INFORMATION SHARING FOR TRAFFIC INCIDENT MANAGEMENT

U.S. Department of Transportation
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ESCUE

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16. Abstract

Traffic incident management focuses on developing procedures, implementing policies, and deploying technologies to more quickly identify incidents, improve response times, and more effectively and efficiently manage the incident scene. Because so many entities are involved in response efforts, rapid and effective traffic incident management relies on successful information sharing between public safety agencies, transportation agencies, and other public and private sector incident responders. This document identifies and summarizes the information needs of public and private incident responders. It describes how information is obtained and shared during an event in order to best support safe, quick response. Additionally this document addresses technical and institutional barriers to information exchange as well as methods devised to overcome these barriers. This report presents key research showcasing the advantages of data sharing between multiple agencies. It identifies and summarizes the information needs of various incident response agencies, describing the means to obtain and share information during an event. Case study information is also presented to illustrate various means of information sharing. Collection and distribution of information is addressed in the context of the incident timeline. Selected best practices for information sharing are presented. Various information sharing barriers are presented as well as some strategies to overcome them.

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U.S. Department
of Transportation
Federal Highway Administration

1200 New Jersey Avenue, SE.
Washington, DC 20590

October 31, 2008

Dear Transportation Professionals and Traffic Incident Management (TIM) Partners:

As part of the mission of the Federal Highway Administration (FHWA) to "***Keep America Moving,***" we need to safeguard the motoring public and those responding to traffic incidents. Safe, quick clearance of highway incidents—a foundation of both mature and developing TIM programs—depends on strong, coordinated multi-agency operations that are supported by integrated communications.

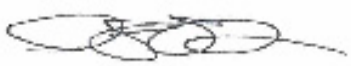
With more vehicles on the Nation's highways, traffic incidents become increasingly life threatening for those involved, including responders dispatched to help. According to the National Traffic Incident Management Coalition (NTIMC), "struck-by" secondary incidents are on the rise. In conjunction with the NTIMC partner organizations in the public safety and transportation arenas, FHWA promotes policies that enhance responder safety (such as driver removal and move-over laws); encourages the use of new technologies and gear to protect responders during roadside operations; and promotes improved safety procedures and safety training of traffic incident responders. In the coming year, FHWA will be launching a new campaign, similar to the highly successful "***Click It or Ticket***" campaign, to increase driver awareness of their roles and duties in safely addressing traffic incidents or public safety responses on the roads.

As a part of this campaign and in support of TIM practitioners, FHWA is pleased to introduce a new set of primers, collectively known as the "***Safe, Quick Clearance Primer Series.***" This series includes five primers that address various issues associated with roadside clearance operations and provide basic building blocks:

- ***Information Sharing for Traffic Incident Management***
- ***Traffic Incident Management in Construction and Maintenance Work Zones***
- ***Traffic Incident Management in Hazardous Materials Spills in Incident Clearance***
- ***Traffic Incident Management Resource Management***, and
- ***Traffic Control Concepts for Incident Clearance***

We encourage comments and contributions to these primers and other FHWA Traffic Incident Management documents. Please feel free to contact our Emergency Transportation Operations Team at ETO@dot.gov with suggestions for future revisions.

Sincerely,



Jeffrey A. Lindley
Associate Administrator for Operations

MOVING THE
AMERICAN
ECONOMY


FIRE-RESCUE

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1.0 INTRODUCTION

Traffic incident management is defined as the "systematic, planned, and coordinated use of human, institutional, mechanical, and technical resources to reduce the duration and impact of incidents, and improve the safety of motorists, crash victims, and incident responders" (*Traffic Incident Management Handbook*, 2000).[1] Traffic incident management focuses on developing procedures, implementing policies, and deploying technologies to more quickly identify incidents, improve response times, and more effectively and efficiently manage the incident scene. With many and varied parties involved in response efforts, rapid and effective traffic incident management relies on successful information sharing between public safety agencies, transportation agencies, and other public and private sector incident responders.

Information sharing is critical for quick and appropriate response because the efforts have direct correlations to public safety and mobility. Information sharing allows multiple agencies to identify needed resources and provide coordinated traffic incident management; it also provides the motoring public with information upon which to base their travel choices.

Purpose of This Document

The purpose of this document is to identify and summarize information needs of public and private incident responders. It describes how information is obtained and shared during an event in order to best support safe, quick response and safe passage for the motoring public. Additionally this document addresses technical and institutional barriers to information exchange as well as methods devised to overcome these barriers. This report will build upon key research and efforts to show the advantages of data sharing between multiple agencies. This document will also highlight information sharing frameworks of response partnerships that successfully manage traffic incidents.

Target Audience

This document is targeted toward three distinct audiences that require information to effectively and efficiently carry out their duties as they respond to an incident. These include:

- *First Responders* – These would include individuals from state and local law enforcement agencies, emergency dispatch centers, fire-recue and emergency medical service departments, and other public service personnel who typically address the immediate incident scene. Their primary duty is to secure the incident scene and look after the needs of the motorists involved in the incident. However, they also work with operations personnel to implement and execute traffic incident management responses.
- *Operations Personnel* – These would include individuals that are typically associated with state and local transportation agencies whose response priorities focus on restoration of normal traffic flow. They work both on scene to support incident response and traffic control as well as in traffic management centers to coordinate the overall incident response. This group

also includes private sector partners, such as towing and hazardous material contractors, that provide emergency services to support clean-up and recovery efforts so a scene can be cleared and traffic delays minimized.

- *Secondary Responders and Additional Stakeholders ("Secondary Responders")* – These would include individuals that take over traffic control set-up responsibilities from first responders and operations personnel as well as individuals from insurance divisions, coroners' and medical examiners' offices, the media, and other entities that have varied participation in a response effort. They are not generally first on scene, and secondary responders provide support functions to assist in the incident response. Their typical focus is traffic control and management as well as support to the incident scene that impacts incident duration, motorist response, and emergency manager actions.

Structure of this Guidebook

This guidebook is one in an Information Series on Traffic Incident Management Safe, Quick Clearance. This guidebook focuses on Information Sharing for Traffic Incident Management. Other guidebooks available in this information series deal with the following topics:

- Traffic Control Concepts for Incident Clearance;
- Hazardous Materials Spills in Incident Clearance;
- Traffic Incident Management in Construction and Maintenance Work Zones; and
- Traffic Incident Management Resource Management.

This document identifies and summarizes the information needs of various incident response entities. It describes the means to obtain and share information during an event and some of the challenges associated with information sharing among multiple agencies. Chapter 2 discusses the various means through which incident responders share information and summarizes case study information from the primary source document that supports these methods of information sharing. Chapter 3 discusses how incident response agencies collect and distribute information in the context of the incident timeline; it also highlights best practices for information sharing followed by various incident response agencies. Chapter 4 discusses various information sharing barriers as well as some strategies to overcome them. Chapter 5 contains references and other suggested readings that were used to develop this guidebook.

