)</sup>
- **Local multidisciplinary TIM training.** Multidisciplinary training—involving personnel from law enforcement, fire and rescue, EMS, transportation, towing and recovery, and other disciplines—can effectively identify operational challenges and solutions, enhance understanding of respective personnel roles and responsibilities, encourage the efficient use of resources, and improve overall TIM operations, particularly if the training is tailored to meet local conditions, policies, procedures, and needs.

Traditional multidisciplinary TIM training typically involves in-person interactions in a classroom environment. In Dallas/Fort Worth, TX, NCTCOG operates a successful, long-term TIM training program. Two separate courses have been designed for first responders/managers and executive-level policy makers. The first responder/manager level course is 2 d (15 h) in duration and offered nine times per year. The executive-level course is 2 h in duration and offered twice per year. Each course explains the goals, objectives, and benefits of multi-agency TIM coordination and training. Students are eligible for Texas Commission on Law Enforcement Officer Standards and Education (TCLEOSE) and Fire Commission credits. In its first 3 yr of operation, more than 600 first responders/managers and 70 executives completed NCTCOG's TIM training courses, resulting in a related significant reduction in lane closures due to incidents.<sup>(87)</sup>

Offering similar training opportunities, the Virginia Department of Transportation (VDOT) teamed with the Virginia Polytechnic Institute and State University (Virginia Tech) to develop the Transportation Emergency Response Institute (TERI) to train VDOT staff, partner agencies, and other stakeholders in responding effectively to roadway emergencies.<sup>(6)</sup>

It is often difficult, however, for multiple disciplines to commit to formal, in-person training on a frequent basis. An alternative training method is to involve representatives from outside a discipline to speak about their role in TIM at regular agency or company training sessions. Several examples of this approach are available from across the Nation:

- The Arizona Highway Patrol offers a 4-h training session to local fire and rescue agencies focused on TIM operations and quick clearance. The training session is credited with changing the way in which fire and rescue personnel position their vehicles at the scene of an incident, reducing overall lane blockage.

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- A similar training course focused on vehicle positioning and scene safety is provided to area fire and rescue agencies by Michigan Department of Transportation personnel. <sup>(6)</sup>
- New Jersey Department of Transportation personnel provide a training session for all recruits at the State Police Academy. In addition, TIM personnel have organized 1-d multidisciplinary training programs involving the State transportation, State and local law enforcement, fire and rescue, EMS, Port Authority, and State Department of Environmental Protection agencies.
- Quick clearance principles are taught in law enforcement academies in New York, as part of continuing rather than basic training. <sup>(6)</sup>
- Georgia is planning to develop a 2- to 4-h TIM training session and integrate it into the Police Officers Standards and Training (POST) program for statewide delivery. <sup>(6)</sup>
- Representatives from the Maryland State Highway Administration speak regularly to trainees in law enforcement and fire academies. Although exposure to public safety personnel has been historically limited—transportation personnel reported having a single hour to address State Police trainees and access to a single fire academy—recent extensive outreach efforts have successfully increased exposure to Maryland’s Roadway Incident Safety Responder Training program, particularly within the State’s fire academies. <sup>(6)</sup>
- The Oregon Department of Transportation supports a local outreach program focused on responder safety that offers TIM training to both local law enforcement and fire and rescue responders. <sup>(66)</sup>
- In Washington, multidisciplinary TIM training is provided cooperatively by the Washington State Department of Transportation, State Patrol, and fire and rescue personnel who emphasize unified command among all three disciplines. The State Patrol district commander in each district works with area transportation and fire district representatives to provide training sessions at least once per quarter. <sup>(6)</sup>

A second alternative to formal, in-person TIM training is to make training widely available through a variety of remote mediums. For example, various training modules related to traffic control, scene safety, and the ICS are available for use by multiple agencies in Indiana. Training materials are available for download at the IN-TIME website, accessible at <http://www.indianaquickclearance.org/>. <sup>(58)</sup> Similarly, training materials consistent with the State’s *Emergency Traffic Control and Scene Guidelines* are available to agencies free of charge in Wisconsin. The training materials, which are available on DVD and include PowerPoint presentations for students and instructors with an accompanying instructor’s manual, can be ordered through the TIME website, accessible at <http://www.dot.wisconsin.gov/travel/stoc/time.htm>. <sup>(71)</sup>

Supporting similar remote training efforts, the North Carolina Department of Transportation recently teamed with the State fire marshal and State and local law enforcement agencies to develop a Highway Incident Safety video, accessible for viewing at [http://www.ncdoi.com/OSFM/RPD/rpd\\_resources\\_HighwaySafety.asp](http://www.ncdoi.com/OSFM/RPD/rpd_resources_HighwaySafety.asp), intended to serve as a training tool for all responders in the State. The video introduces recent changes to apparatus and traffic cone placement at incident scenes and high-visibility chevron striping as per National Fire Protection Association (NFPA) 1901: Standard for Automotive Fire Apparatus. The video also addresses more general principles related to safe vehicle

placement and proper traffic control at incident scenes. The video has been integrated into statewide training in the fire academy, as well as standard training in the Highway Patrol academy. More than 5,000 DVDs will be produced and distributed to agencies around the State. Fire departments that use the video for in-service training receive five free traffic cones for each of their trucks. The development effort, including the supply of traffic cones, was funded through a grant issued by the Federal Emergency Management Agency (FEMA).<sup>(6)</sup>

Most recently, Florida set an ambitious goal of exposing all law enforcement, fire and rescue, and EMS first responders to TIM during the calendar year through a coordinated effort involving the Florida Department of Transportation, Highway Patrol, Police Chiefs Association, Sheriffs Association, and Fire Chiefs Association.<sup>(88)</sup> Initiated in early 2010, the “TIM in ’10” program employs a three-pronged training approach utilizing classroom, online, and video training strategies:

- The 4- to 6-h classroom training module, *Maintenance of Traffic (MOT) for Responders*, describes traffic control principles commensurate with the limited resources available to emergency responders.
- The companion PowerPoint slide series is available online to support independent study.
- The roll call five-part streaming video product, *Time4Safety*, allows individuals or groups of responders to accomplish TIM training in less than 1 h. The video is accessible online at <http://northfloridatpo.com/index.php?id=25>.<sup>(89)</sup>

In its first three months of operation, nearly 200 agencies signed on to participate in the TIM in ’10 program, representing exposure to over 21,000 Florida first responders. The roll call streaming video product, sponsored by the North Florida Transportation Planning Organization, is the most popular training strategy. Several agencies host the video on their websites, and more than 500 DVD versions have been produced and distributed statewide. Florida’s Criminal Justice Standards and Training Commission (CJSTC) has authorized 1 h of mandatory retraining credits for viewing the five-part *Time4Safety* video and will be requiring it in the future basic law enforcement officer training curriculum.<sup>(88)</sup>

- **Tabletop exercises/scenarios.** For TIM training focused on operations, staged incidents provide the best forum for learning, particularly if the time and place of the staged incident are covert. Complex logistics prevent this form of training from occurring frequently, however. A training alternative includes tabletop exercises and scenarios in which representatives from law enforcement, fire and rescue, EMS, transportation, and private industry “act out” what they would do in a sample incident using a two- or three-dimensional representation of the roadway environment (e.g., aerial maps and photographs) and props (e.g., toy cars) representing TIM resources. The benefit of scenario training over on-the-job training is that participants can stop at any time and question other responders about their actions. At an actual incident scene, the urgency of performing actions does not allow this type of insightful discussion.

In the Delaware Valley region in New Jersey and Pennsylvania, the TIM task force for the I-95 corridor through Philadelphia, PA, staged a tabletop exercise with participants from all disciplines. Just weeks after the training exercise was performed, a major incident closed I-95 for several days at the same location as the scenario. The TIM Task Force credits the efficient and effective response to the “actual” incident to the prior participation in the tabletop exercise.

As noted previously, traditional tabletop exercises/scenarios rely upon aerial maps, photographs, props, and other items to replicate the incident environment. More recently, the conduct of tabletop exercises/scenarios can be supported through commercially available virtual incident simulation software. Incident Commander™, developed by the National Institute of Justice, is one example of a virtual training tool. Using three-dimensional, multiplayer computer gaming simulation technology, Incident Commander™ allows TIM personnel to enhance response performance for a variety of large-scale incidents including severe storms and natural disasters; chemical, biological, radiological, and nuclear events; terrorist bombings and insurgencies; explosions and fires; and floods.

With a focus on smaller-scale, traffic-related incidents, the I-95 Corridor Coalition is sponsoring development of the Virtual Incident Management Training program, designed to educate and validate TIM techniques and quick clearance practices. It promotes communication, coordination, and cooperation using practical, interactive incident scenarios for up to 500 responders simultaneously. The program incorporates realistic time delays and resource limitations. Based on direct experience with the Virtual Incident Management Training program prototype, TIM personnel in Baltimore, MD, rated its effectiveness in enhancing the adequacy of multidisciplinary training among responders as high.

- **After-action reviews/debriefings.** Follow-up reviews or assessments of incidents after their occurrence are important to discuss what went well and what actions could be improved upon. Ideally, after-action reviews/debriefings should occur immediately after the incident has been cleared (to ensure that details and procedures of the response effort are not forgotten) but following the necessary data collection. The main goals of these meetings are to constructively critique the procedures used and any decisions made and to determine whether future management could be improved in any way (e.g., by restructuring the procedures, adding extra resources, etc.). Personnel in attendance should include each of the responders who participated in the management effort. The I-95 Corridor Coalition's *Traffic Incident Management Teams Best Practices Report* includes a comprehensive implementation checklist in appendix D for effectively conducting after-action reviews/debriefings. <sup>(6)</sup>

The effectiveness of after-action reviews/debriefings is dependent upon the frequency with which debriefings are held and the tone of the meetings when they are held. After-action reviews that are too infrequent or too cordial (i.e., no one is willing to raise any criticism) may not effectively identify opportunities for improvement in TIM operations.

A number of TIM programs from across the Nation include after-action reviews/debriefings as part of their operations, with varying frequencies of occurrence:

- In Florida, the TIM team conducts after-action reviews/debriefings for major incidents occurring on the Turnpike. <sup>(6)</sup>
- Similarly, the TIM team in Maine and New Hampshire conducts after-action reviews/debriefings following major incidents. Standard forms that allow responders and the incident commander to recall the incident are used. After the debriefing session, a representative from the Southern Maine Regional Planning Commission (SMRPC) develops an After Action Report and distributes it to all participants. <sup>(6)</sup>
- In Austin, TX, after-action reviews/debriefings are held for all incidents longer than 4 h in duration. Debriefings involve responders involved in the incident, as well as the broader AIMHigh Team, to more widely disseminate best practices and lessons learned.

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- On a regular monthly basis, Georgia's TIME Task Force conducts after-action reviews to debrief any major, commercial-vehicle-involved incidents with all responding agencies. <sup>(6)</sup>
- Similarly, Nevada's TIM Coalition meets bimonthly to debrief major incidents. <sup>(6)</sup>
- In the Delaware Valley region in New Jersey and Pennsylvania, incident responders routinely present and discuss recent incidents at quarterly task force meetings. Response to major incidents may require additional discussion and be addressed during a stand-alone after-action review. In both cases, all responders involved in the incident are present at the debriefings.
- In Wisconsin, facilitators use video from the incident scene—recorded by the TMC on 72-h loops—to support post-incident debriefings conducted as part of their TIME program. The practice has proven successful in enhancing the post-incident debriefing process with no negative legal implications. <sup>(6)</sup>
- **Multidisciplinary TIM response plan/operating procedures.** To ensure that TIM training efforts are effective, operations are efficient, and the program has longevity, it is important to develop textual material to support recommended actions. A multidisciplinary TIM response plan or operating procedures generally include the policies and responsibilities for each participating agency or company, response personnel capabilities and training, and resources (i.e., equipment and supplies) and their availability. Responder policies and responsibilities can be fairly general to allow them to be adapted to different incidents but specific enough so that each responder's responsibility within the context of TIM is clear. Any interagency agreements developed to facilitate efficient TIM operations should be included. The most successful TIM response plans/operating procedures are cooperatively developed.

Several examples of TIM response plans/operating procedures are available from across the Nation:

- Arizona's *Statewide Incident Management Plan*—which includes statewide alternate route plans and TMC TIM operations guidelines—was developed with input obtained from legislative, transportation, law enforcement, fire and rescue, and EMS agencies; the towing industry; and others. The plan includes related traffic control agreements with the towing industry. <sup>(90)</sup>
- Maine and New Hampshire's *Traffic Incident Management Action Plan*, cooperatively developed by TIM personnel in both States, is intended to assist in assessing existing local TIM practices and improving the overall TIM process. <sup>(6)</sup>
- In Massachusetts, a *Unified Response Manual (URM)* was first developed in 1998 to encourage consistent and common terminology for responding agencies tasked with managing traffic incidents. This document was recently updated in 2009 and includes an enhanced emphasis on safe, quick incident clearance and procedures for unified command, incident response, incident clearance, and after action reviews.
- Referencing Massachusetts' URM as the model, the Connecticut Transportation Strategy Board's Statewide TIM Task Force studied and identified the need for a similar URM to enhance interagency coordination of first responders at incident scenes in Connecticut. The Department of Emergency Management Homeland Security has agreed to develop a training program from the URM, to be provided to police and fire academies. <sup>(6)</sup>

- In Minnesota, the Twin Cities Metro Incident Management Steering Committee's *Incident Management Recommended Operations Guidelines* defines the roles and responsibilities of different agencies at incident scenes, and provides guidelines for incident response and clearance. The Minnesota statewide plan, currently under development, is modeled after this regional plan.
- A TIM task force, established by the DVRPC, New Jersey Department of Transportation, and New Jersey State Police, was recently recognized with an award for its multidisciplinary *Policy and Procedures Manual*, which defines operational guidelines in response to incidents along I-676, I-76, and I-295. Since the manual was implemented in 2005, incident duration has decreased by 34 percent on I-676, by 10 percent on I-76, and by 14 percent on I-295. <sup>(91)</sup> New Jersey is also currently in the process of finalizing a *Statewide Incident Responders Policy and Procedures Manual*. This statewide manual is currently under review by the superintendent of the New Jersey State Police and the Office of the Attorney General. Once approved, this manual will provide uniform operational guidelines for safe incident operations throughout the State. In a related effort, a second DVRPC TIM task force developed *Traffic Incident Operating Guidelines* for the I-76/I-476 Crossroads area, including standard incident response procedures related to unidirectional response to prevent crossovers, use of a common radio frequency, and use of a single county agency dispatcher for all radio traffic. <sup>(6)</sup>
- The Ohio Department of Transportation developed an *Ohio QuickClear Professional Responders Guide for Safe and Effective Highway Incident Management*, accessible at [http://www.dot.state.oh.us/Divisions/HighwayOps/Traffic/publications2/Ohioquickclear/Documents/Ohio%20QuickClear\\_Oct007.pdf](http://www.dot.state.oh.us/Divisions/HighwayOps/Traffic/publications2/Ohioquickclear/Documents/Ohio%20QuickClear_Oct007.pdf), that describes recommended practice for all agencies and specifically for fire and EMS, law enforcement, transportation, and towing and recovery agencies as part of their broad TIM program. <sup>(8)</sup>
- To support the extended deployment of surveillance and information dissemination systems along the I-35 corridor between Austin and San Antonio, TX, an *Incident Management Response Plan for I-35* was recently developed. <sup>(16)</sup> This effort involved documenting current TIM procedures, determining agency roles and responsibilities, and defining response actions for multiple State and local jurisdictions in the 52-mi corridor.
- Wisconsin's *Emergency Traffic Control and Scene Guidelines* includes accompanying products and initiatives such as a response vehicle visor card for easy reference and TIM practitioner training available on DVD (described previously). Accompanying products are free of charge and can be ordered through the TIME website, accessible at <http://www.dot.wisconsin.gov/travel/stoc/time.htm>. <sup>(71)</sup>

Additional TIM response plans/operating procedures have been developed targeting distinct responders or incident types:

- In an abbreviated format, the Cumberland Valley Volunteer Firemen's Association ERSI developed an eight-step *Roadway Incident Safety Checklist* to encourage safety among fire and rescue personnel during roadway incidents focused on roadway incident safety training; multi-agency planning, training, policies, and procedures; on-scene exposure; apparatus placement and scene protection; warning lights and apparatus visibility; retroreflective and florescent personal protective equipment; safety officers and personnel accountability systems at highway incidents; and public education. <sup>(92)</sup>



- In the Hudson Valley region, New York, a *Media Traffic Incident Management Handbook* was developed to outline the rules and procedures for media personnel when at an incident scene. The handbook requires media personnel to wear approved safety vests, park in a particular position and location, and check in with the on-scene incident commander upon arrival. <sup>(6)</sup>
- Motivated by a single, more-than-90-vehicle collision event—that began with a single car collision with a median barrier and escalated to a catastrophic incident—the North Carolina Highway Patrol developed and implemented a *Multi-vehicle Collision Response Plan*. This plan incorporates the lessons learned in the management of this incident. <sup>(6)</sup>
- **TIM personnel certifications/training requirements.** Personnel certification helps to ensure a certain level of consistency and competency in TIM task performance. Certifications can be valid indefinitely following demonstration of a minimum acceptable knowledge or skill base (i.e., passing an exam) or may require periodic training and recertification to ensure that knowledge and skills remain strong. Certifications can differ by specific area of expertise or with increasing complexity. For example, the Georgia Department of Transportation provides a 208-h certification program for members of its HERO service patrol program.