2.0 INFORMATION EXCHANGE BY PUBLIC AND PRIVATE RESPONDERS

Generally defined, a highway incident is a period of impact due to a vehicle crash, breakdown, or special traffic event in which normally flowing traffic is interrupted. The incident can vary in severity from a breakdown on the shoulder, to roadway blockage from a multi-vehicle crash, to a regional evacuation from a natural or man-made disaster. The scale of the incident influences the scope of the response in terms of agencies involved and resources needed to manage the incident.

This non-recurring congestion results in a reduction in roadway capacity or an abnormal increase in traffic demand. Normal operations of the transportation system are disrupted. Incidents are a major source of roadway congestion, contributing to millions of hours of delay and productive hours wasted as well as causing a direct negative effect on roadway safety and operations.

Incidents are classified in the *Manual on Uniform Traffic Control Devices* [2] based upon duration, each with unique traffic control characteristics and needs:

- *Major* – typically traffic incidents involving hazardous materials, fatal traffic crashes involving numerous vehicles, and other natural or man-made disasters. These traffic incidents typically involve closing all or part of a roadway facility for a period exceeding 2 hours. Traffic control is implemented.
- *Intermediate* – typically affect travel lanes for a time period of 30 minutes to 2 hours, and usually require traffic control on the scene to divert road users past the blockage. Full roadway closures might be needed for short periods during traffic incident clearance to allow traffic incident responders to accomplish their tasks. Traffic control is implemented.
- *Minor* –disabled vehicles and minor crashes that result in lane closures of less than 30 minutes. On-scene responders are typically law enforcement and towing companies, and occasionally highway agency service patrol vehicles. Diversion of traffic into other lanes is often not needed or is needed only briefly. It is not generally possible or practical to set up a lane closure with traffic control devices for a minor traffic incident.

Incident response activities are interdependent, and responders must, therefore, effectively exchange information in order to have the most effective, rapid, and appropriate response to a highway incident. Responders must agree to basic task definitions, lines of authority, organizational issues, and assignments of responsibility. Information must be shared across a variety of boundaries, including technological, organizational, and institutional. While technology can overcome various interoperability issues, successful information sharing begins first with stakeholders' commitment to cooperative partnerships to address organizational and institutional barriers. Overcoming these barriers permits coordinated and integrated response to incidents, and those agencies that work together effectively have

found ways to address the challenges presented by these barriers. The primary reference for this section is the National Cooperative Highway Research Program (NCHRP) Report 520, *Sharing Information between Public Safety and Transportation Agencies for Traffic Incident Management* (2004).[3]This report identifies four broad categories for information exchange:

- Face-to-face
- Remote voice
- Electronic text
- Other media and advanced systems

This section will first introduce some traffic incident management concepts with respect to coordination and communications between response agencies. This will be followed by brief descriptions of the four areas of information sharing practices relative to the three categories of this document's target audience. Successful programs typically use several practices within an environment that support and encourage information exchange.

Traffic Incident Management Concepts

Traffic incident management is the planned, coordinated effort between multiple agencies to deal with incidents and restore normal traffic flow as safely and quickly as possible. This effort makes use of technology, processes, and procedures to reduce incident duration and impact to:

- Reduce incident detection, verification, response, and clearance times to quickly re-establish normal capacity and conditions
- Enhance safety for motorists and field/safety personnel
- Reduce the number of secondary crashes that occur as a result of the primary incident
- Reduce motorist costs, vehicle emissions, and business costs
- Allow resources to resume non-incident activities

The Incident Command System and Unified Command

Incident Command System

Incident responders, particularly law enforcement and fire-rescue personnel, use the federally adopted Incident Command System (ICS), for all types of incident management. ICS was originally developed in the 1970s as an approach for managing responses to rapidly moving wildfires. In the 1980s, federal officials transitioned ICS into the National Incident Management System (NIMS), the basis of response for highway and other incidents. ICS is a standardized, on scene traffic incident management concept that allows responders to adopt an integrated organizational structure without being hindered by jurisdictional boundaries.

ICS includes five major functional areas shown in Figure 1: command, operations, planning, logistics, and finance and administration. These major areas are further broken down into specialized subunits. The area of Intelligence may be included if required.

Command – overall authority associated with the incident, responsible for determining size and magnitude of response and involved personnel

Operations – activities necessary to provide safety, incident stability, property conservation, and restoration of normal highway operations

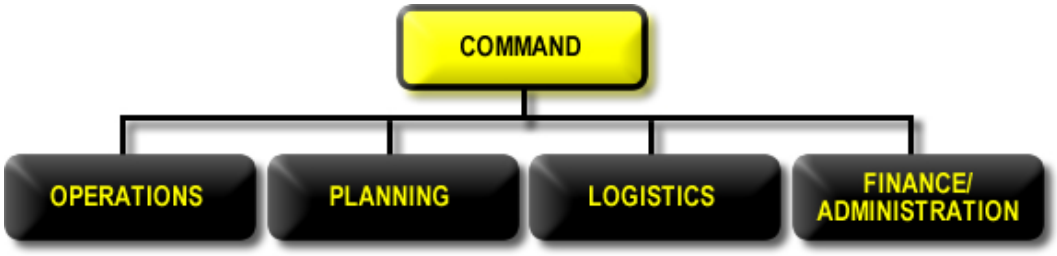
Planning – activities associated with maintaining resource/situation status, development of incident action plans, and providing technical expertise/support to field personnel.

Logistics – services and support for incident response effort in the form of personnel, facilities, and materials.

Financial and Administration – tracking of incident costs/accounts for reimbursement.

Intelligence – analysis and sharing of information and intelligence during the incident.

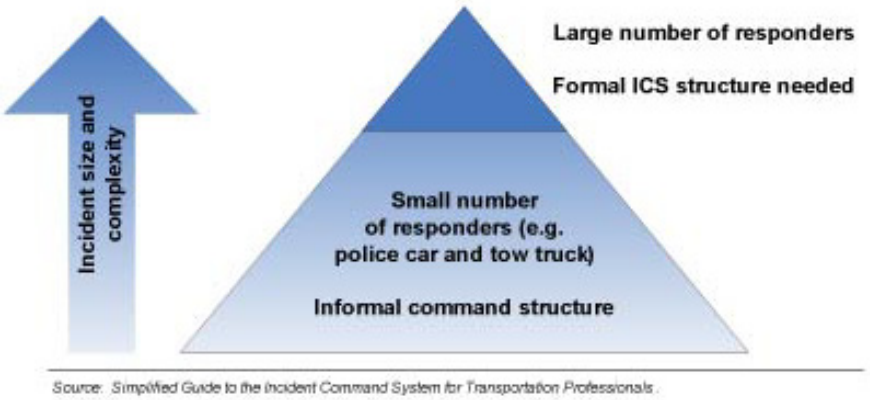
Figure 1. Incident Command Functional Areas [4]



ICS outlines roles and responsibilities for incident responders. Rather than defining who is in charge, ICS provides the management structure for who is in charge of what. ICS allows agencies to work together using common terminologies and operating procedures, leaving command personnel with a better understanding of other agencies' priorities.

ICS is scalable to the level appropriate for the incident and surrounding conditions. Responses can be transitioned from small, single agency to large, multi-agency and vice-versa with minimal adjustments for the agencies involved as shown in Figure 2. ICS provides the structure to allow flexible, agile responses that adapt to real-time field conditions.

Figure 2. Incident Command Structure Needs [5]



Source: Simplified Guide to the Incident Command System for Transportation Professionals.

Unified Command

Unified command (UC) defines the application of ICS when there is more than one agency with incident jurisdiction or when an incident crosses multiple jurisdictions. UC provides a management structure that allows agencies with incident responsibilities to jointly work within an established set of common objectives and strategies that include:

- Agency assignments
- Incident priorities
- Assignment of agency objectives
- Communications protocols
- Knowledge of duties within agency responsibilities
- Acquisition and allocation of materials and resources

When applied effectively, UC facilitates interagency communications and cooperation, leading to efficiencies in response. UC allows all agencies with jurisdictional authority to provide managerial direction at an incident scene while maintaining a common set of objectives and strategies. Command staff report directly to the Incident Commander. The identity of the Incident Commander is dependent on the priority mission at the time. Until the injured are treated and moved, fire-rescue or emergency medical services (EMS) will probably be in charge. When the priorities shift to investigation, law enforcement will take over. As the incident moves into clean-up/recovery, command can shift to the transportation agency or towing contractor. Personnel participate actively until they no longer have a role at the incident. During this process, other agencies have the opportunity to participate in decision making and provide direction to their own personnel; however, overall charge resides in the Incident Commander. A key component of success is the ability to communicate between the varied entities with roles to play in the response effort. Another key factor is the strength of interpersonal relationships, often built in other settings, that allows responders to communicate clearly and effectively with each other during the management of an incident. Some key advantages of UC, as listed in the United States (U.S.) Department of Homeland Security's *National Incident Management System Manual,*[4] are:

Figure 3. Advantages of Using Unified Command [4]

- A single set of objectives is developed for the entire incident A collective approach is used to develop strategies to achieve incident objectives
- Information flow and coordination is improved between all jurisdictions and agencies involved in the incident
- All agencies with responsibility for the incident have an understanding of joint priorities and restrictions
- No agency's legal authorities will be compromised or neglected
- The combined efforts of all agencies are optimized as they perform their respective assignments under a single Incident Action Plan

Information Sharing Practices [3,6,7]

Face-to-Face

Face-to-face communications between incident responders are the most common form of information exchange. Personal exchanges are most effective when responders are able to communicate openly and directly share information and coordinate responses. These exchanges occur both at an incident scene and within shared facilities; and they include both communications during an incident and various planning or debriefing teams that meet outside the course of an incident.

On Scene

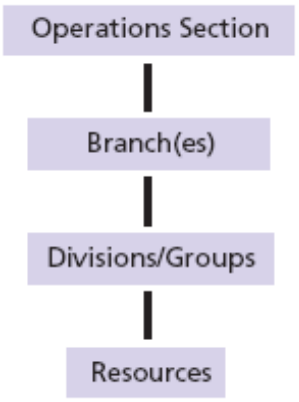
Law enforcement and fire-rescue incident responders are familiar with, and frequently use, the ICS. Responders from transportation agencies are beginning to incorporate ICS applications in their actions both on scene and at traffic management centers.

Most highway incidents involve law enforcement, transportation personnel, and a private tow truck and, therefore, usually do not require formal implementation of ICS. However, when a large-scale, complex incident requires a multiple-agency response, these personnel must understand how ICS defines;

- Operational task responsibilities,
- Chains of command, and
- Scene management practices

Incident responders located on scene work within the operations functional area of ICS. One person directs all incident-related operational activities and reports back to the Incident Commander. Depending on the complexity of the incident, subunits within this structure establish tactical objectives for each phase of response. Resources refer to the personnel and equipment needed to manage the response. The major organizational elements for the operations area are shown in Figure 4.

Figure 4. Organizational Elements [4]



More incident responders are beginning to be trained in ICS and UC in which multiple agencies respond to a single incident. As stated in the *Traffic Incident Management Handbook*, [1] UC facilitates cooperation and participation between multiple agencies/jurisdictions through the following functions:

- Provide overall response direction
- Coordinate effective communication
- Coordinate resource allocation
- Establish incident priorities
- Develop incident objectives
- Develop strategies to achieve objectives
- Assign objectives within the response structure
- Review and approve incident action plans
- Insure the integration of response organizations into the UC structure
- Establish protocols

Following UC principles permits agencies to more cooperatively work together to achieve common objectives. The required teamwork and communications helps to avoid duplication of tasks and activities.

For example, the first responder on scene is responsible to assess the incident, secure the scene, provide emergency care, and call for additional response resources. As response activities occur, incident command shifts as the priority mission changes:

- Emergency response to treat and transport victims and establish scene safety
- Investigate incident
- Clean up/restore/repair incident scene

Effective communications between agencies is critical for successful management of the incident and resumption of normal traffic flow.

Shared Facilities

Shared facilities encompass a variety of locations in which multiple agencies operate jointly, both during the course of an incident and in settings that include debriefing and planning sessions. Traffic operations/management centers (TOC/TMC) can house transportation, public safety, and other personnel who are able to share both communications and information systems, allowing the facility to become a focal point for sharing incident status information in the region. Examples of other shared facilities include 911/dispatch centers and mobile command posts. Co-location of personnel, often initiated through an inter-agency Memoranda of Understanding/Agreement (MOU/MOA), allows partners to work side-by-side within the facility, strengthening relationships between responders as a result of the interpersonal contact. Such facilities evolve to become the focal point of information sharing in a region, beginning with information exchange through face-to-face communications and shared system access.

Planning/Debriefing Sessions

Another important means of information exchange is via incident-related, non-emergency meetings between responders. Such meetings are often held by multi-disciplinary traffic incident management (TIM) teams and task forces that debrief major incidents in order to find ways to improve TIM response. Recommendations from TIM teams range from immediate response improvements to longer term strategic suggestions that may require time, resources, and other commitments for implementation. Regular TIM team meetings provide a neutral environment to effectively discuss lessons learned as well as resolve issues that may have arisen during the management of an incident. Debriefing steps should include:

- Incident re-creation
- Agency input for aspects that worked well and those that did not
- Discussion of potential improvements
- Development of consensus for future events
- Documentation of findings and update of response plans, if appropriate

Remote Voice

The most common ways incident responders share information between the incident scene, operations centers, and public safety facilities using voice communications are:

- Land line telephones
- Wireless telephones
- Land mobile radios

These remote voice tools are often used in combination by all of those involved in the incident and response:

- A disabled or passing motorist dials 911 or a non-emergency assistance number via cellular telephone to notify public safety personnel about an incident
- First responders relay information about the incident via their land mobile radio network

- Response agencies speak to each other via the wired telephone network to coordinate their responses

With voice communications to transmit information to and from the incident scene, responders can quickly adjust to changing conditions. Responders must use clear-text transmissions, mandated by NIMS-ICS guidelines, [4] to prevent misunderstandings of their transmissions. Remote voice information exchange also facilitates the adjustment of response resources and provides an easily used pipeline of information to information dissemination services for the motoring public.