Discussions regarding personnel certifications/training requirements have traditionally focused on improving consistency and competency among towing and recovery operators. Towing and recovery services represent an important component in the TIM process. Their quick response to the incident and their efficient conduct of the removal activity can be a key step in minimizing incident duration. Prequalification procedures can identify towing and recovery companies that have the appropriate equipment, education, certifications, and level of competency to serve as TIM responders. A number of recent programs or initiatives have been developed with a focus on enhancing towing and recovery operations:

- In an effort to improve the quality and consistency of response industry-wide, TRAA developed a three-level National Driver Certification program that incorporates TIM training. An increasing number of law enforcement agencies that contract with towers are now requiring TRAA certification as a qualification for participation.
- In Virginia, adequate towing and recovery standards, training, and equipment requirements are encouraged through State law:

§46.2-2826. Public safety towing and recovery services. The Board shall establish regulations required of Class A and Class B operators to provide public safety towing and recovery services. For the purposes of this section, “public safety towing and recovery services” shall be those towing and recovery and related services requested by a state or local law-enforcement agency. Such regulations shall establish minimum requirements, including qualifications, standards, necessary equipment, and public safety concerns necessary and appropriate to permit a Class A or Class B operator to provide public safety towing and recovery services. No operator shall provide public safety towing and recovery services unless they meet such criteria established by Board regulation applicable to public safety towing and recovery services. Upon submitting evidence to the Board of meeting such criteria, the Board shall maintain, on a timely basis, a list to be readily available to state and local law-enforcement agencies of Class A and Class B operators who meet the Board’s criteria for providing public safety towing and recovery services.

- In New York's Hudson Valley region, a High-Bid Contract Towing program is administered by the New York State Department of Transportation, supervised by the New York State Police, and awarded on the basis of competitive bidding. Contracts are awarded to the highest responsible bidder, with concurrent strict qualifications and guidelines, including regular inspections and response times less than 30 min. <sup>(6)</sup>

Personnel certifications and training requirements have also been identified as a possible strategy to enhance the adequacy and consistency of traffic control training among TIM personnel. While transportation personnel receive extensive training in proper traffic control procedures, nontransportation personnel are often ill equipped and untrained to provide extensive traffic control at the scene of an incident. Because they are often first on the scene, however, requiring a minimum level of competency in proper traffic control procedures could enhance scene management. Existing training courses that already target nontransportation personnel—such as the American Traffic Safety Services Association's (ATSSA) *Emergency Traffic Control (ETC) for Emergency Responders* course—provide opportunities for achieving certification in the event such certification is required. This 4-h course covers principles and concepts of temporary traffic control presented in Section 6.1 of the MUTCD. <sup>(37)</sup> Additional information regarding effective traffic control for TIM operations is available in FHWA's *Traffic Control Concepts for Incident Clearance Primer*, accessible at <http://ops.fhwa.dot.gov/publications/fhwahop08057/fhwahop08057.pdf>. <sup>(93)</sup>

Considering a broader range of TIM responders, research is currently underway as part of the Strategic Highway Research Program's reliability focus area (SHRP 2 L 12) that considers the potential for responder certification in support of NTIMC's NUG, with a focus on the common core competencies that promote a shared understanding of the requirements for achieving the safety of responders and motorists, quick response, and effective communications at traffic incident scenes. Products developed as part of this effort include a checklist of responder actions and associated core competencies, a curriculum and instruction outline for key responder types, and a recommended framework for responder certification. A pilot training course was delivered to TIM personnel in Indiana in March 2010 and, based on the evaluation of the proposed certification approach, will be considered for more widespread implementation.

Regardless of the nature and extent of required training, personnel certifications and training requirements are ineffective without active enforcement. Law enforcement or transportation agencies responsible for ensuring compliance may have limited resources to allocate to this activity. Consequently, it is important when implementing TIM certifications and standards that a companion strategy for efficiently enforcing the requirements be developed. Prequalification procedures for participating in TIM activities can determine initial eligibility; periodic checks can be performed to determine ongoing eligibility. Suitable "punishments" are also required for not meeting the certification/standards requirements.

For example, a TIM task force in the Delaware Valley region in New Jersey and Pennsylvania has begun using a Policy Violation Acknowledgement Form to ensure that TIM personnel are following appropriate on-scene procedures. Although TIM personnel are not officially "certified," participating law enforcement, fire and rescue, EMS, transportation, towing and recovery, and communications agencies are required to indicate concurrence with the region's multidisciplinary *Policy and Procedures Manual* and commit to take corrective action against individuals within their respective agencies when an unsafe procedural violation is observed. Any responder can anonymously complete the Policy Violation Acknowledgement Form and submit it to the DVRPC Feedback Committee. The committee will investigate the violation and meet with agency management to ensure corrective actions are taken.

Maintaining the privacy of the violating agency, the violation forms are reviewed at regular task force meetings to share lessons learned. <sup>(6)</sup>

## Communications

TIM communications includes the exchange of information both on- and off-scene, and within and between participating agencies and private companies. Critical communication links include an agency's dispatch with agency responders in the field, an agency's field responders with another agency's field responders, and an agency's dispatch with another agency's dispatch.

Common challenges to effective communication include the following:

- **Limited en-route and on-scene communications.** Limited communications capabilities compromise both en-route and on-scene operations. En route to the incident, speed and convenience could be improved if response personnel from different agencies were able to communicate directly with one another. For example, law enforcement personnel already at the scene of an incident may want to inform the dispatched towing and recovery operator to take an alternate, more time-efficient route. Instead, the towing and recovery operator may lose 15 min or more weaving through the traffic backup. When agencies from different or multiple jurisdictions need to coordinate response actions on-scene, personnel often rely upon other, inefficient means of communication (such as relaying messages through multiple dispatchers or using runners to hand-carry messages). For example, law enforcement personnel may want to inform transportation personnel of the need to close a lane temporarily to remove the wreckage from the scene. Transportation personnel may be controlling traffic a significant distance upstream of the incident. Limited communications capabilities among responders prevent the request from being made directly.
- **Inefficient communications.** Both dispatchers and field personnel have been faced with not knowing whom to call, not calling the appropriate person, and not having accurate numbers for contacting the appropriate person. As a result, multiple calls are often made to reach the appropriate personnel, wasting time and heightening frustration. It is important to know not only whom to call but under what circumstances. For example, during normal operating hours, transportation department supervisors may want incident response requests routed through them, but this chain of command is likely to change during after-hours operations. Locating specialty equipment may also require several calls before the equipment can be successfully dispatched. On-scene, efficient communications are required to quickly identify who is directing the overall management of the scene (i.e., incident commander), determine what actions are required, and convey any unexpected developments or challenges to other responders at the scene whose subsequent actions may be impacted. The use of specialized codes or acronyms that are not understood by all responders on-scene further challenges efficient communications.

Table 9 identifies the various tools and strategies that have proven effective in overcoming each of these challenges and identifies select locations where these tools and strategies are in use. Note that additional tools and strategies that were more variable in their reported effectiveness—including common or interoperable radio systems, the cross installation of radios, and the use of console patches—are included in appendix C.

Table 9. Communications challenges, strategies, and select implementation locations.

COMMUNICATIONS STRATEGIES	Limited Communications	Inefficient Communications	EXAMPLE APPLICATIONS
Common Mutual-Aid Frequency/Channel	●		ME/NH
Alternative Communications Devices	●		WI
Wireless Information Networks	●		AR, DC/MD/VA, IL, MA (Westford), MS
Mobile Unified Communications Vehicle	●		IL (Chicago), OR (Tillamook Co.)
Standardized Communications Terminology/Protocol		●	75+ U.S. Metropolitan Areas (Resource Lists), 58+ U.S. Metropolitan Areas (ICS), Institute of Electrical and Electronics Engineers, Inc. (IEEE)/Global Justice XML Data Model (GJXDM)

Additional descriptive information regarding the various tools and strategies and select locations where these tools and strategies are in use is provided below.

- Common mutual-aid frequency/channel.** Emergency radio systems that allow everyone at an incident scene to communicate on a common mutual-aid frequency or channel for the duration of the incident is recommended by the National Institute of Justice (NIJ) in their *InShort Fact Sheet* as a low-cost interoperability solution. <sup>(94)</sup> Certain designated frequencies can be programmed into radios for all agencies. As long as all radios are in the same frequency band, responders can select a designated channel to communicate with personnel from other agencies. One disadvantage to this approach is that the single interoperability radio frequency can become congested in the event of a major incident. <sup>(95)</sup>

In Maine and New Hampshire, a Public Safety Interoperability Communications Grant was recently awarded through the National Electrical Manufacturers Association (NEMA) to assist first responders in programming current radio equipment to support the temporary use of designated frequencies during incidents.

- Alternative communications devices.** The use of alternative communications devices—such as cellular telephones or alphanumeric pagers—has proven somewhat promising in mitigating interagency communications challenges. These alternative devices are relatively inexpensive to purchase, operate, and maintain. In some instances, strict guidelines describing when to use such devices and for what purposes may be required. To be most effective, a list of cellular telephone numbers or pager numbers should be compiled and distributed to appropriate response personnel. If the contact list is not maintained and updated, alternative communications devices will quickly lose their effectiveness.

Alternative communications devices are widely used—both formally and informally—to support TIM operations across the Nation. In Wisconsin, the Southeast Wisconsin Communications Resource/Support Group (SEWCRSG) was established to enhance public safety communication systems through regular dialogue and information sharing, training, interoperability advancement, and coordination with other related state/local initiatives. One key goal is to identify alternative methods for communicating if primary communication

methods have been disabled or are not functioning properly. Wisconsin's TIME program members participate in SEWCRSG, along with personnel from various State and local public safety agencies and the Wisconsin Department of Transportation. <sup>(96)</sup>

- **Wireless information networks.** Wireless technology can also be used to improve communications capabilities among TIM responders. For example, the States of Maryland and Virginia and the District of Columbia operate a multi-State, multidiscipline interoperable public safety and transportation wireless data system—the Capital Wireless Information Net (CapWIN)—intended to allow law enforcement, transportation, and fire and rescue personnel to communicate across jurisdictions and disciplines, and access operational information. CapWIN allows secure one-to-one and group public and private discussions, provides a searchable directory of individual first responders, and provides access to regional transportation data and multiple State/Federal law enforcement criminal databases to support operations. Similar systems are currently in use or under development in other States including Arkansas, Illinois, and Mississippi.

At the local level, the Westford Fire Department in Westford, MA, also utilizes a wireless information network to interconnect disparate voice, data, and video systems from the nearby towns of Ashland, Beverly, and Lawrence, MA, providing for interoperability while allowing users to keep their existing equipment. This approach has proven to be more cost-effective than converting all agencies to a common radio platform. <sup>(97)</sup>

- **Mobile unified communications vehicle.** During large-scale, complex incidents, an on-site mobile unified communications vehicle equipped with a wide range of radio communications and interoperability equipment may more effectively support on-scene activities, particularly when on-scene responders are utilizing disparate radio systems. Mobile unified communications vehicles may also be utilized to “back up” fixed communications systems, should remote TMC/dispatch center capabilities be impeded.

In Chicago, IL, a unified communications vehicle supports the efforts of the OEMC. In addition to being equipped with various radio communications and interoperability equipment, the vehicle can also uplink to satellites, capture and transmit real-time video, and support up to 100 telephone lines. If the OEMC loses functionality, the unified communications vehicle can largely replicate its capabilities. <sup>(74)</sup>

Similarly, Tillamook County, OR, recently purchased a mobile command/communications vehicle (MCCV) to enhance its public safety communications across the largely rural jurisdiction. The truck-drawn trailer provides a satellite uplink and supports interoperability through radio-over-Internet protocol (RoIP); is equipped with three call-taker dispatch positions, allowing it to replace a crippled dispatch center; and has enough onboard battery power to run all systems for more than 3 h before needing connection to exterior power. Radio communications are reportedly vastly improved as a result of the MCCV. <sup>(97)</sup>

- **Standardized communications terminology/protocol.** Many challenges to effective incident-related communications are procedural in nature. Often, these challenges relate to a lack of awareness regarding whom to call or how to call the appropriate person(s). The development of personnel or equipment resource lists (described previously under “Task-Specific Challenges and Strategies—Response”), in use in more than 75 major metropolitan areas in the United States, can significantly enhance communications off-site or between dispatchers and on-scene personnel. <sup>(2)</sup> Accompanying standardized communications protocols can be

developed to formalize and increase awareness of each agency's call-out procedures and contact points around the clock.

On-scene, use of a command post and other ICS principles can facilitate effective communications. Personnel from each responding agency are staged at the command post; information and directions are disseminated from the command post to each agency's respective personnel. As noted previously, at least 65 agencies in 58 major U.S. metropolitan areas are operating under ICS principles. <sup>(2)</sup>

For both on-scene and off-scene communications, the use of common terms (i.e., common definitions and lingo) for personnel, equipment, and facilities is essential to effective communication among TIM responders, particularly as it relates to task assignments and expectations. The use of specialized codes or acronyms that are not understood by all responders on-scene should be avoided. The use of common terminology and "plain language" was also recommended by the NIJ as a low-cost interoperability solution in their *InShort Fact Sheet*. <sup>(94)</sup>

As a related note, the use of common terminology is also essential when exchanging information automatically using various technologies. IEEE has developed a suite of standards (IEEE Std 1512, 1512.1, 1512.2, 1512.3, and 1512.4) intended to establish common TIM message sets that reduce duplication among public safety and traffic management centers. <sup>(98)</sup> Concurrently, the public safety community has developed the GJXDM, supported by the Global Justice Information Sharing Initiative and operating under the auspices of the Office of Justice Programs in the U.S. Department of Justice (USDOJ). Initiated in 2005, the ITS Transportation and Public Safety Information Exchange Project is a collaborative effort between the USDOT and USDOJ and is engaged in the development of standardized information exchange incorporating both IEEE and GJXDM standards. This project will not supplant existing intracommunity standards, but instead focuses on identifying the common information interests of the two communities and developing exchange methods for data sharing where their interests intersect. <sup>(99)</sup>

## Technology

Technology plays an important role in every aspect of TIM. In a number of instances, the use of technology can be demonstrated to directly increase the efficiency and, in some cases, the effectiveness of responders performing their duties. For example:

- Access to CCTV images of an incident prior to arriving on-scene supports both the dispatch of appropriate equipment and quicker dispatch of resources (i.e., instant tow dispatch).
- Use of AVL and geographic information system (GIS) technologies can identify and mobilize resources that are closest in proximity to the incident scene, reducing overall travel times.
- Traffic signal priority systems can reduce delay for emergency vehicles along signalized arterials en route to the incident scene.
- On-scene, portable intrusion alarm systems—consisting of a sensing mechanism that forms a partial perimeter around the incident scene and an audible alarm that warns incident responders if an approaching vehicle inappropriately enters the scene—provide a technology-based alternative to the use of response vehicles for responder protection.