Land-line Telephones

Wired telephones are sometimes the only means available to share information between separately housed response entities. Wired telephones include voice and facsimile transmissions. They are critical for public safety communications, including 911 calls, and some portions of the cellular network make use of the land-line telephone network.

Wireless Telephones

Cellular phones, and less commonly used satellite telephones, are used between on scene and in-facility incident responders. Motorists, both those involved in an incident as well as passers-by, use cellular phones to call for assistance; however, there can be accuracy issues as unfamiliar motorists incorrectly identify incident locations. Cameras in cellular telephones have become common place and can be used to wirelessly transmit visual information; however, image transmission via wireless telephone is usually not a first action by incident responders. Cellular capabilities are improving as the network matures—both in terms of use of the network and cellular phone features (push-to-talk networks that sometimes replaces land mobile radios, text messaging, internet access, and still/video camera phones).

Land Mobile Radios

Radios can be used by incident responders to communicate directly with each other. While they are typically used within a single agency because of interoperability issues, sharing the radio frequency with other incident responders can facilitate response. For example, service patrol personnel may operate on a law enforcement radio network to communicate directly with law enforcement, both at the incident scene as well as with a dispatch center, with the result that response times may be reduced. Safeguards, including specialized training and procedures, must be put into place to overcome security concerns about sensitive information for shared communications with law enforcement agencies. One alternative is to allow civilian personnel to listen, but not talk, over the radio. Another benefit of sharing radio communications is that transportation personnel can handle minor incident response issues and communications, freeing public safety responders to handle emergency issues.

Electronic Text

Electronic text messaging is an automated way to share incident-related information quickly with large numbers of agencies and people with minimal resources. While not the primary method for inter-agency communications, electronic text messaging can be used to share information broadly and quickly. Categories of electronic text systems are:

- Alphanumeric pagers
- Email
- Traffic incident-related systems, including computer aided dispatch (CAD)

Pagers can be used to transmit abbreviated messages to incident responders; email text can be more detailed. Both are quick means to broadcast information to predefined response groups. Additionally, pages and email blasts can be sent to the public as a subscription service, sometimes in conjunction with 511 traveler information services, so motorists can be advised of traffic conditions. If necessary, they can avoid becoming part of the incident queue through route diversions and adjustments, reducing the overall incident's impact and duration.

CAD sharing by law enforcement is becoming more common. Because the information entered into CAD is sensitive, non-law enforcement personnel must undergo certain precautions (background checks, training, etc.) to satisfy security requirements. Read-only, sometimes filtered, access allows other responders to call for and adjust response resources more effectively. For example, transportation personnel can monitor CAD systems to track incident progress and adjust their own response efforts. CAD systems also become a valuable record keeping tool when debriefing or analyzing an incident's response for areas of improvement. Interoperability issues can impact information exchange using CAD, since many CAD systems are proprietary and, therefore, pose technological challenges to sharing information. Integration can occur; however, institutional and technological barriers must be overcome to do so effectively.

Other Media and Advanced Systems

Other integrated technologies can be used to share incident-related information between transportation and public safety agencies. Advanced traffic management systems (ATMS) normally include surveillance and communications technologies. They also address the needs of two different audiences: response personnel from the public and private sectors, and the motoring public trying to navigate around an incident.

Intelligent transportation systems (ITS) field devices for incident detection and verification include in-ground and mounted sensors and closed-circuit television (CCTV) cameras. Visual verification allows increased accuracy of response because agencies can see what resources are needed for incident response and repair and, therefore, dispatch them more quickly and accurately. Images and detection data can be readily shared with co-located agencies or remotely if integration needs have been addressed. Visual imagery allows response agencies to adjust their response, manage traffic, and disseminate information.

Information dissemination occurs through the use of electronic message signs (both portable and fixed), highway advisory radios, and telephone- and web-based 511 traveler information services. Information shared in this manner can be received by motorists, who can then evaluate roadway conditions, and decide if and how to adjust their travels during the course of an incident. This same information is useful to response agencies that need to travel on the roadway network quickly and efficiently, helping them reduce their own response times. Real-time information regarding roadway conditions, congestion, and scene details helps responders arrive, respond, and leave an incident scene more quickly.

ITS media allow more accurate, timely, and reliable information sharing through an important technological set of tools that can be used by multiple responders to support traffic incident management response efforts. However, because ITS applications can have greater communications bandwidth requirements than remote voice or electronic text methods, especially when video is involved, the quality of the information shared may be impacted. For example, video may need to be reconfigured to snapshot or streamed images over the

internet. Dynamic map displays, part of a traveler information system, may not provide the level of detail desired for the roadway network because of the time needed to load and refresh the information. These issues must be addressed during the developmental stage so that the varying audiences can obtain the correct information and appropriate level of detail for effective actions and decision making.

Information Sharing Case Studies

Examples of successful information sharing between incident responders are numerous; some key examples are highlighted below.

NCHRP Report 520 Case Studies

NCHRP Report 520, *Sharing Information between Public Safety and Transportation Agencies for Traffic Incident Management* (2004)[3] reviews the effectiveness of information sharing for the following nine locations with active traffic incident management programs that involve public safety, transportation, and other public and private sector entities. Key stakeholders are transportation departments and local/state law enforcement agencies. Whether or not these agencies are physically co-located at the common facility, the sites provide varying examples and levels of success with the information sharing practices previously described in this section for the purposes of incident detection and notification, response, and site management.

- *Albany* – close working relationships between two transportation agencies (New York Department of Transportation (DOT) and New York State Thruway Authority) two law enforcement divisions (New York State Police and Albany Police Department); regional coordination and various information-sharing applications in place for a long time period.
- *Austin* – Texas DOT, Austin Police Department, Austin Fire Department, and Travis County EMS are co-located in a TMC facility that serves as a focal point for information exchange through cooperatively developed technologies. The agencies have shared radio and video systems, and they have also integrated the CAD and traffic management systems.
- *Cincinnati* – Ohio and Kentucky transportation agencies have joined to regularly and routinely share traffic information through the Advanced Regional Traffic Interactive Management Information System (ARTIMIS). Strong regional TIM teams convene at the center to handle major incidents with involvement by relevant public safety and transportation partners in the region. This mature interagency operation includes a partnership with CVS Pharmacies to provide roadway service patrols.
- *Minneapolis* – Minnesota DOT and Minnesota State Police operate in a co-located TMC facility with a shared radio communications system (800 MHz) that includes workstations for media, and transportation and law enforcement. Additional joint communications centers throughout the state are also in place.
- *Phoenix* – Arizona DOT, Maricopa County DOT, and Phoenix Fire Department share radio systems, phone lines, traveler information workstations, facsimile and pagers, and CCTV images in their efforts to overcome institutional barriers to information sharing.

- *Salt Lake City* – strong inter-agency relationships between Utah DOT and Utah Highway Patrol leveraged upgrades resulting from the 2000 Winter Olympics to enhance information sharing both in the operations facility and on scene. Technical challenges were overcome by incorporating the same radio communications and CAD systems. Agencies share video images as well.
- *San Antonio* – strong institutional framework and joint activities of key transportation and public safety agencies have led to highly integrated communications and information sharing. Representatives include Metropolitan Transit Authority, San Antonio Public Works Department, Alamo Dome, San Antonio Police Department, Bexar County Sheriff Department, EMS, county health departments, and private sector towing and recovery providers. Texas DOT (TxDOT) and the San Antonio Police Department work together in the TransGuide Operations Center, a central point for incident and emergency response.
- *San Diego* – CalTrans and the California Highway Patrol have undertaken a CAD interface project to bridge communications between transportation and public safety agencies; while the project itself was only partially successful, the technical and institutional barriers identified have laid the foundation for a similar future project that will build upon the agencies' commitment to share information.
- *Seattle* – Washington DOT (WSDOT), Washington State Police (WSP), and the Washington State Legislature share a common focus that has led to coordinated traffic incident management and strong information sharing practices in the Seattle region. Together WSDOT and WSP have developed and implemented advanced technologies for inter-jurisdictional and inter-disciplinary communications.

NCHRP Report 520 results for the categories of information sharing described in this section are presented in Table 1, taken directly from the report. Further detailed research can be found in the report.

Table 1. Methods of Sharing TIM Between Transportation and Public Safety Agencies at Survey Locations. [3]

Geographical Region	Face-to-Face	Remote Voice	Electronic Text	Other Media and Advanced Systems
Albany, NY	State Police co-located with State DOT at one center; State Police co-located with Thruway Authority at another center.	State DOT Service Patrols share public safety radios; State Police and Thruway share a radio system and dispatchers; Senior staff use commercial wireless service "talk groups."	Joint CAD system shared at Thruway center.	ATMS data, images, and video shared remotely through experimental wireless broadband service.
Austin, TX	State DOT, city fire and police depts., and county EMS will be co-located at center.	Service Patrols equipped with local police radios.	Capability under development to share traffic incident data from public safety CAD data remotely.	Control of transportation CCTVs shared with local police.

Geographical Region	Face-to-Face	Remote Voice	Electronic Text	Other Media and Advanced Systems
Cincinnati, OH	Transportation center hosts regional Incident Management Team operations.	ARTIMIS shares public safety radios; multiple agencies use commercial wireless service "talk groups."	Capability under development to share CAD data with ARTIMIS.	Transportation CCTV images available on traveler information website.
Minneapolis, MN	State Patrol and State DOT staff co-located at a regional center. State Patrol and service patrol staff co-located at another location.	State Patrol and State DOT share the 800MHz radio system. Senior staff use of commercial wireless service "talk groups."	Service Patrols have read-only terminals from State Patrol CAD. State DOT can access State Patrol CAD.	State DOT CCTV and other traffic management systems are shared with State Patrol.
Phoenix, AZ	—	Service Patrols equipped with State Patrol and State DOT radios.	State DOT highway condition workstations provided to local fire dept. and emergency services div. County DOT incident response teams use alphanumeric pagers.	State DOT CCTV shared with local fire dept.
Salt Lake City, UT	Highway Patrol and State DOT staff co-located at the regional center, but separated by elevated soundproof glass partition.	All Highway Patrol and State DOT field units use the same radio system and dispatchers. Service Patrols are fully integrated into law enforcement radio system.	State Patrol CAD shared with State DOT	State DOT CCTV and other traffic management systems are shared with Highway Patrol.
San Antonio, TX	Local Police and State DOT co-located at the regional center.	Service Patrols equipped with local police radios. New radio system will provide common channels for State DOT and local police and fire.	Incident data from local police CAD shared with State DOT traveler information system.	State DOT CCTV images are shared with local government and news agencies.
San Diego, CA	State Patrol and State DOT co-located at the regional center.	Service Patrols equipped with local police radios.	State DOT has read-only access to Highway Patrol CAD.	Incident information from Highway Patrol CAD is provided to State DOT traveler information website.
Seattle, WA	—	Service Patrols equipped with State Patrol radios. Intercom system (with handsets) is used between State DOT center and State Patrol 9-1-1 call center.	State DOT partially shares State Patrol CAD system. State DOT has CAD terminal for entering traffic incident information.	State DOT CCTV shared with State Patrol (includes control of cameras).

All locations use standard telephones and facsimile machines for information sharing.
ARTIMIS = Advanced Regional Traffic Interactive Management Information System.
ATMS = advanced traffic management system.
CAD = computer-aided dispatching.
CCTV = closed-circuit television.
DOT = department of transportation.
EMS = emergency medical services.

Additional Case Studies

Kentucky's Intelligence Fusion Center [8]

Kentucky's Intelligence Fusion Center, a unified hub that uses a remotely accessed data sharing and analysis system, coordinates and connects all levels of law enforcement and public safety agencies as well as the private sector. The center's goal is to improve intelligence sharing between responders. The public is also encouraged to report suspicious activities through a telephone hotline. While this exchange of information is done primarily in the context of enhancing domestic security and reducing criminal activity, improvements to

information sharing also enhance traffic incident management activities as some of the same organizations involved in the center deal with traffic incident management. Agencies involved in the Kentucky Intelligence Fusion Center include:

- Kentucky Office of Homeland Security
- Kentucky State Police
- Kentucky Transportation Cabinet
- Kentucky Department of Corrections
- Kentucky Department of Military Affairs
- Kentucky Vehicle Enforcement
- Federal Bureau of Investigation
- Bureau of Alcohol, Tobacco, Firearms, and Explosives
- United States Department of Homeland Security
- Lexington Division of Police

A fusion center is a unified information hub linking all types of information collected by law enforcement and public safety agencies that is necessary to combat criminal activity and domestic and international terrorism; the ultimate result of this linkage is to bring together agencies with common purpose. These same agencies are also charged with the responsibility of being the first responders for emergency and incident management. It is a natural extension of this mechanism to also serve as the basis of the necessary communication, coordination, and cooperation among these agencies charged with first response to traffic incidents. To this end, the capabilities of the Kentucky Intelligence Fusion Center, relative to information sharing for incident response, include:

- Shared database to assist federal, state, and local law enforcement agencies with information requests, reporting requirements, and /or performance measures
- Receipt of law enforcement field reports from in-car mobile data computers
- Radio communications dispatching for state police
- AMBER Alert notification
- Connection to multiple intelligence and information sharing networks
- Traffic and TIM center monitoring of highway construction, maintenance, weather, and other events
- Monitoring and updating of the Kentucky 511 traveler information system
- Monitoring of regional traffic center Web sites in Louisville, Lexington, and the Northern Kentucky-Cincinnati area

FDOT District Five and Florida Highway Patrol [9]

FDOT's District Five Road Ranger Service Patrol is currently operating on the State Law Enforcement Radio System (SLERS). This pilot project is in the Orlando metropolitan area where the Florida Department of Transportation (FDOT) TMC is co-located with the Florida Highway Patrol (FHP) Communications Center. The radio system allows Road Rangers to

communicate directly with FHP Troopers at incident scenes and also with FHP dispatchers. Response times have been reduced as incidents are identified more quickly by multiple responding entities, either by having a Road Ranger come upon a disabled vehicle and making the first call into the dispatch center, or by having a Road Ranger hear the dispatch call over the radio.