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- To maintain traffic flow along an alternate route, use of RTSC plans to manage traffic around the incident scene relieves law enforcement personnel from this duty and allows them to perform other tasks for which they are trained (i.e., crash investigation).
- When an incident requires investigation by law enforcement personnel, the use of TSSE or photogrammetry can dramatically reduce investigation time while increasing the quality and quantity of measurements captured.

The smooth integration of technology into TIM policies and practices can help to support widespread implementation and use. However, a number of challenges regarding technology use exist:

- **Lack of standards.** Technology standards, typically developed by industry consensus, define how system components operate within a consistent framework. Equipment-related standards generally describe design, material, processing, safety aspects, or performance characteristics of equipment used for controlling, directing, or informing users of transportation facilities. They may include specific testing procedures and guidance for evaluating the test results based on the equipment's intended use. Software or protocol standards generally define software or communications procedures used in transportation facilities, systems, communications, or equipment. These standards may include message sets, object definitions, data dictionaries, and other components of application software, operating systems, and communications protocols.

Standards can be mandatory or less restrictive, including only recommended or optional specifications. Agencies that deploy technologies without consideration for standards, however, may be locked into proprietary specifications, custom interfaces, higher long-term operating and maintenance costs, reduced options for vendor competition and price stability, a need for unique training and specialized skills, and early obsolescence. To expand such a system, agencies must either buy the same brand of equipment or redesign/rebuild the existing system at significant cost. Despite the noted benefits of and incentives for incorporating standards into upgrades and enhancements of existing systems or into new systems, TIM agency personnel may be inadequately prepared to do so.

- **Limited technology integration/interoperability.** The use of standards in upgrades to existing systems and in new systems promotes integration and interoperability among systems and system components by supporting data sharing between components manufactured by different vendors at different times, across different applications, and among agencies located in different jurisdictions. Technological challenges arise when trying to integrate new systems with existing or legacy systems. These challenges are compounded when system integration or interoperability is required across multiple agencies or multiple jurisdictions. Coordination among Federal, State, and local agencies or public safety and transportation agencies has typically lacked cohesion. The public and private sectors must also cooperate. The technical expertise needed to deploy, operate, and maintain many technologies may be beyond the current capability of many State and local agencies; the private sector's expertise may be essential to the system's success.
- **Inadequate life-cycle costing.** Life-cycle costing involves the analysis of the costs of a system or a component over its entire life span. Typical costs for a system may include design, development, and acquisition costs; operating and maintenance costs; and disposal costs. A complete life-cycle cost analysis may also adjust for discount rates, interest rates, depreciation, present value of money, etc. With respect to the cost inputs for such an

analysis, design, development, acquisition, and disposal costs are generally deterministic. Operation and maintenance costs can vary significantly based on the complexity of the system and the random nature of system failures. The novelty of many of the technologies utilized for TIM challenges the accurate prediction of system costs over its lifetime. Consequently, these types of analyses may be performed infrequently.

Table 10 identifies the various tools and strategies that have proven effective in overcoming each of these challenges and identifies select locations where these tools and strategies are in use. Note that additional tools and strategies that were more variable in their reported effectiveness—including regional ITS architectures and life-cycle cost requirements for State procurement—are included in appendix C.

Table 10. Technology challenges, strategies, and select implementation locations.

TECHNOLOGY STRATEGIES	Lack of Standards	Limited Integration/ Interoperability	Inadequate Life-Cycle Costing	EXAMPLE APPLICATIONS
Expedited Standards Development Process	●			Law Enforcement Information Technology Standards Council (CAD Systems)
Standards Requirements for State Procurement		●		FHWA (ITS)

Additional descriptive information regarding the various tools and strategies and select locations where these tools and strategies are in use is provided below.

- Expedited standards development process.** The development of robust standards to support technology deployment is a lengthy process. At the national level, draft standards for ITS deployments must be developed, balloted and amended as appropriate, approved, and published, which can take several years. Once the draft standards are published, time is needed for manufacturers to incorporate the standards into the devices and systems and make the technology available.

While this process is necessary for the development of high-quality technical and functional standards, agencies may become impatient with the timeline if they are seeking to deploy technologies in response to a contemporary challenge or may forfeit near-term funding opportunities that may no longer be available when the technology standards mature. While little can be done to speed the national standards development process, agencies can expedite local technology deployment by fully utilizing existing national standards. One such example includes the development of functional standards for CAD systems by the Law Enforcement Information Technology Standards Council.<sup>(100)</sup> These specifications are designed to assist law enforcement agencies in designing and procuring CAD systems and identifying the basic functional requirements to achieve interoperability among systems.

If no related standards apply, agencies can consult draft national standards currently under development to help guide appropriate content and considerations for newly developed



standards at the State level. Some risk exists in basing State-level standards on draft national standards; changes in content or requirements may cause inconsistencies. Agencies must then weigh the benefits of expedited technology deployment with the potential added costs of system modifications to support interoperability. Once the standard is developed, the existence of a standard must be made known, and an ongoing process for maintaining and updating the standard is required. Standards can be reviewed on a periodic cycle to ensure currency, validity, and applicability based on current knowledge, trends, and developments.

- **Standards requirements for State procurement.** For ITS development, agencies are being asked to incorporate standards into upgrades of existing systems and into new systems to promote interoperability and reduce life-cycle costs. As an added incentive, FHWA currently requires that all ITS projects funded from the Highway Trust Fund be in conformance with the National ITS Architecture and officially adopted standards. Similar requirements could be integrated into the State-level procurement process to ensure that minimum levels of system and component interoperability are obtained and life-cycle costs for the agency are minimized.

The effectiveness of State procurement standards requirements is dependent upon the wide range of services offered by private-sector system integrators in terms of both functionality outputs and timeliness. Complex integrations have a high associated risk of compromised functionality and time delays. Integrating new systems with existing or legacy systems can prove challenging. In some cases, it may be more cost-effective to abandon a legacy system in favor of a newly developed system rather than try to integrate the two. For agencies involved in TIM, this is not often the case. Public safety or transportation agency legacy systems may have been deployed on a regional or statewide level and at a significant cost. Integration of new applications with existing systems often proves to be more cost-effective.

## Performance Measurement

Performance measurement provides the necessary feedback to TIM responders to allow them to improve operations. Equally important, performance measurement provides decision makers with the data to demonstrate the value of TIM programs and justify their related expenditures.

Common challenges to effective performance measurement stem from the following:

- **Inconsistent definitions.** While many agencies currently measure performance related to TIM in a single-agency context, the definitions of these measures are often inconsistent between transportation and public safety disciplines. For example, both transportation and public safety agencies use “response time” as a critical performance measure; however, the operational definition of this measure varies significantly. Transportation agencies generally define “response time” as the time between when an incident was reported to their agency and when the first responder from any official response agency arrived on-scene. Emergency service providers generally define “response time” as the time between when a call was received by their dispatcher and when their first response vehicle arrived on-scene. <sup>(101)</sup> The operational definition of “clearance time” also varies considerably between transportation and public safety agencies. Transportation agencies typically define “clearance time” as the time between when the first responders arrived on the scene and when the capacity of the facility was fully restored (i.e., when the incident was removed from the travel lanes). <sup>(101)</sup> Law enforcement agencies typically record their time “back in service,” but this often includes enforcement or investigatory duties that take place off-site with no impact to the

primary incident roadway (i.e., if a law enforcement officer pushes an involved vehicle to a nearby parking lot and gathers victim and witness information).

Performance measure definitions used by public safety agencies are fairly standard across the industry. National reporting databases—such as the National Fire Incident Reporting System—have encouraged agencies to adopt common terminology and collect data in a consistent manner. For transportation agencies, performance measure definitions are generally local decisions and, hence, are more variable.

- **Lack of consensus and supporting data.** Where officials fear public controversy over failure to meet stated goals, or unfair comparisons to results from other jurisdictions, there can be resistance to setting performance goals and defining associated measures. One example of potential conflict is a law enforcement agency establishing a priority to improve response times to high-priority incidents (i.e., lane-blocking or injury incidents) while admittedly sacrificing response times to lower-priority incidents. The proposed TIM performance measure may include all incident types, ranging from lane-blocking, injury incidents to minor vehicle disablements, and hence may reflect a higher incident response time and duration than that currently reported by law enforcement. Resistance from just a single agency can preclude consensus and limit progress in developing associated TIM performance measurement methods.

Even if consensus is reached on intended performance goals and measures, the ability to capture the information needed to support these measures may be limited. Many agencies currently collect and analyze data to measure their performance toward meeting the goals and objectives specific to their agencies. Measuring performance for TIM requires collecting program performance data that may be different from agency-specific performance data. Oftentimes, limited documentation of incidents and their management exists. Incident occurrence may be regularly recorded, but more detailed information relative to the type of incident, response times and procedures, and traffic management activities is typically not documented. For example, consider the data captured through a typical CAD system. The time at which the first recordable awareness of an incident occurs is automatically captured from the 9-1-1 call time tag for the majority of incidents. The time at which all travel lanes are available for traffic flow (i.e., towing and recovery personnel have physically cleared the travel lanes) may be recorded in an open field entry on the incident report, but this information is likely neither comprehensive nor consistent. Further, access to historic information entered in open fields is not supported by query methods and requires manual review of individual records.

- **Limited data sharing and accessibility.** Measuring performance for TIM may require the assimilation of data originating from multiple agencies. Certain sensitivities inevitably arise regarding data confidentiality and system security. For example, law enforcement agencies may have concerns about releasing certain incident-related information recorded in the CAD system for fear of compromising investigations or other personal or proprietary information related to law enforcement activities. Conversely, transportation agencies may be reluctant to release taped video from CCTV cameras, uncertain of how the information will be used. Data security concerns, particularly for law enforcement and homeland security organizations, complicate the already difficult problems in data sharing. Security issues increase costs and can impact the timeliness of data sharing.

Table 11 identifies the various tools and strategies that have proven effective in overcoming each of these challenges and identifies select locations where these tools and strategies are in use. Note

that additional tools and strategies that were more variable in their reported effectiveness—including State Traffic Records Coordinating Committee partnerships and a dedicated TIM database—are included in appendix C.

Table 11. Performance measurement challenges, strategies, and select implementation locations.

PERFORMANCE MEASUREMENT STRATEGIES	Inconsistent Definitions	Lack of Consensus/ Data	Limited Data Sharing/ Accessibility	EXAMPLE APPLICATIONS
National Performance Measurement Guidance	●	●		TIM Focus State Initiative (FSI), TIM Performance Measurement Knowledge Management System/Listserv
Annual TIM Self-Assessment		●		75+ U.S. Metropolitan Areas
Strong Funding and Performance Link		●		MD, WA
Multi-agency Data Exchange Protocol		●	●	CA (San Diego), CO (El Paso/Teller Co.), NV (Clark Co.), TX (Ft. Worth), UT, WA

Additional descriptive information regarding the various tools and strategies and select locations where these tools and strategies are in use is provided below.

- **National performance measurement guidance.** At the national level, the recently developed NUG recommends setting goals for performance and progress as a primary strategy. In partnership with transportation and law enforcement agencies in 11 States, FHWA recently completed a focus state initiative on TIM performance measures that resulted in three uniformly defined, TIM-specific objectives and associated performance metrics. These objectives and associated performance metrics include the following:
  - Reduce roadway clearance time—the time between the first recordable awareness of the incident by a responsible agency and the first confirmation that all lanes are available for traffic flow.
  - Reduce incident clearance time—the time between the first recordable awareness of the incident by a responsible agency and the time at which the last responder has left the scene.
  - Reduce the number of secondary incidents—the number of unplanned incidents beginning with the time of detection of the primary incident where a collision occurs as a result of the original incident either within the incident scene or within the queue in either direction.

Early pilot testing of the roadway clearance time and incident clearance time metrics confirmed that States are able to use the same TIM-specific performance metrics to analyze their respective programs, collect and analyze the necessary data to support TIM-specific performance metrics although the methods of data collection may vary, and compare program-level TIM performance using common metrics. The secondary incident performance metric has not yet been field-tested.

A follow-on investigation, again sponsored by FHWA, is currently underway to encourage adoption of these three standard TIM-specific performance metrics by States. In addition, FHWA recently made available the TIM Performance Measurement Knowledgebase and listserv, accessible at

[http://www.ops.fhwa.dot.gov/eto\\_tim\\_pse/preparedness/tim/knowledgebase/index.htm](http://www.ops.fhwa.dot.gov/eto_tim_pse/preparedness/tim/knowledgebase/index.htm).

<sup>(102)</sup> The knowledgebase allows users to search for or browse information by resource type, performance measures, or related conferences and events. Participants can join the listserv—intended to allow users to share knowledge and insights with the broader TIM community—by sending an email to [TIMPM@dot.gov](mailto:TIMPM@dot.gov).

Additional information regarding the TIM FSI is available in the final report, accessible at <http://ops.fhwa.dot.gov/publications/fhwahop10010/fhwahop10010.pdf>, or in a related informational briefing, accessible at

[http://ops.fhwa.dot.gov/publications/fhwahop10009/tim\\_fsi.pdf](http://ops.fhwa.dot.gov/publications/fhwahop10009/tim_fsi.pdf).<sup>(103,104)</sup> Similarly, additional information regarding the TIM Performance Measurement Knowledgebase is available in an informational briefing accessible at

[http://ops.fhwa.dot.gov/publications/fhwahop10011/tim\\_kms.pdf](http://ops.fhwa.dot.gov/publications/fhwahop10011/tim_kms.pdf).<sup>(105)</sup>

- **Annual TIM self-assessment.** In 2003, FHWA began facilitating annual self-assessments of TIM programs (TIMSA) in the largest 75 urban areas of the United States. Early participants were asked to respond to 34 questions related to program and institutional, operational, and communications and technology issues using a five-point relative scale ranging from 0 (no progress in this area) to 4 (efforts in this area are outstanding). In 2008, the TIMSA was revised to better align with the NUG and NIMS and incorporate performance measurement. The TIMSA now consists of the following:
  - Strategic questions regarding formal policies, understanding among agencies, and performance measurement and program evaluation.
  - Tactical questions covering on-scene response and clearance practices, traffic control, and responder and motorist safety.
  - Support questions regarding interagency communications, data sharing, ITS, and traveler information.

Annual self-assessments have enabled State and local program managers and practitioners to evaluate their TIM programs and identify strengths and weaknesses in their programs in order to prioritize program activities and initiatives. At a national level, the assessments enable FHWA to evaluate progress in TIM and to identify national TIM program initiatives. Each year, the new assessment is compared against the baseline established in initial assessments in 2003 and 2004 and against the previous year's assessment. FHWA publishes an annual TIMSA National Summary Report, aggregating data from all urban areas. Reports for 2003 through 2009 are available for download at FHWA's Traffic Incident Management Self Assessment website, accessible at

[http://ops.fhwa.dot.gov/eto\\_tim\\_pse/preparedness/tim/self.htm](http://ops.fhwa.dot.gov/eto_tim_pse/preparedness/tim/self.htm).<sup>(106)</sup>

- **Strong funding and performance link.** Similar to performance-based incentive programs instituted at the employee level, TIM can be evaluated at the program level with performance tied to continued or increased program support. Performance measures defined explicitly for TIM should also reflect broader agency-wide or statewide goals related to increased productivity, cost-efficiency, and improved quality in the delivery of State services. Incorporating performance measures into formal long-range plans can help to ensure that TIM programs receive adequate attention in prioritization of projects for funding.

For example, States that were early to adopt, track, and report improvements in average incident clearance time as a TIM-specific performance metric describe it as a powerful tool for communicating with their State legislatures and with the public. Departments of transportation in both Maryland and Washington have made progress in securing more consistent, reliable TIM program funding from their State legislatures as a result of TIM performance measurement. WSDOT also reports notable success in improving public perception of their agency. Specifically, TIM personnel in Baltimore, MD, rated a strong funding and performance link as “very high” in effectively reaching consensus and developing supporting performance data. This rating suggests a high level of confidence in the benefits provided by TIM programs and an agency’s ability to adequately capture and report these benefits to decision makers.

- **Multi-agency data exchange protocol.** After TIM program performance measures are defined and associated targets and goals are set, it is necessary to specify what data will be used to measure each objective, how the data will be collected and analyzed, and who will be responsible for the data. Specific considerations may include methods for reconciling inconsistencies in performance metric definitions; filtering unnecessary data; efficiently assimilating data from disparate agency databases developed under different data standards; and performing analysis, evaluation, and reporting with varying levels of aggregation to target different audiences. The information-sharing process and each agency’s role in that process can be initially defined in a multi-agency data use concept of operations document.

To address sensitivities regarding data confidentiality and system security, agencies can develop written agreements that delimit the use and distribution of data:

- In Washington, WSP had concerns about releasing incident-related information recorded in the CAD system to the WSDOT, citing concerns over the integrity of investigations and the personal and proprietary nature of some of the information. The two agencies successfully established a protocol describing the nature and extent of information provided to WSDOT. <sup>(107)</sup>
- At the national level, the USDOJ Office of Community Oriented Policing Services recently published a guide intended to help law enforcement executives and information technology managers develop and implement security policies to protect sensitive data such as case reports, investigative data, criminal intelligence, and personal information. The *Law Enforcement Tech Guide for Information Technology Security: How to Assess Risk and Establish Effective Policies* details strategies for identifying security risks and effective measures to mitigate those risks. <sup>(108)</sup>

Specifically, agencies should consider data ownership and recipients, data use and retention times, and protection of confidential information. Depending on the agreements and processes in place, sensitive data may be completely unavailable, may have operational restrictions placed on them, or may require additional system development to implement filters to extract data that can be shared. Some data security issues cannot be overcome without enabling legislative action.

Multi-agency data exchange can be supported at a range of automation levels. At the highest level, disparate data collection systems can be fully integrated to automatically exchange predefined data with designated partner agencies. Both Utah and Washington participated in the FHWA-sponsored National Evaluation of the CAD-TMC Integration Field

Operational Test to demonstrate the integration of CAD systems with advanced traffic management systems (ATMS) used by transportation agencies: <sup>(109,110)</sup>

- In Utah, UDOT's CommuterLink ATMS was already integrated with DPS's CAD system. Consequently, the State focused on expanding integration to include four distinct CAD systems in the Salt Lake Valley operated by the Valley Emergency Communications Center, Salt Lake City Fire Department, Salt Lake City Police Department, and Utah Transit Authority. The project was unique in its integration and electronic transfer of data between such a wide variety of emergency and traffic management centers. <sup>(111)</sup>
- In Washington, WSDOT's Internet-based Condition Acquisition and Reporting System (CARS)—that enables State and local agencies to share information on incidents, weather conditions, traffic delays, etc.—was integrated with the WSP's CAD system. Using a direct computer-based interface, a filtered incident report, including on-screen map displays, appears in CARS within a minute of transfer from the CAD system. <sup>(112)</sup>

Developments have also recently emerged to ease the integration of disparate CAD systems, effectively supporting data exchange among public safety agencies in multiple jurisdictions. For example, the CAD-to-CAD Interoperability Guide is a programming interface that enables multiple dispatch centers with disparate CAD systems to connect with each other. Notable CAD-to-CAD implementations include the Clark County, NV, Combined Communications Center; the El Paso/Teller County, CO, 9-1-1 Authority; the City of Fort Worth, TX; and the City of San Diego, CA, Fire/EMS Dispatch Center. The CAD-to-CAD Interoperability Guide is available for download at [http://www.tritech.com/sol\\_interfacestandards.asp](http://www.tritech.com/sol_interfacestandards.asp). <sup>(113)</sup>

As data exchange expands between multiple agencies, development of an accompanying data dictionary may be required. A data dictionary is a centralized repository of information about data—its meaning, relationships to other data, origin, usage, and format. TIM agencies can benefit from a common data dictionary that catalogs the organization, contents, and conventions of one or more databases owned and maintained by the various TIM agencies. Enhanced knowledge about each agency's databases will not only enhance ongoing TIM program performance measurement that requires data originating from multiple agencies but may also identify and encourage additional data-sharing opportunities.

## Program Resources and Funding

To establish, maintain, and improve TIM programs, adequate and ongoing resources to support operation must be available. Program administrators must not only understand the funding process at Federal, State, and local levels, but must also be able to identify specific sources of monetary support appropriate for TIM and must successfully compete for it. Additional funding cannot be viewed in isolation as a panacea to address TIM challenges. However, adequate funding can help to support incremental improvements in TIM efforts by providing program equipment, personnel, or further research.

Common challenges related to TIM program resources and funding include the following:

- **Limited resources and funding.** TIM is just one among many competing claims for limited transportation resources. Transportation funding from Federal and State levels pits TIM needs against more traditional, better-understood activities such as interstate construction, pavement rehabilitation, and transit improvements. Securing TIM resources within transportation agencies is especially difficult. Frequently, transportation personnel assigned

to TIM duties have other full-time responsibilities in maintenance, traffic engineering, or ITS. Further, transportation emergency management is often distinct from TIM in organizational and reporting terms although these activities are most often carried out by the same people at the field operational level. <sup>(65)</sup> As a result, it can be very difficult to isolate how much money is currently being spent on TIM personnel and equipment agency-wide, which impedes the ability to make a solid argument for increasing allocations.

- Inadequate outreach to executives.** Although TIM addresses issues that are of concern to the motoring public—congestion and travel delay, public health and safety, the Nation’s economic health, energy savings, public safety resources, responder safety, and citizen satisfaction with government services—few elected or appointed decision makers at all levels of government have made TIM a priority. Decision makers are subject to scrutiny from the public at large, who have grown more conscious of transportation issues at the same time that they have become increasingly wary of new or higher taxes in any form. To effectively encourage investment in TIM by decision makers, the associated benefits of TIM programs need to be succinctly and strongly articulated and promoted.

Table 12 identifies the various tools and strategies that have proven effective in overcoming each of these challenges and identifies select locations where these tools and strategies are in use. Note that additional tools and strategies that were more variable in their reported effectiveness—including cost recovery mechanisms and TIM requirements in new construction contracts—are included in appendix C.

Table 12. Program resources and funding challenges, strategies, and select implementation locations.

PROGRAM RESOURCES AND FUNDING STRATEGIES	Limited Resources/ Funding	Inadequate Outreach to Executives	EXAMPLE APPLICATIONS
Dedicated, Ongoing Funding	●		CA, MD, NJ/PA (Delaware Valley Region)
Guidelines for Federal/State Funding Sources	●		FL (Orlando), WI
Metropolitan Planning Organization Partnerships	●		FL, NJ/PA (Delaware Valley Region), TN (Chattanooga), TX (Austin)
TIM Strategic Plan	●		FL, GA (Atlanta), KY, TN, TX (Austin)
Efficient/Effective TIM Resource Management	●		MD (Baltimore)
Executive Outreach Materials/Events		●	GA (Atlanta), National Volunteer Fire Council (NVFC) Cost Savings Calculators

Additional descriptive information regarding the various tools and strategies and select locations where these tools and strategies are in use is provided below.

- Dedicated, ongoing funding.** Although dedicated, ongoing funding cannot be viewed as a panacea to address TIM challenges, its benefits in maintaining and expanding successful TIM programs should not be overlooked:

- Incident management personnel in Baltimore, MD, emphasized the importance of dedicated, ongoing funding, noting that its availability in their State protects their TIM program from district-level budget cuts.
- Dedicated funding made available through the DVRPC's Office of Transportation Operations Management provides committed staff to manage their five active regional TIM task forces in the Delaware Valley region in New Jersey and Pennsylvania.

As noted previously, TIM duties are often performed concurrently by personnel from different agencies and the private sector, as well as different divisions within single agencies. This program structure challenges the ability to accurately assess and dedicate a funding stream for ongoing operations. Service patrols—able to operate as more of a stand-alone program—provide an exception and are often included as a separate line item in State or local budgets. Uniquely in California, service patrols are supported with combined Federal, State, and local funds, with local funds originating from a \$1 annual vehicle registration fee in participating counties.

- **Guidelines for Federal/State funding sources.** By far, the largest source of Federal funding for TIM is the Federal-aid program under which Congress appropriates Federal dollars to various transportation categories (i.e., safety, congestion management, etc.) and distributes these funds to States according to a funding formula. The States, with approval from the various MPOs, must then decide how the Federal-aid dollars are spent. The Federal Government also provides States with grants to fund their transportation programs, including TIM. From the State level, monies may then be passed on to local governments, depending on the needs and circumstances. State or local grant recipients may be required to provide matching resources and agree to various stipulations regarding what the funds may be spent on, how the program will be managed, and how the recipient will report to the sponsor. Historically, funds to support TIM have originated from the National Highway System, Interstate Maintenance, Surface Transportation, CMAQ, Research and Technology Innovation, and Highway Safety (402) programs.

With the multitude of potential Federal and State funding sources—each having explicit conditions for eligibility and use—guidelines that address funding opportunities, requirements, and limitations in the context of TIM could provide benefit to TIM program administrators seeking to develop, expand, or enhance TIM efforts.

An increased awareness of funding opportunities coupled with a little creativity can serve to maximize potential investments. Consider the following examples:

- Recognizing that the response time to incidents in Orlando, FL, was above the State average, the Florida Department of Transportation agreed to fund 20 Florida Highway Patrol troopers with a dedicated TIM focus. <sup>(6)</sup>
- The Wisconsin Department of Transportation developed a multi-agency (including towing and recovery) procurement list that allows TIM members to purchase traffic control equipment at a quantity discount. Two low-bid vendors were selected for a 1-yr extendable contract. Member agencies contact the vendors directly to order. <sup>(6)</sup>
- **Metropolitan planning organization partnerships.** Metropolitan planning organizations provide a unique opportunity to support TIM through their distinctive role in facilitating regional planning and programming decisions, providing a forum for cooperative decision making, working toward regional consensus, developing regional and institutional agreements, serving as a repository for comprehensive data, etc. Nearly 400 MPOs currently



exist in the United States, concentrated in urban areas with populations greater than 50,000.

In recent years, MPOs have been encouraged to assume a greater and more consistent role in a broader range of management and operations (M&O) activities, including TIM, and recognize that more effort needs to be made in helping TIM agencies achieve their goals. Despite this direction, the Association of Metropolitan Planning Organizations (AMPO) observed in a 2003 survey that, while 65.91 percent of MPOs included M&O programs or strategies in their long-range transportation plans, this inclusion was “ad hoc” in 29 percent of the cases. Similarly, 63.64 percent of MPOs reported inclusion of M&O programs or strategies in their transportation improvement programs. When prompted to detail the nature of their M&O programs or strategies, TIM activities were reported by only 22.73 percent of MPOs, suggesting an inadequate level of priority and/or integration of TIM into the planning process. <sup>(114)</sup>

Partnering with MPOs can help to elevate awareness of TIM as a viable transportation investment and can support long-term integration of TIM into regional planning and programming decisions. Several examples of successful MPO partnerships exist from across the Nation:

- In Florida, TIM agency leaders routinely meet with MPO governing boards to secure additional funding, including funding to support personnel training efforts. <sup>(6)</sup>
- The MPO (DVRPC) actually leads the various TIM task forces in the Delaware Valley region in New Jersey and Pennsylvania, ensuring an active partnership. <sup>(6)</sup> TIM programs have been incorporated into DVRPC’s *Transportation Operations Master Plan* and the long-range *Connections 2035: The Regional Plan for a Sustainable Future*.
- In Chattanooga, TN, initial leadership to establish a local TIM team originated from the Chattanooga MPO. <sup>(9)</sup>
- In Austin, TX, a representative from the Capital Area Metropolitan Planning Organization (CAMPO) is an active participant in the AIMHigh Team. As a result of this involvement, the region was successful in securing \$2 million in American Recovery and Reinvestment Act 2009 funds to reinstate a service patrol program along the I-35 corridor. In addition, TIM programs have been newly incorporated into CAMPO’s *2035 Regional Transportation Plan*.
- **TIM strategic plan.** Unlike a TIM response plan focused on defining the multidisciplinary actions taken in response to an incident event, a TIM strategic plan considers broader, long-term TIM program development. For a given locale, a TIM strategic plan most often establishes local program goals and objectives, response challenges and needs, potential strategies for improvement, and a short- to long-term implementation plan. Strategic plans focused on TIM should be developed through consensus of all affected agencies and private companies. A TIM strategic plan can not only provide focus for ongoing program performance monitoring, but can improve agency relations and can help to garner additional program support.

Examples of effective TIM strategic plans include the following:

- In Florida, the *Statewide Traffic Incident Management (TIM) Strategic Plan* was developed to identify programs and actions to sustain the commitment to and expand

- the TIM program to better meet traveler needs. The plan is available in four formats: the strategic plan, an executive summary, a more detailed plan summary, and a very detailed reference document. <sup>(6)</sup>
- In Georgia, the TIME Task Force developed an executive-level *Strategic Vision* that describes methods to achieve measurable TIM improvements that can have an immediate, substantial, and lasting impact on reducing nonrecurring congestion based on a review of regional issues and national best practices. <sup>(6)</sup>
  - The Kentucky Transportation Cabinet—with input from FHWA, State and local law enforcement, emergency management, and other agencies—developed a statewide *Highway Incident Management Strategic Plan* that includes the mission, goals, objectives, and implementation timeline for 49 prioritized action strategies. <sup>(115)</sup>
  - Nevada’s TIM Coalition developed a *Strategic Actions Plan* that included a new vision for institutional integration; an overall TIM mission and related goals and objectives; coalition responsibilities, proposed projects to support TIM efforts, and estimated program costs. <sup>(6)</sup>
  - State personnel from the Tennessee Departments of Transportation, Safety, Commerce and Insurance, and Emergency Management cooperatively developed and adopted—through a four-department resolution—a TIM strategic plan. The statewide plan considers four geographic regions, each staffed with a TIM coordinator and responsible for incident reporting. <sup>(65)</sup>
  - In Texas, the *Austin-Area Incident Management for Highways (AIMHigh) Traffic Incident Management Strategic Plan* was cooperatively developed by representatives from law enforcement, fire and rescue, EMS, transportation, towing and recovery, and other agencies and is intended to direct long-term, sustainable TIM investment and development. <sup>(116)</sup> The *Strategic Plan* describes the general mission, goals, and objectives for the AIMHigh program; current status of TIM operations in the greater Austin area, including key stakeholders, supporting resources, operational challenges, and recent improvements; proposed tools and strategies to specifically address outstanding operational and institutional challenges and further enhance TIM operations; associated implementation requirements for the proposed TIM tools and strategies, including identification of lead agencies and estimated initial and ongoing costs; and next steps to ensure ongoing TIM improvements in the greater Austin area.
- **Efficient/effective TIM resource management.** Efficient and effective TIM resource management relies upon the utilization of appropriate personnel who are best qualified (i.e., capable but not overqualified) for the various tasks, appropriate equipment by function (i.e., use of the least costly equipment capable of performing the function), and appropriate technology capable of supporting various on-site resource tasks (described previously under *Technology*), as well as a reduction in overall resources required through reduced redundancy across disciplines.

When personnel who are capable but not overqualified are assigned to various tasks, uniquely trained personnel can focus on other TIM functions. For example, the use of transportation personnel to manage traffic at and around the incident scene would relieve law enforcement personnel from this duty and allow them to perform other tasks for which they are trained (i.e., crash investigation). Similarly, a higher level of efficiency and equal or higher effectiveness may be obtained by using a transportation vehicle equipped with an

arrow board and additional traffic control devices to protect the scene rather than law enforcement or fire and rescue vehicles.

As noted previously with respect to training, commonalities in responder competencies allow various TIM functions to be performed by personnel from multiple agencies, with varying degrees of efficiency and effectiveness. For example, personnel from each agency are capable of providing scene protection, initial medical care, and limited documentation. With the exception of EMS personnel, personnel from each agency are capable of providing temporary traffic control, limited firefighting, and cleanup. Transportation and law enforcement personnel are each capable of mobilizing extra response, providing traveler information via DMS or through media contacts, modifying traffic signal timings, and removing the vehicle from the roadway. Fire and rescue and transportation personnel are each capable of mitigating minor vehicle fluid leaks. Fewer commonalities in equipment function are observed between the various TIM response agencies. Certain fire and rescue vehicles are equipped to provide advanced medical care, similar to EMS vehicles. Both law enforcement and transportation vehicles are often equipped with push bumpers for quickly removing vehicles from the travel lanes or shoulder. Additionally, law enforcement, fire and rescue, and transportation agencies commonly carry various hand tools in their vehicles to support debris removal and cleanup. The most pronounced commonality is the use of each agency's vehicles for scene protection. A concerted effort can be made to identify potential overlap in personnel competencies and equipment function and reduce potential redundancies in operations.