These varied locations have demonstrated that no single approach to information sharing is best. Local factors and organizational issues must be identified and addressed to achieve effective interagency communications practices that are influenced by interoperability issues and interpersonal relationships.

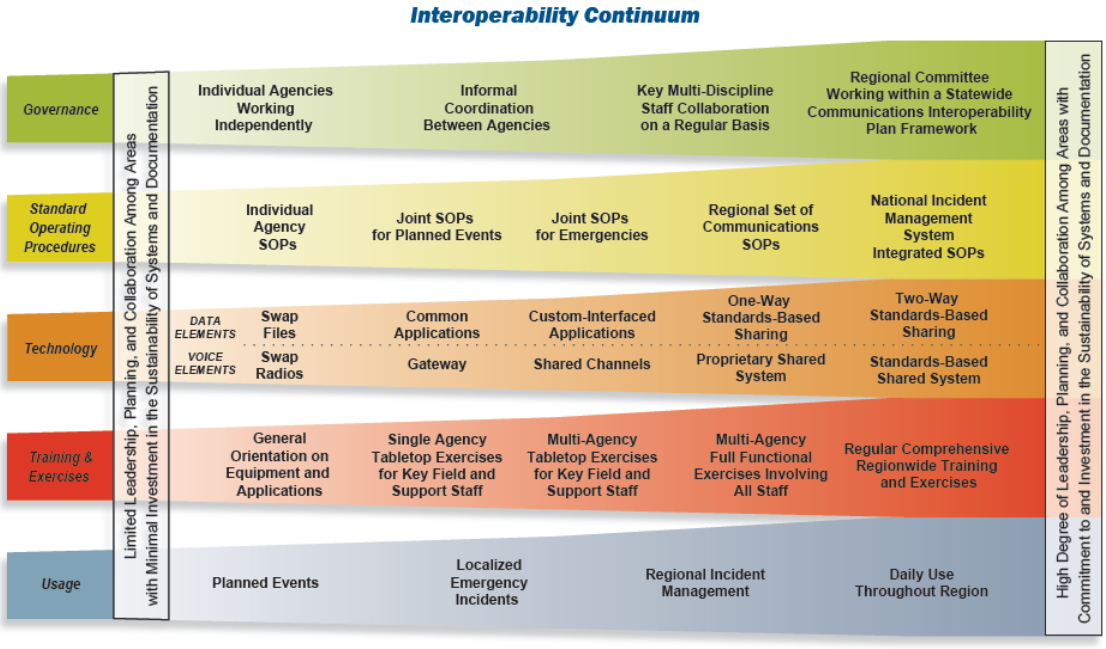
SAFECOM[10, 11]

The lack of interoperability between emergency responders—the ability for agencies to exchange voice or data with one another via radio communication systems—has been a long-standing, complex, and costly problem that has affected their responses to incidents and emergencies. In addition to incompatible communications equipment, responders also have to deal with funding issues, insufficient planning and coordination, a limited radio spectrum, and limited equipment standards. Wireless devices can provide some relief, but the cellular network is quickly overwhelmed during an incident or emergency and then becomes unreliable and unavailable. This issue was highlighted during the tragic events of September 11, 2001. As a result, the SAFECOM program was established as a communications program within the Department of Homeland Security's Office for Interoperability and Compatibility. SAFECOM "provides research, development, testing and evaluation, guidance, tools, and templates on communications-related issues to local, tribal, state, and Federal emergency response agencies working to improve emergency response through more effective and efficient interoperable wireless communications."[10]

SAFECOM is a practitioner-driver program; i.e., local and state emergency responder input and guidance are heavily relied-upon in the pursuit of solutions to interoperability issues. Based upon the results of a pilot initiative in ten urban areas completed in 2004, five factors critical to the success of interoperability were identified in an "Interoperability Continuum" or guiding principles as follows and shown in Figure 5:

- Governance
- Standard operating procedures
- Technology
- Training and exercises
- Usage

Figure 5. SAFECOM Interoperability Continuum [12]



Public safety communications requirements for voice and data interoperability were first released in 2004. These requirements serve as a first step for establishing base-level communications and interoperability standards for emergency response agencies, a process that is expected to take up to 20 years to achieve. In the interim, SAFECOM has[11]:

- Created the Federal Interagency Coordination Council (FICC) to coordinate funding, technical assistance, standards development, and regulations affecting communications and interoperability across the federal government;
- Published a Statement of Requirements which, for the first time, defines what it will take to achieve full interoperability and provides industry requirements against which to map their product capabilities;
- Issued a request for proposals for the development of a national interoperability baseline;
- Initiated an effort to accelerate the development of critical standards for interoperability;
- Created a Grant Guidance document that has been used by the Federal Emergency Management Agency, Community Oriented Policing Services, and Office of Domestic Preparedness state block grant program to promote interoperability improvement efforts.
- Established a task force with the Federal Communications Commission to consider spectrum and regulatory issues that can strengthen emergency response interoperability;
- Created a model methodology for developing statewide communications plans;

- Released a Request for Information to industry that netted more than 150 responses; and
- Worked with the emergency response community (local, tribal, state, and federal) to develop a governance document that defines both how SAFECOM will operate and how participating agencies will work within that framework.

3.0 INFORMATION COLLECTION AND DISTRIBUTION PRACTICES THAT MAXIMIZE SAFETY AND FACILITATE QUICK CLEARANCE

Information is vital to providing an effective incident response. With better information collection, incident response is improved by ensuring that the proper equipment and resources are available to the responders at the time when it is needed on scene. Better information dissemination allows travelers to make better decisions regarding departure time, mode choice, and route to take.

Improved coordination and communications between incident responders helps reduce incident impacts. The means and effectiveness through which response agencies collect and distribute incident information affects the duration of the incident, discussed below. Successful agencies use best practices that make use of:

- Integrated response
- Automation or technology
- Strong relationships
- Shared command/understanding of how scene command changes
- Understanding of roles and responsibilities of involved entities
- Ability to debrief, measure, and learn

Two sets of documents that form the basis for this section are the *Results of the U.S. DOT CAD-TMC Field Operations Team (Washington and Utah)*[13,14] and the *Traffic Incident Management Focus States Initiative on TIM Performance Measurement*.[15]

The Incident Timeline[16]

While nomenclature and details can vary from state to state, there are generally five areas recognized as part of the incident timeline. Each step has unique characteristics that allow for performance assessment in after-action reviews. When changes to administrative, operational, or technological processes are implemented, the overall duration of an incident and its impacts can be shortened. Key elements to shorten timeframes are: implementation of intelligent transportation systems (ITS), inter-agency coordination, and improvements derived from after-action reviews.

Incident Detection

The crash or incident occurs, and traffic queues begin to build from lane blockages or “rubbernecking.” The earlier responding agencies are aware of an incident, the more quickly resources can be sent to resolve the situation. Automating this process through the use of detection equipment removes the reliance of human detection, whether by law enforcement/emergency personnel notification or cell phone calls from passing motorists.