As reported in FHWA's *Traffic Incident Management Resource Management Primer*, accessible at <http://ops.fhwa.dot.gov/publications/fhwahop08060/fhwahop08060.pdf>, the cost savings attributable to more efficient and effective TIM resource management is not trivial. <sup>(117)</sup> Results indicate a cost savings of between \$215.81 and \$364.59 per incident through the use of appropriate personnel and a reduction in the monetary value of equipment exposed to potential damage of up to \$2.02 million per incident through the use of more appropriate equipment and/or technology. Reduced redundancy in resources is estimated to save \$793.97 per incident in personnel costs and decrease the monetary value of equipment exposed to potential damage of up to \$1.45 million per incident.

Incident management personnel in Stockton, CA, noted that TIM functional limitations imposed on transportation personnel in their locale (i.e., transportation personnel are prevented from performing certain TIM functions by agency policy) preclude a more extensive use of this strategy and a higher level of effectiveness. Conversely, TIM personnel in Baltimore, MD, reported some success in achieving more efficient and effective TIM resource management, citing significant benefits attributable to the coordination of information from multiple agencies afforded through the use of technology and the ability to provide other agencies with resources that they may not otherwise be able to access.

- **Executive outreach materials/events.** To secure program resources and funding, TIM administrators need to promote their programs among key decision makers and the public at large, to whom decision makers ultimately report. Although this group includes mayors, city and county council members, governors, members of Congress, and special district representatives, State legislators usually have the greatest ability to directly influence an agency's operation through its budget and through legislative review or oversight. State legislators review the operation of agencies and have the authority to set budget and staffing levels. Programs that are demonstrated to be in high demand fare better in the decision-making process.

To support this effort, various types of outreach materials targeting State legislators (or other decision makers) can be developed to strongly yet succinctly convey the importance of TIM. Letters of thanks sent by people who have been assisted in the field can be particularly useful in this capacity. In addition, TIM administrators can invite key decision makers to ride along with response personnel to observe day-to-day operations or involve them in more extensive TIM program scanning tours to observe successful operations in other locales.

The popular HERO service patrol in Atlanta, GA, clearly illustrates the success of this approach. As a highly visible element of the broader TIM program, the Georgia Department of Transportation is deluged with letters of appreciation from motorists for its service. The public support and positive publicity that the HERO program has garnered put pressure on politicians and policymakers to sustain and develop the program and offer security for other, less visible elements of the TIM program by association. <sup>(118)</sup>

In a unique development effort, the National Volunteer Fire Council (NVFC) developed Cost Savings Calculators for volunteer fire and rescue and EMS agencies, intended to estimate the economic savings attributable to these volunteer agencies. Companion resources, including related studies and a customizable PowerPoint presentation, assisted in demonstrating and justifying the need for increased community and governmental support. The Cost Savings Calculators and companion resources, with restricted access for NVFC members, can be downloaded from the NVFC website, accessible at [http://www.nvfc.org/page/801/Cost\\_Savings\\_Calculators.htm](http://www.nvfc.org/page/801/Cost_Savings_Calculators.htm). <sup>(119)</sup>



## CONCLUDING REMARKS

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The intent of this investigation was to encourage a higher level of effectiveness in TIM activities through the identification of current “best practices” in the United States and a synergistic partnership with NTIMC to support both the identification of U.S. best practices and the implementation of these practices by State, regional, and local TIM partners.

### Best Practice TIM Tools and Strategies

In response to common task-specific and cross-cutting challenges and impediments to TIM efforts identified in the United States, a number of potential tools and strategies for improving TIM efforts were identified through a review of various published and electronic information sources and input from TIM practitioners representing law enforcement, fire and rescue, EMS, transportation, and towing and recovery agencies in Arizona, California, Florida, Maryland, Michigan, Nevada, New Jersey, New York, Ohio, Pennsylvania, Tennessee, Texas, Utah, and Washington.

Task-specific tools and strategies generally reported to be most effective in enhancing TIM efforts include the following:

- Detection and verification:
  - Field verification by on-site responders and CCTV cameras to support confirmation of incident occurrence and enhance the assessment of incident needs and the subsequent dispatch of appropriate personnel and resources to the scene.
  - Frequent or enhanced roadway reference markers and enhanced 9-1-1/automated positioning systems to support accurate identification of incident location by motorists or response personnel.
  - In rural areas, motorist aid call boxes and ACNS to speed detection.
- Traveler information:
  - 5-1-1 systems, traveler information websites, and media partnerships to enhance the provision of traveler information to motorists who are primarily off-site in an effort to reduce traffic demand at the incident scene.
  - Dynamic message signs and associated standardized DMS message sets and use protocol to enhance the provision of traveler information to motorists who are approaching the incident scene, including the consistency with which traveler information is presented.
- Response:
  - Personnel and equipment resource lists and TRAA’s *Vehicle Identification Guide* to support the dispatch of appropriate resources to the incident scene.
  - Instant tow dispatch procedures and towing and recovery zone-based contracts to speed response to the incident scene by towing and recovery personnel through expedited dispatch and reduced travel distances.
  - Enhanced CAD, dual or optimized dispatch procedures, and motorcycle patrols to speed response to the incident scene by public safety personnel through reduced travel distances and increased maneuverability in congested conditions.

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- Equipment staging areas and pre-positioned equipment to enhance availability of and reduce wait time for specialty equipment that may be slow to mobilize and to improve access to and speed deployment of supporting equipment, such as traffic control devices.
- Scene management and traffic control:
  - The ICS to reduce confusion over on-scene authority and provide a unified command structure for decision making.
  - Response vehicle parking plans to enhance on-scene maneuverability.
  - High-visibility safety apparel and vehicle markings, on-scene emergency lighting procedures, and safe, quick clearance *Move Over* laws that require motorists approaching an incident to reduce speed and/or change lanes to enhance responder safety at the scene.
  - Effective traffic control through on-site traffic management teams and end-of-queue advance warning systems to provide advance warning of a downstream incident or associated congestion and subsequently reduce the occurrence of secondary incidents.
  - Alternate route plans to effectively reduce excess delay.
- Quick clearance and recovery:
  - Abandoned vehicle legislation/policy to expedite the clearance of abandoned vehicles from the roadway right-of-way and minimize the risk for abandoned-vehicle-involved secondary incidents.
  - Safe, quick clearance *Driver Removal* laws, service patrols, vehicle-mounted push bumpers, and incident investigation sites to speed the clearance of minor incidents by either the involved motorists or response personnel.
  - Safe, quick clearance *Authority Removal* laws, quick clearance/open roads policy, non-cargo vehicle fluid discharge policy, fatality certification/removal policy, and quick clearance using fire apparatus to speed the clearance of major incidents through the provision of common clearance goals, the authority to take appropriate action, and protection against liability for those actions.
  - Expedited crash investigation to speed the clearance of major incidents involving a fatality or other suspicious circumstances requiring additional information gathering at the incident scene.
  - Towing and recovery quick clearance incentives to speed the clearance of major incidents through the provision of financial rewards and or penalties tied to performance for participating towing and recovery agencies.
  - Major incident response teams to speed the clearance of major incidents through a high level of familiarity among the various team members and their authority to mobilize the necessary personnel and equipment to respond.

These tools and strategies, including their functional area of primary impact and select implementation locations, are summarized in table 13.

Table 13. Task-specific strategies and select implementation locations.

TASK-SPECIFIC STRATEGIES	Detection/Verification	Traveler Information	Response	Scene Management/ Traffic Control	Quick Clearance/ Recovery	EXAMPLE APPLICATIONS
Field Verification by On-Site Responders	●					NY (Hudson Valley Region)
Closed-Circuit Television Cameras	●					76+ U.S. Metropolitan Areas, MD
Frequent/Enhanced Roadway Reference Markers	●					FL, NJ/PA (Delaware Valley Region), OH, TN
Enhanced 9-1-1/ Automated Positioning Systems	●					TX (San Antonio)
Motorist Aid Call Boxes	●					27+ U.S. Metropolitan Areas, GA
Automated Collision Notification Systems	●					16+ U.S. Metropolitan Areas, NY (Erie Co.)
5-1-1 Systems		●				33+ States
Traveler Information Websites		●				39+ States
Media Partnerships		●				53+ U.S. Metropolitan Areas
Dynamic Message Signs		●				81+ U.S. Metropolitan Areas, CA (Stockton)
Standardized DMS Message Sets/ Use Protocol		●				73+ U.S. Metropolitan Areas, TX (Austin, San Antonio)
Personnel/Equipment Resource Lists			●			75+ U.S. Metropolitan Areas
Towing and Recovery <i>Vehicle Identification Guide</i>			●			NJ/PA (Delaware Valley Region), TX (Austin)
Instant Tow Dispatch Procedures			●			WA (Seattle)
Towing and Recovery Zone-Based Contracts			●			TX (Houston)
Enhanced Computer-Aided Dispatch			●			43+ Agencies in U.S. Metropolitan Areas, CA (Los Angeles), NM (Albuquerque), TN (Sequatchie Co.)
Dual/Optimized Dispatch Procedures			●			NJ
Motorcycle Patrols			●			All or Nearly U.S. Metropolitan Areas
Equipment Staging Areas/ Pre-positioned Equipment			●			TN, WI
Incident Command System				●		58+ U.S. Metropolitan Areas, WA
Response Vehicle Parking Plans				●		AZ (Phoenix), CO (Lakewood), IA, MI (Farmington), TX (Lancaster)
High-Visibility Safety Apparel/ Vehicle Markings				●		CO (Eagle)
On-Scene Emergency Lighting Procedures				●		TX (Austin, San Antonio)
Safe, Quick Clearance Laws— <i>Move Over</i>				●		47 States, including CA, FL, GA, IN, TN
Effective Traffic Control Through On-Site Traffic Management Teams				●		CA (Stockton), FL (Southeast), NJ
End-of-Queue Advance Warning Systems				●		CA (Bishop, Los Angeles, Redding, Stockton), NJ (Camden), TN (Chattanooga), UT (Salt Lake City)



Table 13. Task-specific strategies and select implementation locations (continued).

TASK-SPECIFIC STRATEGIES	Detection/Verification	Traveler Information	Response	Scene Management/Traffic Control	Quick Clearance/Recovery	EXAMPLE APPLICATIONS
Alternate Route Plans				●		62+ U.S. Metropolitan Areas, CA (Anaheim), FL (Northeast), ME/NH, NJ/PA (Delaware Valley Region), WI
Abandoned Vehicle Legislation/Policy					●	21+ U.S. Metropolitan Areas, IN, NC
Safe, Quick Clearance Laws— <i>Driver Removal</i>					●	~25 States, including FL, GA, MD, NC, OH, SC, TN, TX, VA, WI
Service Patrols					●	130+ U.S. Metropolitan Areas, AZ (Phoenix), CA, FL, GA (Atlanta), IN, MD, MN, NM (Albuquerque), OR, TN, UT (Salt Lake City)
Vehicle-Mounted Push Bumpers					●	CA (Redding, Stockton), MD (Baltimore), NJ/PA (Delaware Valley Region), OH (Cincinnati), TN (Chattanooga), TX (Austin), UT (Salt Lake City)
Incident Investigation Sites					●	16+ U.S. Metropolitan Areas, TX (Houston)
Safe, Quick Clearance Laws— <i>Authority Removal</i>					●	AZ, CA, CO, FL, GA, IL, IN, KY, MO, NM, NC, OH, OR, SC, TN, TX, VA, WA
Quick Clearance/Open Roads Policy					●	35+ U.S. Metropolitan Areas, CA, FL, GA, ID, IN, LA, MD, NV, NH, TN, UT, WA, WI
Non-cargo Vehicle Fluid Discharge Policy					●	FL, MN
Fatality Certification/Removal Policy					●	PA, TN, TX (Austin), WA
Expedited Crash Investigation					●	93+ U.S. Metropolitan Areas, FL, IN, TX (North Central Region), UT
Quick Clearance Using Fire Apparatus					●	TX (Austin)
Towing and Recovery Quick Clearance Incentives					●	FL, GA, WA
Major Incident Response Teams					●	DE, FL, IL (Chicago), LA, MD, NJ, OH (Cincinnati, Columbus), NY, TX (Dallas Co.), WA

Tools and strategies generally reported to be most effective in addressing cross-cutting TIM challenges include the following:

- Agency relations:
  - Routine, periodic “TIM team” meetings to encourage ongoing dialogue among TIM responders, increasing awareness of priorities and roles.
  - Joint agency/jurisdictional protocols and traffic/emergency management centers to formalize agency relations and respective roles in TIM and to demonstrate commitment through common resource/facility investments.

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- Training:
  - National TIM training and information clearinghouses/communities of practice to support information dissemination and exchange among various response agencies involved in TIM regarding national best practices.
  - Local multidisciplinary TIM training and associated tabletop exercises/scenarios and after-action reviews/debriefings to encourage joint and effective training among responders and improved TIM operations at the local level.
  - Multidisciplinary TIM response plan/operating procedures to formalize recommended actions in support of future TIM training efforts, enhanced TIM responder competency, and consistent TIM operations.
  - TIM personnel certifications/training requirements to support enhanced TIM responder competency and consistent TIM operations.
- Communications:
  - Common mutual-aid frequency/channel, alternative communications devices, wireless information networks, and an associated standardized communications terminology/protocol to enhance en-route and on-scene communications among responders from different agencies.
  - Mobile unified communications vehicle to enhance en-route and on-scene communications among responders from different agencies for major incidents and emergencies.
- Technology:
  - Expedited standards development process and standards requirements for State procurement to facilitate/encourage the use of standards and subsequently enhance system and component interoperability and minimize life-cycle costs of investments.
- Performance measurement:
  - National performance measurement guidance to lend consistency and consensus to TIM performance metrics at the State and program levels.
  - Annual TIM self-assessment to support identification of TIM strengths and weaknesses and subsequent activities and initiatives to encourage continued TIM improvements at the national, State, and program levels.
  - Strong funding and performance link to ensure that the effectiveness of TIM programs can be demonstrated and that TIM programs subsequently receive adequate attention in prioritization of projects for funding.
  - Multi-agency data exchange protocol to enhance data sharing and accessibility in support of TIM performance measurement activities.
- Program resources and funding:
  - Dedicated, ongoing funding, guidelines for federal/state funding sources, MPO partnerships, and an associated TIM strategic plan to ensure ongoing access to program resources and funding.
  - Efficient/effective TIM resource management to encourage optimum use of existing TIM resources.

- Executive outreach materials/events to ensure that the effectiveness of TIM programs is adequately demonstrated to decision makers and that TIM programs subsequently receive adequate attention in prioritization of projects for funding.

These tools and strategies, including their institutional area of primary impact and select implementation locations, are summarized in table 14.

Additional tools and strategies, infrequently or inconsistently observed to be effective, are included in “Appendix B: Additional Task-Specific Strategies” and “Appendix C: Additional Cross-Cutting Strategies” for supplemental reference.

Table 14. Cross-cutting strategies and select implementation locations.

CROSS-CUTTING STRATEGIES	Agency Relations	Training	Communications	Technology	Performance Measurement	Program Resources/ Funding	EXAMPLE APPLICATIONS
Routine, Periodic “TIM Team” Meetings	●						GA (Atlanta), MI (Detroit), NJ/PA (Delaware Valley Region), TX (Austin), WA, WI
Joint Agency/Jurisdictional Protocols	●						FL (Southeast), WA
Joint Traffic/Emergency Management Center	●						FL, GA (Atlanta), IL (Chicago), NY (Hudson Valley Region, New York), RI, TX (Austin), UT (Salt Lake City)
National TIM Training		●					NHI, DHS (NIMS), CITE, <i>Traffic Incident Management Systems</i>
Information Clearinghouses/ Communities of Practice		●					NTIMC, ResponderSafety.com, I-95 Quick Clearance Toolkit, IACP Technology Clearinghouse, IAFC Vehicle Safety Resources, FL (Southwest), GA, IN, NV, NJ/PA (Delaware Valley Region), NY, WA, WI
Local Multidisciplinary TIM Training		●					AZ, FL, GA, IN, MD, MI, NC, NJ, NY, OR, TX (Dallas, Ft. Worth), VA, WA, WI
Tabletop Exercises/Scenarios		●					NJ/PA (Delaware Valley Region), MD
After-Action Reviews/Debriefings		●					FL, ME/NH, GA, NV, NJ/PA (Delaware Valley Region), TX (Austin), WI
Multidisciplinary TIM Response Plan/Operating Procedures		●					AZ, CT, ME/NH, MA, MN, NJ/PA (Delaware Valley Region), NY, NC, OH, TX (Austin, San Antonio), WI
TIM Personnel Certifications/Training Requirements		●					TRAA, GA, NJ/PA (Delaware Valley Region), NY (Hudson Valley Region), VA
Common Mutual-Aid Frequency/Channel			●				ME/NH
Alternative Communications Devices			●				WI
Wireless Information Networks			●				AR, DC/MD/VA, IL, MA (Westford), MS
Mobile Unified Communications Vehicle			●				IL (Chicago), OR (Tillamook Co.)

Table 14. Cross-cutting strategies and select implementation locations (continued).

CROSS-CUTTING STRATEGIES	Agency Relations	Training	Communications	Technology	Performance Measurement	Program Resources/ Funding	EXAMPLE APPLICATIONS
Standardized Communications Terminology/Protocol			●				75+ U.S. Metropolitan Areas (Resource Lists), 58+ U.S. Metropolitan Areas (ICS), IEEE/GJXDM
Expedited Standards Development Process				●			Law Enforcement Information Technology Standards Council (CAD Systems)
Standards Requirements for State Procurement				●			FHWA (ITS)
National Performance Measurement Guidance					●		TIM FSI, TIM Performance Measurement Knowledge Management System/Listserv
Annual TIM Self-Assessment					●		75+ U.S. Metropolitan Areas
Strong Funding and Performance Link					●		MD, WA
Multi-agency Data Exchange Protocol					●		CA (San Diego), CO (El Paso/Teller Co.), NV (Clark Co.), TX (Ft. Worth), UT, WA
Dedicated, Ongoing Funding						●	CA, MD, NJ/PA (Delaware Valley Region)
Guidelines for Federal/State Funding Sources						●	FL (Orlando), WI
Metropolitan Planning Organization Partnerships						●	FL, NJ/PA (Delaware Valley Region), TN (Chattanooga), TX (Austin)
TIM Strategic Plan						●	FL, GA (Atlanta), KY, TN, TX (Austin)
Efficient/Effective TIM Resource Management						●	MD (Baltimore)
Executive Outreach Materials/Events						●	GA (Atlanta), NVFC Cost Savings Calculators

## Implementation

When considering the myriad of task-specific and cross-cutting tools and strategies identified in this document, note that in some cases, select TIM tools and strategies must operate concurrently to fully realize the benefits to operations (e.g., DMS and standardized DMS message sets/use protocol). In addition, this investigation did not consider cost in relation to effectiveness. Low- or no-cost tools or strategies with moderate reported or observed effectiveness may prove to be better implementation options than higher-cost strategies with the same or potentially higher benefits. Consequently, additional information gathering is recommended prior to implementation.

At a local, regional, or State level, TIM administrative or operations personnel considering implementation of a particular tool or strategy can refer to the appropriate references for published

findings cited in this document or contact TIM practitioners participating in this investigation directly by telephone or email to obtain more information.

The tools and strategies described in the main body of this report include those that are most commonly and consistently reported to be effective. For those additional tools and strategies infrequently or inconsistently observed to be effective (included in appendix B and appendix C), experiences that resulted in a low relative effectiveness rating may be of most interest to TIM administrative or operations personnel considering implementation of a specific tool or strategy, particularly if others have reported only positive experiences. Identification of potential pitfalls early in the implementation stage can help to ensure that the same shortcomings are not propagated and that the full effectiveness of TIM efforts can be realized.

At a national level, NTIMC, working in close cooperation with FHWA, provides a unique forum for disseminating the information presented here directly through its website and through participation in various outreach activities and events. Stated goals of NTIMC include promoting and supporting the successful development and conduct of local, regional, and statewide TIM programs through peer networking, mentoring, and knowledge exchange among public safety and transportation professionals, and providing leadership in the development of multidisciplinary best practices, guides, standards, and performance measures in support of sound TIM activities.

As evidenced by the wide range of observed and reported effectiveness for singular TIM tools and strategies among the various participating locales, longer-term efforts of NTIMC, again working in close cooperation with FHWA, should focus on standardizing practices to consistently maximize the effectiveness of TIM efforts. In many cases, this may require additional research to identify the local conditions related to the nature and extent of operation, maintenance, marketing, etc. that have a significant impact on the perceived or measured success of specific TIM efforts. More consistent implementation of TIM tools and strategies will enhance not only the cost-effectiveness of program operation but also its sustainability over time.

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## APPENDIX A: TRAFFIC INCIDENT MANAGEMENT PERSONNEL CONTACTS

Table 15. Traffic Incident Management Personnel Contacts.

STATE	METROPOLITAN AREA	CONTACT
Arizona	Statewide	Jack Hegarty Lt. Colonel Arizona Highway Patrol <a href="mailto:jhegarty@azdps.gov">jhegarty@azdps.gov</a>
California	Statewide	Lawrence Wooster, P.E. Chief, Incident Management Operations Branch Traffic Operations Division California Department of Transportation (Caltrans) (916) 654-6104 <a href="mailto:larry_wooster@dot.ca.gov">larry_wooster@dot.ca.gov</a>
	Bishop	Sam Esquenazi Senior Transportation Engineer Transportation Management Team Supervisor
	Los Angeles	Terry Erlwein Traffic Operations Engineer
	Redding	Mike Gunter Traffic Engineer, District 2 (530) 225-3206 <a href="mailto:mike_gunter@dot.ca.gov">mike_gunter@dot.ca.gov</a>
	Stockton	Toni Moon
	Windsor (North of San Francisco)	Doug Williams Fire Chief Rincon Valley Fire Protection District (707) 539-1801 <a href="mailto:dwilliams@rvfire.org">dwilliams@rvfire.org</a>
Florida	Statewide	Grady T. Carrick Chief, Northern Regional Commander Florida Highway Patrol (904) 695-4096 <a href="mailto:gradycarrick@flhsmv.gov">gradycarrick@flhsmv.gov</a>
Maryland	Baltimore	Alvin Marquess Deputy Director of Operations Maryland State Highway Administration (410) 582-5677 <a href="mailto:amarquess@sha.state.md.us">amarquess@sha.state.md.us</a>
Michigan	Clarkston	Bob Cesario Captain, EMS Coordinator Independence Fire Department (248) 625-5468 <a href="mailto:bcesario@independencefire.us">bcesario@independencefire.us</a>

Table 15. Traffic Incident Management Personnel Contacts (continued).

STATE	METROPOLITAN AREA	CONTACT
Nevada	Henderson (Southeast of Las Vegas)	Brad Fuller Deputy Fire Chief City of Henderson (702) 267-2214 <a href="mailto:bradley.fuller@cityofhenderson.com">bradley.fuller@cityofhenderson.com</a>
New Jersey	Statewide	Dhanesh Motiani Director of Traffic Operations New Jersey Department of Transportation (609) 530-4690 <a href="mailto:Dhanesh.Motiani@dot.state.nj.us">Dhanesh.Motiani@dot.state.nj.us</a>
		Jim Hogan Executive Director of Statewide Traffic Operations Office New Jersey Department of Transportation (609) 530-4690 <a href="mailto:Jim.Hogan@dot.state.nj.us">Jim.Hogan@dot.state.nj.us</a>
New Jersey/ Pennsylvania	Delaware Valley Region	Laurie Matkowski Senior Transportation Engineer DVRPC TIM Task Forces (215) 238-2853 <a href="mailto:lmatkowski@dvrpc.org">lmatkowski@dvrpc.org</a>
		Joseph A. Zito Sergeant of Police/Co-chair, DVRPC NJ TIM Task Force Delaware River Port Authority Police (856) 969-7842 <a href="mailto:jazito@drpa.org">jazito@drpa.org</a>
		William Robb Chief, Blackwood Fire Company Co-chair, DVRPC NJ TIM Task Force <a href="mailto:R3737at84@aol.com">R3737at84@aol.com</a>
New York	New York	Les Greenwood Program Coordinator of Highway Safety Program New York State Office of Fire Prevention and Control (518) 858-6877 <a href="mailto:les.Greenwood@dos.state.ny.us">les.Greenwood@dos.state.ny.us</a>
Ohio	Cincinnati	Robert Hungler Lieutenant, Traffic Unit Cincinnati Police Department (513) 352-2514 <a href="mailto:robert.hungler@cincinnati-oh.gov">robert.hungler@cincinnati-oh.gov</a>
		Susan Farver-Springer Admin. Asst. to Deputy Director Ohio Dept. of Transportation, District 8 (513) 933-6531 <a href="mailto:susan.springer@dot.state.oh.us">susan.springer@dot.state.oh.us</a>

Table 15. Traffic Incident Management Personnel Contacts (continued).

STATE	METROPOLITAN AREA	CONTACT
Tennessee	Chattanooga	Robert Van Horn Region 2 Incident Management Coordinator Tennessee Department of Transportation (423) 510-1168 <a href="mailto:robert.vanhorn@state.tn.us">robert.vanhorn@state.tn.us</a>
Texas	Austin	Brian Burk Engineer Texas Department of Transportation, Austin District (512) 974-0899 <a href="mailto:bburk@dot.state.tx.us">bburk@dot.state.tx.us</a>
	Houston	Jeanette Rash President, Fast Tow/SafeClear (281) 850-4001 <a href="mailto:jeanette@jrash.com">jeanette@jrash.com</a>
	North Central Region	Marian Thompson Transportation System Operations Supervisor Congestion Management and Systems Operation North Central Texas Council of Governments (817) 608-2336 <a href="mailto:mthompson@nctcog.org">mthompson@nctcog.org</a>
Utah	Salt Lake City	David Kinnecom Traffic Management Engineer Utah Department of Transportation (801) 877-3707 <a href="mailto:dkinnecom@msn.com">dkinnecom@msn.com</a>
Washington	Bellevue (East of Seattle)	Warren A. Merritt Deputy Fire Chief Bellevue Fire Department (425) 452-2016 <a href="mailto:wmerritt@bellevuewa.gov">wmerritt@bellevuewa.gov</a>





## APPENDIX B: ADDITIONAL TASK-SPECIFIC CHALLENGES AND STRATEGIES

For many of the individual tools and strategies intended to address task-specific challenges, a wide range of effectiveness was observed and/or reported by locale, 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. Because of their potential to be effective under certain implementation scenarios, these additional tools and strategies—infrequently or inconsistently observed to be effective—are included here.

### Detection and Verification

Table 16 identifies the various tools and strategies that were infrequently or inconsistently observed to be effective in overcoming challenges related to detection and verification and identifies select locations where these tools and strategies are in use. Whenever possible, the example locations reflect locales where the various tools and strategies have proven to be both effective and ineffective to support additional information gathering regarding factors contributing to a particular tool or strategy’s performance.

Table 16. Detection and verification challenges, strategies, and select implementation locations.

DETECTION AND VERIFICATION STRATEGIES	CHALLENGES				EXAMPLE APPLICATIONS
	Slow Detection	Inconsistent Notification	Inaccurate Incident Reports	Dispatcher Overload	
Electronic Loop Detectors	●				48+ U.S. Metropolitan Areas; Ineffective: MD (Baltimore), OH (Cincinnati), UT (Salt Lake City)
Probe Vehicles	●				Ineffective: OH (Cincinnati)
Incident Notification Protocol		●			Effective: FL, ME/NH; Ineffective: MD

Additional descriptive information regarding the various tools and strategies and select locations where these tools and strategies are in use is provided below.

- Electronic loop detectors.** Electronic or inductive loop detectors are the most common method of detecting vehicles and sensing incidents automatically. In 2004, the ITS Deployment Survey estimated that approximately 20 percent of all freeway miles across 48 U.S. metropolitan areas were equipped with electronic loop detectors. <sup>(2)</sup> Electronic loop detectors identify changes in vehicle speed as vehicles pass over successive loops embedded in the roadway. The loop information (i.e., speed and loop occupancy) is interpreted by detection algorithms (software) to pick up patterns indicative of incidents. They do not provide a means for verification.

The accuracy of incident detection using electronic loops is limited at both low and high traffic volumes. The effectiveness of electronic loop detectors in supporting TIM operations

was variable, with the poorest performance reported in Baltimore, MD, Cincinnati, OH, and Salt Lake City, UT, where cold temperatures and winter road surface conditions may have a detrimental effect on electronic loop detector reliability.

- **Probe vehicles.** Similar to electronic or inductive loop detectors, specially equipped vehicles can be used to detect changes in vehicle speed. Companion detection algorithms (software) are used to pick up patterns that are indicative of incidents. Although several types of technologies can support the use of probe vehicles, GPS is proving to be most prevalent. Probe vehicles are equipped with GPS receivers and two-way communication to receive satellite signals. The positional information determined from the GPS signals is transmitted to a control center to display the real-time position of the probe vehicles. Travel time information, and any noted changes in travel speed, can be determined from the collected data. Fleet vehicles, such as public transit buses, often provide a cost-effective probe vehicle sample.

Incident management personnel in Cincinnati, OH, reported utilizing probe vehicles as part of their regional ITS efforts and rated their effectiveness in speeding incident detection as “low.”

- **Incident notification protocol.** To address the inconsistent notification of support responders when an incident occurs, Maryland formalized incident notification procedures in an interagency agreement between the Maryland State Police and the Maryland State Highway Administration. This agreement is intended to ensure that transportation personnel are notified consistently for each appropriate incident irrespective of different law enforcement officers managing the incident. To date, incident management personnel in Baltimore, MD, rated this mechanism as “low” in effectively standardizing an incident notification protocol in their locale.

Comparatively, incident notification procedures in Florida and Maine/New Hampshire were recently identified as best practices in the I-95 Corridor Coalition’s *Traffic Management Teams Best Practice Report*:<sup>(6)</sup>

- The Florida Department of Transportation utilizes an automated notification system as part of their SunGuide™ TMC software application that permits the operator to quickly assemble a list of individuals in multiple agencies to alert when different types of incidents occur.
- In Maine and New Hampshire, a call tree—initiated by the on-scene incident commander—is used to enhance notification of and communications between regional response agencies, State officials, and local municipalities during major incidents.

## Traveler Information

Table 17 identifies the various tools and strategies that were infrequently or inconsistently observed to be effective in overcoming challenges related to traveler information and identifies select locations where these tools and strategies are in use. Whenever possible, the example locations reflect locales where the various tools and strategies have proven to be both effective and ineffective to support additional information gathering regarding factors contributing to a particular tool or strategy’s performance.

Table 17. Traveler information challenges, strategies, and select implementation locations.

TRAVELER INFORMATION STRATEGIES	Accurate Traveler Information	Inconsistent DMS Use	EXAMPLE APPLICATIONS
Incident Update Protocol	●		Moderately Effective: CA (Redding, Stockton), NJ (Camden), OH (Cincinnati), TN (Chattanooga)
Highway Advisory Radio	●		59+ U.S. Metropolitan Areas; Effective: CA (Stockton, Redding), OH (Cincinnati), TX (Austin); Ineffective: CA (Bishop), NJ (Camden), MD (Baltimore), UT (Salt Lake City)

Additional descriptive information regarding the various tools and strategies and select locations where these tools and strategies are in use is provided below.

- Incident update protocol.** Incident duration is difficult to report accurately, yet it is one of the most important to the motoring public. For incident responders, the dynamic nature and uniqueness of each incident challenge accurately estimating duration. Duration is especially difficult to predict at larger-scale incidents where a number of different agency personnel are performing many individual tasks. Consequently, the initial estimate should be periodically updated as the incident progresses to better reflect known conditions. Formalizing update procedures with step-by-step procedures or a standardized checklist helps to ensure that provision of the most accurate and comprehensive information does not get overlooked in the performance of other incident-related duties.