This is the first time someone in an official capacity learns of the incident and has an opportunity to follow a response plan.

Incident Verification
Once an incident is detected and a response agency (transportation management center [TMC] or law enforcement) is aware of an incident, the location, scope, and impact of the event must be verified quickly so that the appropriate resources can be sent out to the scene. Verification through closed-circuit television (CCTV) cameras or video from other sources is extremely useful because it eliminates the time needed to send a person to the scene for verification. Scene images can often be shared with multiple responding partners so that all can take appropriate action.

Incident Response
Incident response resources are called for and then arrive. They can include law enforcement, transportation agency resources, wreckers, hazardous material clean-up specialists, specialty equipment, etc. Having the personnel with appropriate resources and training arrive quickly is critical. Pre-established routes or wrong-way access to a site while following a law enforcement pilot vehicle are examples of ways response vehicles may avoid traffic queues that grow quickly after an incident occurs.

Incident Clearance
Once the area is declared safe for cleanup for responders, motorists, and other personnel on scene (there may be fire or other dangers, loads may be unsafe, etc. that must be addressed first), the incident response team can get to work. The response team must have the right equipment available so that scene clearance and temporary repair work, if needed, can begin so that the roadway can be re-opened to traffic. This time is lengthened if equipment is missing; the full complement of needed equipment must be at the incident scene. Changes to the clearance component of the incident timeline may be addressed during multi-agency sessions (traffic incident management team meetings and workshops) where traffic incident management (TIM) partners discuss and learn from previous and proposed practices. Development of agreements, execution of tabletop exercises, and discussion of after-action reviews are also extremely helpful in reducing incident clearance times. Sharing automated information, clear communication, understanding and agreeing upon roles and authority, and cooperative work efforts go a long way in addressing incident scene needs by minimizing institutional barriers and increasing collaboration. These areas are best addressed away from the incident scene so that interactions between responders are clear and all roles are understood rather than when actions are critical and pressure mounts for the roadway to re-open quickly.

Incident Recovery
When the incident is finally cleared and the roadway is re-opened, time is needed for queues to dissipate. Recovery time is the period from the re-opening of all lanes to the resumption of normal traffic flow. This time is largely dependent upon the length of the queue from the incident; an accepted estimate is that for every minute of lane closure, four minutes of recovery time is needed once lanes are re-opened. If fewer vehicles join the waiting traffic stream and possibly divert to other roadways or modes, they do not become part of the incident queue, in turn shortening the time needed to resume normal conditions. Traveler information services, partnerships with the media, and ITS information dissemination devices placed in advance of the queue help travelers make route decisions that can keep them from driving unwittingly into an incident queue for an unknown period of time. Because travelers

themselves have a part in controlling this part of the incident timeline, the information they receive must be accurate, timely, and reliable.

Information Collection

When a traffic incident occurs, it must be detected and verified before any response activities can begin; incident details are needed for effective, efficient response and management of traffic. This information can be collected by on scene personnel, ITS information detection field devices, or a combination of these elements. It must then be shared between agencies that handle various components of the response. This type of information exchange does not always occur easily; information collected may go back to a TMC or public safety/law enforcement dispatch center that is not integrated or does not allow for other forms of information exchange. No matter which means is used to collect the information; it must be shared across jurisdictions and organizations in order to realize improvements in overall safety and operations.

CAD and ATMS

CAD systems are used to track incident information with a focus on managing public safety or law enforcement responses. Many existing CAD systems are proprietary and do not easily share information with systems with different interfaces. Between themselves, CAD systems often work in independent frameworks with inconsistent standards and formats. Most major metropolitan areas in the United States (U.S.) have some type of ATMS to manage their transportation operations and incident response from some type of centralized TMC. They tend to use different data, message formats, and standards in their ATMS, further complicating integration efforts with law-enforcement CAD systems.

There is widespread agreement that these two types of information should be shared, but exactly how this is to be done is not always clear. For example, there are concerns about the type and amount of data potentially exchanged between agencies. Some CAD information is sensitive and, if inappropriately released, could compromise law enforcement activities. There are concerns about overwhelming incident response partners with too much information. However, these challenges have been successfully overcome when institutional and technical challenges were met and operational procedures amended to make best use of this newly shared information. These results are realized in two recent Field Operational Tests (FOT) performed in the states of Utah and Washington.

State of Utah

Utah's integrated CAD-TMC system was intended to include the following elements:

- Create common message sets
- Support inter-agency service requests via data specification sets (DSS)
- Select commonly used operating system and language
- Develop legacy system interfaces between state, county, and municipal government systems
- Integrate transit
- Develop event tracking to manage and update planned events

While the Utah Department of Transportation (UDOT) and Utah Highway Patrol (UHP) staffs were previously co-located, integration of the systems eliminated the need for operators of either agency to observe multiple computer terminals. The result of this inter-agency cooperation has enhanced field operations and real-time information exchange from the earliest notification of an incident through its eventual resolution. Field device information from cameras, loop detectors, and other ITS applications were available to all staffs and provided more accurate and reliable incident location data. Incidents were documented more efficiently and with better data. Staffs from different agencies were able to work together more effectively because they were receiving and responding to the same information. They were able to achieve much improved inter-agency working relationships, both during the management of an incident and during non-incident planning/debriefing sessions.

A system performance study was designed to describe the FOT environment in a way that could transfer the CAD-TMC integration concept to other locations, identify system performance measures to comparative results, identify limitations in the deployed system, and identify other factors affecting the system's performance. Key to this FOT's success is that the State of Utah had a well-established incident response program prior to the information exchange enhancements. Results of the CAD-TMC FOT from the Final Evaluation Report are given in Table 2.

Table 2. System Performance Test Results Summary[14]

Evaluation Objective	Hypothesis	Test Results
Objective #1: Document the system component performance.	The system meets functional specifications.	Achieved.
	The CAD and TMC systems will be able to link data on an incident.	Achieved.
	Using the system improved incident response procedures.	To a significant extent, achieved through prior projects. Project specific impact not measurable.
Objective #2: Automate the seamless transfer of information between traffic management workstations and police, fire, and EMS CAD systems from different vendors.	The system meets functional specifications.	Achieved.
	The FOTs will decrease the reliance on manual methods for exchanging information.	Preliminary result - achieved.
	The FOTs will increase the extent and reliability of information exchanges.	Preliminary result - achieved.
Objective #3: Extend the level of integration to include secondary responders such as utilities, towing and recovery, public works, and highway maintenance personnel.	Improved integration of secondary responders will reduce incident recovery time by getting required recovery personnel to the incident site as quickly as possible to begin recovery operations.	Secondary responders (ambulance, utilities, etc.) were not included in the project.

The CAD-TMC FOT also looks at whether or not the integration improved efficiency and productivity of incident response, reduced delays and improved mobility, enhanced incident-specific response plans, improved responder safety and reduced secondary crashes, and improved incident information for travelers. System impact test results from the CAD-TMC FOT are given in Table 3.