Incident management personnel in Redding, CA, Stockton, CA, Camden, NJ, Cincinnati, OH, and Chattanooga, TN, reported using an incident update protocol and consistently rated its effectiveness in enhancing the accuracy of traveler information as “moderate” in their respective locales.

- Highway advisory radio.** Highway advisory radio can be used in isolation or in combination with DMSs and other technologies as part of a broader ATIS to provide traffic information to motorists at or approaching an incident. Highway advisory radio primarily broadcasts at 530 or 1610 kHz on the AM band; roadside signing is commonly used to advise motorists to tune to the HAR frequency “when flashing.” Highway advisory radio has a larger area of coverage than DMSs and can reach motorists farther upstream of an incident. In addition, HAR can provide longer, more detailed messages, including bilingual messages. Both portable and permanently installed HAR systems are available, with a transmission range of up to 1 and 4 mi, respectively. Highway advisory radio is only effective if the motorist tunes the radio to the proper HAR frequency.

In 2007, the ITS Deployment Survey reported 59 metropolitan areas in the United States using HAR systems.<sup>(2)</sup> Of the participants in this investigation, HAR systems were rated as “low” in effectively enhancing traveler information by TIM personnel in Bishop, CA, Baltimore, MD, Camden, NJ, and Salt Lake City, UT. Conversely, TIM personnel in Stockton, CA, Redding, CA, Cincinnati, OH, and Austin, TX, rated HAR systems as “moderate” to “very high.”

The range in reported effectiveness may be indicative of the level of effort expended to maintain the traveler information broadcast on HAR systems. Proper HAR system operation is personnel intensive; motorists will reject an information source that provides outdated or irrelevant information.

## Response

Table 18 identifies the various tools and strategies that were infrequently or inconsistently observed to be effective in overcoming challenges related to incident response and identifies select locations where these tools and strategies are in use. Whenever possible, the example locations reflect locales where the various tools and strategies have proven to be both effective and ineffective to support additional information gathering regarding factors contributing to a particular tool or strategy's performance.

Table 18. Response challenges, strategies, and select implementation locations.

RESPONSE STRATEGIES	Achieving Optimum Response	Difficult Scene Access	EXAMPLE APPLICATIONS
Median Crossovers		●	Effective: CA (Bishop, Redding), MD (Baltimore), NJ/PA (Delaware Valley Region), NY (New York), OH (Cincinnati), TN (Chattanooga), TX (Austin); Ineffective: UT (Salt Lake City), WA (Bellevue)
Traffic Signal Pre-emption		●	Effective: CA (Redding, Windsor), MD (Baltimore), NV (Henderson), NY (New York), TX (Austin, Houston), WA (Bellevue); Ineffective: NJ/PA (Delaware Valley Region), UT (Salt Lake City)

Additional descriptive information regarding the various tools and strategies and select locations where these tools and strategies are in use is provided below.

- Median crossovers.** Access to an incident is often a problem. Roadway geometrics or traffic congestion poses particular problems for large fire and towing and recovery equipment. Movable median barriers and emergency crossovers (U-turns) at key locations can significantly reduce response times for emergency and support vehicles. To accurately identify the most appropriate locations for improved emergency access, historical incident location data and input from all responding agencies should be considered.

Of the participants in this investigation, TIM personnel in Bishop, CA, Redding, CA, Baltimore, MD, the Delaware Valley region in New Jersey and Pennsylvania, New York, NY, Cincinnati, OH, Chattanooga, TN, and Austin, TX, reported utilizing median crossovers and rated their effectiveness in enhancing access to the incident scene as “moderate” to “very high” in their respective locales. Comparatively, median crossovers were rated as “low” by TIM personnel in Salt Lake City, UT, and Bellevue, WA.

The range in reported effectiveness may be indicative of the appropriateness of median crossover locations, their frequency, or—in cold weather environments—the effort expended in keeping the median crossovers passable (i.e., free of snow and ice) for incident response vehicles.

- **Traffic signal pre-emption.** Traffic signal pre-emption systems allow the normal operation of traffic signals to be temporarily interrupted, giving emergency vehicles priority by changing traffic signals in the path of the vehicle to green and stopping conflicting traffic. Emitters installed on emergency vehicles are generally calibrated to activate signals within 0.25 mi. Traffic signal pre-emption systems can reduce response time for emergency responders and minimize the potential for conflict with another vehicle while the emergency vehicle is en route to the scene.

Early studies regarding traffic signal pre-emption indicated the potential for significant benefit. Following implementation of traffic signal pre-emption systems at 22 intersections, Houston, TX, reported a decrease in the average emergency vehicle travel time of 16 to 23 percent.<sup>(120)</sup> Of the participants in this investigation, TIM personnel in Redding, CA, Windsor, CA, Baltimore, MD, Henderson, NV, New York, NY, Austin, TX, and Bellevue, WA, rated traffic signal pre-emption as “moderate” to “very high” in effectively enhancing access to the incident scene. Comparatively, traffic signal pre-emption was rated as “very low” to “low” in effectively enhancing scene access by TIM personnel in the Delaware Valley region in New Jersey and Pennsylvania and Salt Lake City, UT.

The range in reported effectiveness may be explained, in part, by the number of intersections equipped with traffic signal pre-emption and the effort expended in maintaining the system to ensure ongoing functionality.

## Scene Management and Traffic Control

Table 19 identifies the various tools and strategies that were infrequently or inconsistently observed to be effective in overcoming challenges related to scene management and traffic control and identifies select locations where these tools and strategies are in use. Whenever possible, the example locations reflect locales where the various tools and strategies have proven to be both effective and ineffective to support additional information gathering regarding factors contributing to a particular tool or strategy’s performance.

Table 19. Scene management and traffic control challenges, strategies, and select implementation locations.

SCENE MANAGEMENT AND TRAFFIC CONTROL STRATEGIES	Confusion over Authority/Roles	Difficult On-Scene Maneuverability	Responder Safety	Secondary Incidents	Excess Delay	EXAMPLE APPLICATIONS
Intrusion Detection/Warning Systems	●					Moderately Effective: NJ (Camden)
Secondary/Responder-Involved Incident Tracking		●				Effective: MD (Baltimore), NY (New York), OH (Cincinnati); Ineffective: NJ/PA (Delaware Valley Region)

Table 19. Scene management and traffic control challenges, strategies, and select implementation locations (continued).

SCENE MANAGEMENT AND TRAFFIC CONTROL STRATEGIES	Confusion over Authority/Roles	Difficult On-Scene Maneuverability	Responder Safety	Secondary Incidents	Excess Delay	EXAMPLE APPLICATIONS
Responsive Traffic Signal Control Systems			●			28+ U.S. Metropolitan Areas; Effective: CA (Los Angeles), DE (Newark), FL (Broward Co.), MI (Detroit, Oakland Co.), MN (Minneapolis), NJ (Camden); Ineffective: UT (Salt Lake City)
Alternative Traffic Signal Timing Plans			●			Moderately Effective: CA (Redding), MD (Baltimore), NJ (Camden)
Active Lane/Ramp Controls			●			20+ U.S. Metropolitan Areas; Ineffective: NJ (Camden), UT (Salt Lake City)
Reserved/Special-Use Lane Temporary Use Policy			●			Effective: CA (Los Angeles), MD (Baltimore), VA; Ineffective: NJ (Camden)

Additional descriptive information regarding the various tools and strategies and select locations where these tools and strategies are in use is provided below.

- Intrusion detection/warning systems.** Commonly used for ensuring safety through construction work zones but also appropriate for longer-duration incidents, portable intrusion detection/warning systems utilize sensors to detect errant or excessive-speed vehicles and an audible warning device to alert responders; no physical protection is provided. Various commercial products are available that utilize infrared, microwave, or pneumatic tube sensor technologies.

Incident management personnel in Camden, NJ, rated intrusion detection/warning systems as only moderately effective in effectively enhancing responder safety.

- Secondary and responder-involved incident tracking.** Incidents can generally be considered secondary to a primary incident if the time and location of the incident can be correlated with the primary incident, including the queue dissipation times. The occurrence of secondary incidents can point to the need for specific incident management strategies such as improved traffic control at the scene, faster clearance times, the use of traffic diversions or alternate routes, the provision of additional traveler information, and more. The challenge is that the definition of secondary incidents is not standardized, and many agencies do not even attempt to classify an incident as secondary, treating all reported incidents as separate, primary incidents.

As noted previously in the main body of this document under “Cross-Cutting Challenges and Strategies—Performance Measurement,” a key outcome of FHWA’s recently completed Focus State Initiative on TIM Performance Measures was a uniformly defined objective and performance metric focused on secondary incidents: <sup>(103)</sup>

**Reduce number of secondary incidents:** number of unplanned incidents beginning with the time of detection of the primary incident where a collision occurs as a result of the original incident either within the incident scene or within the queue in either direction.

A follow-on investigation, again sponsored by FHWA, is currently underway to encourage adoption of this and two additional standard TIM-specific performance metrics by States.

A subset of secondary incidents includes those that involve incident responders at the scene. Responder-involved incident tracking has largely been motivated by Occupation Safety and Health Administration (OSHA) reporting requirements (*CFR Part 1904*). These records are not specific in terms of the personnel, function, or event leading to the resulting injury to support accurate determination of responder injuries and fatalities resulting from TIM activities. Accurate estimates of responder injuries and fatalities attributable specifically to TIM activities can help to elevate the importance of and investment in effective scene management and traffic control strategies.

Law enforcement agencies maintain distinct records and have developed companion websites to increase awareness of officer injuries and fatalities (i.e., National Law Enforcement Officers Memorial Fund Website: <http://www.nleomf.org/memorial> and the Officer Down Memorial Page, Inc.: <http://www.odmp.org/>).<sup>(121,122)</sup> With a focus on fire and rescue and EMS personnel, the IAFC initiated the National Fire Fighter Near-Miss Reporting System aimed at turning near-miss experiences into lessons learned, enhancing overall safety (National Fire Fighter Near-Miss Reporting System Website: <http://www.firefighternearmiss.com/>).<sup>(123)</sup> Recently, TRAA initiated a similar effort to record and increase awareness of towing and recovery operator injuries and fatalities (Survivor Fund Website: <http://www.thesurvivorfund.com/need.php>).<sup>(25)</sup>

Despite the fact that increased information and awareness of secondary and responder-involved incidents can encourage further investment in protective tools and strategies to enhance both public and responder safety, participants in this investigation reported wide-ranging effectiveness. Incident management personnel in Baltimore, MD, New York, NY, and Cincinnati, OH, rated the tracking of secondary incidents to effectively reduce their occurrence as “moderate” to “high” in their respective locales. Comparatively, this same strategy was rated as “very low” to “low” in effectively enhancing public and responder safety by TIM personnel in the Delaware Valley region in New Jersey and Pennsylvania.

- **Responsive traffic signal control systems.** Responsive traffic signal control systems (RTSC) use algorithms that perform real-time optimization of traffic signal splits, offsets, phase lengths, and phase sequences based on current traffic conditions, demand, and system capacity to minimize delay and reduce the number of vehicle stops. Responsive traffic signal control systems offer potential benefit to motorists who have been rerouted because of an incident. Currently, if an incident occurs on the freeway, traffic reroutes onto arterials or city streets. This additional and unexpected increase in traffic volume quickly results in congested conditions. System technologies “sense” the increased traffic demand using electronic loops, video imaging, or microwave sensors and automatically adjust the signal timings to improve traffic flow. In 2007, the ITS Deployment Survey estimated that approximately 4 percent of all arterial signals across 28 metropolitan areas in the United States were equipped with RTSC systems.<sup>(2)</sup>

Early studies regarding RTSC systems indicated the potential for significant benefit. Network simulation of the Detroit, MI, commercial business district indicated that the use of RTSC



systems for detours around an incident reduced delay by 60 to 70 percent for affected paths. <sup>(124)</sup> Deployments of RTCS in Los Angeles, CA, Broward County, FL, Newark, DE, Oakland County, MI, and Minneapolis, MN, reportedly resulted in delay reductions of 19 to 44 percent, travel time reductions of 13 to 25 percent, and a decrease in the number of stops of 28 to 41 percent. <sup>(125)</sup> Of the participants in this investigation, the effectiveness of RTSC systems was reported to be more variable. Incident management personnel in Baltimore, MD, and Camden, NJ, rated RTCS systems as “moderate” to “very high” in effectively reducing excess delay. Conversely, TIM personnel in Salt Lake City, UT, rated these same systems as “low.”

The range in reported effectiveness may be explained, in part, by the geographic extent of the RTSC system, the performance of the algorithms in responding to real-time traffic conditions, and the effort expended in maintaining the system to ensure ongoing functionality.

- **Alternative traffic signal timing plans.** In the absence of RTSC systems, the use of alternative or modified traffic signal timing plans during incident events can effectively improve traffic flow by providing additional green time along designated alternate routes. Most traffic signal controllers allow multiple programs to be set. Response personnel can override the normal program manually, or in some cases the timing may be set remotely from a TMC. Alternate route signal timing plans can be developed in conjunction with alternate route plans.

Incident management personnel in Redding, CA, Baltimore, MD, and Camden, NJ, reported using alternative traffic signal timing plans and consistently rated their effectiveness in reducing excess delay as “moderate” to “high.”

- **Active lane/ramp controls.** Along the affected roadway, overhead lane control signals can be used in managed lane systems to permit or prohibit the use of specific lanes. When lane control signals are placed over the individual lanes of highway, vehicular traffic may travel in any lane over which a green signal is shown but shall not enter or travel in any lane over which a red signal is shown. For TIM, variable lane closures can be used to shift traffic out of downstream blocked lanes well in advance of the incident scene. Lane control signals can also be used to indicate interim shoulder or special-use (e.g., toll, managed, or high-occupancy vehicle [HOV]) lane operations.

When large numbers of diverted vehicles attempt to merge onto an alternate freeway or back on the same freeway downstream of an incident, regular ramp meter timing may create long queues, which may spill back onto local streets. Most ramp-metering controllers allow either queue override or queue adjustment to flush the queue and allow vehicles to enter the freeway. Queue override temporarily suspends ramp metering, while queue adjustment temporarily increases the metering rate to allow more vehicles to enter.

In 2007, the ITS Deployment Survey estimated that approximately 6 percent of all freeway miles across 23 metropolitan areas in the United States were equipped with lane control signals and approximately 16 percent of all freeway ramps across 20 metropolitan areas were equipped with ramp meters. <sup>(2)</sup> Despite their relative widespread implementation, TIM personnel in Camden, NJ, and Salt Lake City, UT, rated active lane/ramp controls as “very low” to “low” in effectively reducing excess delay.

The low reported effectiveness of these systems may be explained, in part, by the level of effort required to actively manage lane/ramp use and the level of compliance from motorists.

- **Reserved/special-use lane temporary use policy.** Temporary use of reserved or special lanes (e.g., toll, managed, or HOV lanes) during incidents relies on the suspension of toll fees or vehicle occupancy or type restrictions to temporarily encourage or mandate lane use by general-purpose traffic. During a major incident, it may be useful to suspend reserved/special-use lane restrictions; the additional capacity in the reserved/special-use lane can replace, in part, the mainline capacity lost because of the incident. Interim use of reserved/special-use lanes during a major incident requires an effective traveler information system (i.e., a network of variable message signs and highway advisory radio along with media reports) to inform motorists of modified reserved/special-use lane use policies. Field personnel should actively direct the diversion process to ensure motorists are aware of the proper action. To maintain the credibility of reserved/special-use lanes, its use by general-purpose traffic should be considered a last resort in an incident management plan. Preferred alternatives may include the use of alternate routes or shoulders as travel lanes.

A set of criteria that define when reserved/special-use lanes should be opened for interim use is imperative to provide consistency. Specific criteria for interim use of reserved/special-use lanes generally consider the time it takes to clear an incident and the percentage of reduced capacity caused by the incident. For example, in Virginia, if the operation of clearing a major incident lasts longer than 2 h or if an incident blocks 50 percent of the main lanes in the peak direction, then the restrictions on the HOV lane will be lifted. <sup>(126)</sup>

Of the participants in this investigation, TIM personnel in Los Angeles, CA, and Baltimore, MD, rated reserved/special-use lane use protocols as “high” and “very high,” respectively, in effectively reducing excess delay. Comparatively, TIM personnel in Camden, NJ, rated this same strategy as “very low” in effectively reducing excess delay.

Low effectiveness ratings may be explained, in part, by a particularly restrictive use protocol that does not allow sufficient access to the reserved/special-use lanes or a high level of congestion in the reserved/special-use lanes that does not adequately alleviate delay.



## APPENDIX C: ADDITIONAL CROSS-CUTTING CHALLENGES AND STRATEGIES

For many of the individual tools and strategies intended to address cross-cutting challenges, a wide range of effectiveness was observed and/or reported by locale, 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. Because of their potential to be effective under certain implementation scenarios, these additional tools and strategies—infrequently or inconsistently observed to be effective—are included here.

### Agency Relations

Table 20 identifies the various tools and strategies that were infrequently or inconsistently observed to be effective in overcoming challenges related to agency relations and identifies select locations where these tools and strategies are in use. Whenever possible, the example locations reflect locales where the various tools and strategies have proven to be both effective and ineffective to support additional information gathering regarding factors contributing to a particular tool or strategy’s performance.

Table 20. Agency relations challenges, strategies, and select implementation locations.

AGENCY RELATIONS STRATEGIES	Different Priorities/ Cultures	Institutionalizing TIM	EXAMPLE APPLICATIONS
Viable Agency Career Path in TIM		●	Effective: CA (Windsor), MD (Baltimore); Ineffective: NJ/PA (Delaware Valley Region)

Additional descriptive information regarding the various tools and strategies and select locations where these tools and strategies are in use is provided below.

- Viable agency career path in TIM.** As noted previously in the main body of this document under “Cross-Cutting Challenges and Strategies—Program Resources and Funding,” transportation personnel often assigned to TIM duties have other full-time responsibilities in maintenance, traffic engineering, or ITS. Over time, TIM may evolve into a professional subspecialty within the transportation profession, practiced by full-time personnel who have clear responsibilities and accountability through reporting and performance measurement for stable and funded TIM programs. This evolution in TIM will provide a viable career path for TIM personnel, leading to enhanced retention of personnel and associated knowledge and skill sets and more effective, long-term working relationships with other incident responders.

In 2000, the Tennessee Department of Transportation established an Office of Incident Management with responsibility for the HELP service patrol program and for building a statewide TIM program. In 2001, the Office of Incident Management became a separate unit reporting to the assistant chief engineer for operations. <sup>(9)</sup>

Of the participants in this investigation, TIM personnel in Windsor, CA, and Baltimore, MD, rated a viable career path in TIM as “high” to “very high” in effectively institutionalizing TIM, citing the ability to retain qualified personnel as a significant benefit. Comparatively, TIM personnel in the Delaware Valley region in New Jersey and Pennsylvania rated the effectiveness of this same strategy as “low.”

## Communications

Table 21 identifies the various tools and strategies that were infrequently or inconsistently observed to be effective in overcoming challenges related to communications and identifies select locations where these tools and strategies are in use. Whenever possible, the example locations reflect locales where the various tools and strategies have proven to be both effective and ineffective to support additional information gathering regarding factors contributing to a particular tool or strategy’s performance.

Table 21. Communications challenges, strategies, and select implementation locations.

COMMUNICATIONS STRATEGIES	Limited Communications	Inefficient Communications	EXAMPLE APPLICATIONS
Common/Interoperable Radio Systems	●		Effective: CA (Windsor), NY (New York), OH (Cincinnati), RI, TX (Austin); Ineffective: NJ/PA (Delaware Valley Region)
Cross Installation of Radios	●		Effective: CA (Stockton), FL, MD (Baltimore), TX (Austin); Ineffective: CA (Redding), NJ/PA (Delaware Valley Region)
Console Patch	●		Effective: MD (Baltimore), NJ/PA (Delaware Valley Region); Ineffective: CA (Redding), UT (Salt Lake City)

Additional descriptive information regarding the various tools and strategies and select locations where these tools and strategies are in use is provided below.

- Common/interoperable radio systems.** A permanent communications solution can be achieved by building or procuring a single radio system that serves multiple TIM agencies or taking steps to make existing radio systems interoperable. Under the first scenario, multiple agencies typically share in the system costs, ensuring that their collective performance requirements are met. In particular, trunked systems can be configured to allow agencies to have their own talk groups (i.e., allowing them to communicate as if they had a system dedicated to their agency when appropriate) and allow interagency talk groups to be utilized when interoperability is required.

Response agencies are heavily invested in existing radio systems; it may be extremely difficult to persuade agencies to abandon these investments for new systems. In many cases however, public safety agencies already utilize common/interoperable radio systems, effectively limiting the investment required to achieve commonality to transportation and

other support agencies. Rhode Island is currently in the process of procuring an 800-MHz radio system to allow statewide radio access among TIM responders. <sup>(6)</sup>

As an alternative to building or procuring a single radio system, steps can be taken to make most existing radio systems interoperable. The National Task Force on Interoperability developed an informational guide entitled *Why Can't We Talk? Working Together to Bridge the Communications Gap to Save Lives—A Guide for Public Officials*. <sup>(127)</sup> The guide examines the critical barriers to interoperability (the ability of different systems to exchange both voice and data communications), provides guidelines for assessing a jurisdiction's interoperability, and suggests interim technology strategies to close gaps.

Of the participants in this investigation, TIM personnel in the Delaware Valley region in New Jersey and Pennsylvania rated common radio systems as "low" in effectively enhancing en-route and on-scene communications. Conversely, TIM personnel in Windsor, CA, New York, NY, Cincinnati, OH, and Austin, TX, rated the effectiveness of this same strategy as "moderate" to "very high" in effectively enhancing en-route and on-scene communications.

- **Cross installation of radios.** Cross installation of conventional radios in response vehicles provides a less costly approach to improving communication among TIM responders from different agencies (i.e., a transportation radio is installed in a police vehicle in addition to the police radio and vice versa). Resources can usually be made available to allow for the installation of one agency's radio in another agency's vehicle; both agencies benefit if the swap of radios is equal. The cross installation of radios is only effective at improving communication between a few agencies; cross installation of radios is limited by physical space in the vehicle and the ability to simultaneously monitor and operate several different radio systems. Hence, to be most effective, cross installation of radios requires the identification of the most critical communication links.

The Florida Department of Transportation has recently secured authority to utilize the Statewide Law Enforcement Radio System for all Road Ranger Safety Service Patrols. The use of these 800-MHz radios allows direct communications with the regional law enforcement dispatch centers, TMCs, and Florida Highway Patrol incident responders. The Florida Department of Transportation has purchased these radios and is in the process of distributing them to the districts. <sup>(6)</sup>

Consistent with Florida's perceived effectiveness of this strategy, TIM personnel in Stockton, CA, Baltimore, MD, and Austin, TX, rated the cross installation of radios as "moderate" to "high" in effectively enhancing en-route and on-scene communications in their respective locales. Comparatively, TIM personnel in Redding, CA, and the Delaware Valley region in New Jersey and Pennsylvania rated this same strategy as "low," noting that not all TIM responders were sufficiently trained in the use of outside agency radios.

- **Console patch.** A more temporary measure is to deploy a console patch or gateway interface device that receives a transmission from one radio system and rebroadcasts it on another radio system. One disadvantage of this approach is that it ties up a frequency (channel) for each different radio system when in use. However, given the relatively low cost of retransmission devices and the achievable deployment with little or no changes required to existing radio systems, this approach has significant potential, particularly as a near-term solution or as part of a transitional strategy toward more complete communications capabilities. <sup>(95)</sup>

Of the participants in this investigation, TIM personnel in Redding, CA, and Salt Lake City, UT, rated the use of radio console patches as “very low” to “low” in effectively enhancing en-route and on-scene communications. Conversely, TIM personnel in the Delaware Valley region in New Jersey and Pennsylvania rated the effectiveness of this same strategy as “high.” Incident management personnel in Baltimore, MD, rated the effectiveness of radio console patches as “moderate” in enhancing en-route and on-scene communications but noted that this effectiveness rating was based on infrequent use.

## Technology

Table 22 identifies the various tools and strategies that were infrequently or inconsistently observed to be effective in overcoming challenges related to technology and identifies select locations where these tools and strategies are in use. Whenever possible, the example locations reflect locales where the various tools and strategies have proven to be both effective and ineffective to support additional information gathering regarding factors contributing to a particular tool or strategy’s performance.

Table 22. Technology challenges, strategies, and select implementation locations.

TECHNOLOGY STRATEGIES	Lack of Standards	Limited Integration/ Interoperability	Inadequate Life-Cycle Costing	EXAMPLE APPLICATIONS
Regional ITS Architecture		●		Effective: MD (Baltimore), TX (Austin); Ineffective: CA (Bishop), NJ/PA (Delaware Valley Region)
Life-Cycle Cost Requirements for State Procurement			●	Ineffective: CA (Redding), TN (Chattanooga)

Additional descriptive information regarding the various tools and strategies and select locations where these tools and strategies are in use is provided below.

- Regional ITS architecture.** The National ITS Architecture provides a common framework for planning, defining, and integrating technology-based systems and components. The architecture defines the system functions that are required, the locations where these functions reside (e.g., the field or the vehicle), and the information and data flows that connect these functions and physical subsystems together into an integrated system. The National ITS Architecture can be used to develop a regional ITS architecture, tailored to address local conditions and investment needs. Subsequent technology-based project requests are then compared for adherence to the regional ITS architecture.

Of the participants in this investigation, TIM personnel in Bishop, CA, and the Delaware Valley region in New Jersey and Pennsylvania rated a regional ITS architecture as “very low” to “low” in effectively encouraging technology integration and interoperability in their respective locales. Incident management personnel in Austin, TX, rated the effectiveness of this same strategy as “moderate.” Conversely, TIM personnel in Baltimore, MD, rated the effectiveness of a regional ITS architecture as “very high,” noting resulting benefits related to information and resource sharing.

The range in effectiveness may be further explained by the timeliness of regional architecture development (i.e., older architectures may not adequately reflect local conditions that have changed over time) and the level of input originally obtained from diverse TIM response agencies.

- Life-cycle cost requirements for State procurement.** Typical costs for a system over its life span may include design, development, and acquisition costs; operating and maintenance costs; and disposal costs. Design, development, acquisition, and disposal costs are generally deterministic, but operating and maintenance costs can vary significantly based on the complexity of the system and the random nature of system failures. Consequently, agencies may be surprised by the magnitude of operating and maintenance costs associated with technology deployment and be ill prepared to cover these costs without sacrificing some other aspect of service. By requiring life-cycle costing as part of the State procurement process, agencies can better anticipate and plan for comprehensive technology costs at the time of procurement.

Incident management personnel in Redding, CA, and Chattanooga, TN, consistently rated life-cycle costing requirements for State procurement as “low” in effectively enhancing the use of technology. This low rating may suggest a sufficient level of technology deployment experience by TIM program administrators to successfully anticipate life-cycle costs without State procurement requirements. It may also suggest a lack of confidence in life-cycle cost estimates, particularly related to the operation and maintenance of technology-based systems.

## Performance Measurement

Table 23 identifies the various tools and strategies that were infrequently or inconsistently observed to be effective in overcoming challenges related to performance measurement and identifies select locations where these tools and strategies are in use. Whenever possible, the example locations reflect locales where the various tools and strategies have proven to be both effective and ineffective to support additional information gathering regarding factors contributing to a particular tool or strategy’s performance.

Table 23. Performance measurement challenges, strategies, and select implementation locations.

PERFORMANCE MEASUREMENT STRATEGIES	Inconsistent Definitions	Lack of Consensus/ Data	Limited Data Sharing/ Accessibility	EXAMPLE APPLICATIONS
State Traffic Records Coordinating Committee Partnerships		●		Ineffective: CA (Bishop)
Dedicated TIM Database		●		Effective: OH (Cincinnati); Ineffective: NJ/PA (Delaware Valley Region), NY (New York)



Additional descriptive information regarding the various tools and strategies and select locations where these tools and strategies are in use is provided below.

- State traffic records coordinating committee partnerships.** At the State level, traffic records coordinating committees represent multiple agencies involved in traffic records initiation, storage, transmission, and dissemination with the intent of improving the accessibility, timeliness, accuracy, and completeness of statewide traffic-related information. These committees strive to maximize utilization and functionality; improve data accuracy, timeliness, and linkages; advance electronic data collection; protect privacy; and minimize redundancies in related systems, allowing agencies to better accomplish individual goals.

TIM personnel in Bishop, CA, reported utilizing partnerships with State traffic records coordinating committees but rated their effectiveness in reaching consensus and supporting TIM performance measurement as “low.”

- Dedicated TIM database.** As an alternative to integrating distinct agency databases with companion data exchange protocol, a dedicated database may be specifically developed to accommodate TIM performance measurement needs. Such a database should support monitoring of multi-agency TIM goals and objectives, be accessible to all key TIM agencies, and not be burdensome with other single-agency data collection and reporting duties.

Of the participants in this investigation, TIM personnel in the Delaware Valley region in New Jersey and Pennsylvania and New York, NY, rated the effectiveness of a dedicated TIM database in reaching consensus and supporting TIM performance measurement as “low.” Personnel in New York, NY, noted, however, that such a database exists only in select State regions. Conversely, TIM personnel in Cincinnati, OH, rated this same strategy as “high.”

## Program Resources and Funding

Table 24 identifies the various tools and strategies that were infrequently or inconsistently observed to be effective in overcoming challenges related to program resources and funding and identifies select locations where these tools and strategies are in use. Whenever possible, the example locations reflect locales where the various tools and strategies have proven to be both effective and ineffective to support additional information gathering regarding factors contributing to a particular tool or strategy’s performance.

Table 24. Program resources and funding challenges, strategies, and select implementation locations.

PROGRAM RESOURCES AND FUNDING STRATEGIES	Limited Resources/ Funding	Inadequate Outreach to Executives	EXAMPLE APPLICATIONS
Cost Recovery Mechanisms/Databases	●		Effective: CA (Stockton, Windsor), MD (Baltimore), UT (Salt Lake City), WA; Ineffective: CA (Redding), NJ/PA (Delaware Valley Region)
TIM Requirements in New Construction Contracts	●		Ineffective: CA (Redding), MD (Baltimore)

Additional descriptive information regarding the various tools and strategies and select locations where these tools and strategies are in use is provided below.

- **Cost recovery mechanisms/databases.** States commonly collect and maintain various TIM data to provide historical operational performance information (i.e., changes in response or clearance times), ensure ongoing operational improvement, and justify program continuance. Select States, such as Washington, collect and maintain data with a broader focus: to allow departments of transportation to recover more of the costs of the incident response effort from the insurance companies of the parties at fault, and to improve agency budget and planning forecasts.

Of the participants in this investigation, TIM personnel in Stockton, CA, Windsor, CA, Baltimore, MD, and Salt Lake City, UT, rated cost recovery mechanisms/databases as “moderate” to “high” in effectively enhancing limited program resources and funding. Comparatively, TIM personnel in Redding, CA, and the Delaware Valley region in New Jersey and Pennsylvania rated the effectiveness of this same strategy in enhancing limited program resources and funding as “very low.”

The range of reported effectiveness may be explained, in part, by differences in the nature and extent of cost recovery and the level of effort required to maintain such a recovery system.

- **TIM requirements in new construction contracts.** Major construction events present an opportunity for securing additional program resources and funding to support TIM efforts. A portion of construction project funding may be required to be set aside for traffic management operations, such as TIM in construction zones, which may continue even after a project has been completed. Eligible traffic management activities may include traffic signal control, freeway surveillance, DMS, HAR, and temporary service patrols.

Of the participants in this investigation, TIM personnel in Redding, CA, and Baltimore, MD, rated this strategy as “very low” to “low” in effectively enhancing limited program resources and funding. Incident management personnel in Baltimore, MD, noted an infrequency of use, contributing to its low reported effectiveness ratings.

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