Table 3. System Impact Test Results Summary [14]

Evaluation Objective	Hypothesis	Test Results
Objective #1: Productivity –To determine if the CAD-TMC integration improves the efficiency and productivity of incident response.	CAD-TMC integration enhances communications among responders.	Achieved - Key issue to be addressed is that of refining information exchange to meet agency specific requirements.
	CAD-TMC integration improves efficiency of on-scene operations.	Not measured during the evaluation.
	CAD-TMC integration enhances efficiency in documenting incident management.	Achieved.
	CAD-TMC integration reduces incident clearance times.	Not measured during the evaluation.
Objective #2: Mobility - To determine if the CAD-TMC integration improves mobility and reduces delays during incidents.	CAD-TMC integration enhances mobility during incident management (IM) activities.	No impact measured during the evaluation.
Objective #3: Capacity/ Throughput -To determine if CAD-TMC integration enhanced incident-specific traffic management plans.	CAD-TMC integration enhances incident-specific traffic management plans.	Not measured during the evaluation.
Objective #4: Safety - CAD-TMC integration will reduce exposure of response personnel and secondary crashes during incident response activities.	CAD-TMC increases safety for response personnel.	Not measured during the evaluation.
	CAD-TMC increases safety to the traveling public.	Not measured during the evaluation.
Objective #5: Traveler Information - To determine if CAD-TMC integration will improve incident management information available to travelers.	CAD-TMC integration enhances customer satisfaction and mobility during incident management activities by improving traveler information.	Qualitative assessment: Improved ability to post incident information for public access via 511, Web site.
UTA Objective: To determine if the integration of the UTA CAD system improves UTA's ability to respond to incidents.	The CAD-TMC integration will enable UTA to more effectively implement reroute decisions in response to an incident.	CAD-TMC integration provided real-time information on unplanned incidents and complemented existing UTA incident management procedures. Additional benefit from system is information provided on planned incidents, such as road closures and/or construction activities.

State of Washington[13]

The Washington Department of Transportation (WSDOT) resources have had tremendous value in incident response and, therefore, a strong relationship exists between WSDOT and the Washington State Police (WSP). A Joint Operations Policy Statement (JOPS) encourages WSP CAD dispatchers and WSDOT TMC operators to exchange incident information and share response data. Prior to the FOT, WSP would begin the process to share information since emergency calls are received by their dispatch center, making it the primary incident information source. WSDOT TMC operators would sometimes note incident information from ITS field devices and record it in their Condition Acquisition and Reporting System (CARS). In either situation, information was typically shared between agencies verbally via telephone or radio or by monitoring read-only remote data terminals. While effective, these methods were time and labor intensive. The FOT was done in conjunction with the implementation of a new WSP CAD system with a common platform for all dispatchers and an improved ability to capture and record incident data.

Washington's integrated CAD-TMC system has three primary elements:

- PRIMARYALERT CAD Interface to filter data from WSP CAD and push it to WSDOT CARS, intended to be seamless and automatic through software code, filtering non-traffic information, and facilitating data sharing
- RESPONSE SUPPORT Web Interface to provide WSDOT traffic information to WSP CAD dispatchers to facilitate response efforts, such as traffic, construction, or other activities that could impact emergency response
- SECONDARY ALERT CAD Interface to push WSP CAD information to secondary responders such as local emergency medical service (EMS) providers, tow truck dispatchers, and local utility companies

Information exchange was based on use of the latest ITS and internet industry standards using open hardware and software platforms, institutional agreements based on agency operating requirements, and use of commercial, off-the-shelf technology and standard data exchange mechanisms.

A system performance study was design to describe the FOT environment in a way that could transfer the CAD-TMC integration concept to other locations, identify system performance measures to comparative results, identify limitations in the deployed system, and identify other factors affecting the system's performance. Key to this FOT's success is the strong existing relationship between WSDOT and WSP, leading to a well-established incident response program prior to the information exchange enhancements. Results of the CAD-TMC FOT from the Final Evaluation Report are given in Table 4.

Table 4. System Performance Test Results Summary [13]

Evaluation Objective	Hypothesis	Test Results
Objective #1: Document the system component performance.	The system meets functional specifications.	Achieved.
	The CAD and TMC systems will be able to link data on an incident.	Achieved.
	Using the system improved incident response procedures.	To a significant extent, achieved through prior projects. Project-specific impact not measurable.
Objective #2: Automate the seamless transfer of information between traffic management workstations and police, and EMS CAD systems from different vendors.	The system meets functional specifications.	Achieved.
	The FOTs will decrease the reliance on manual methods for exchanging information.	Achieved previously through placement of CAD terminals at TMCs. Enhanced through project.
	The FOTs will increase the extent and reliability of information exchanges.	Preliminary result - achieved.
Objective #3: Extend the level of integration to include secondary responders such as utilities, towing and recovery, public works, and highway maintenance personnel.	Improved integration of secondary responders will reduce incident recovery time by getting required recovery personnel to the incident site as quickly as possible to begin recovery operations.	Not achieved during the evaluation period.

The CAD-TMC FOT also looks at whether or not the integration improved efficiency and productivity of incident response, reduced delays and improved mobility, enhanced incident-specific response plans, improved responder safety and reduced secondary crashes, and

improved incident information for travelers. System impact test results from the CAD-TMC FOT are given in Table 5.

Table 5. System Impact Test Results Summary[13]

Evaluation Objective	Hypothesis	Test Results
Objective #1: Productivity - To determine if the CAD-TMC integration improves the efficiency and productivity of incident response.	CAD-TMC integration enhances communications among responders.	Achieved with WSDOT and WSP.
	CAD-TMC integration improves efficiency of on-scene operations	Not measured during the evaluation.
	CAD-TMC integration enhances efficiency in documenting incident management.	Partially achieved; further reductions will enhance results.
	CAD-TMC integration reduces incident clearance times.	Not measured during the evaluation.
Objective #2: Mobility - To determine if the CAD-TMC integration improves mobility and reduces delays during incidents.	CAD-TMC integration enhances mobility during incident management activities.	No impact measured during the evaluation.
Objective #3: Capacity/ Throughput - To determine if CAD-TMC integration enhanced incident-specific traffic management plans	CAD-TMC integration enhances incident-specific traffic management plans.	Not measured during the evaluation.
Objective #4: Safety - CAD-TMC integration will reduce exposure of response personnel and secondary crashes during incident response activities.	CAD-TMC increases safety for response personnel.	Not measured during the evaluation.
	CAD-TMC increases safety to the traveling public.	Not measured during the evaluation.
Objective #5: Traveler Information - To determine if CAD-TMC integration will improve incident management information available to travelers.	CAD-TMC integration enhances customer satisfaction and mobility during incident management activities by improving traveler information.	Not directly measured. Increased number of incidents posted to traveler information systems indicates improved flow of information to public.

Improving Information Dissemination Between Incident Responders

Improving the level of coordination and collaboration between incident responders helps to reduce the impact of incidents. Better information dissemination can facilitate this coordination and collaboration. Table 6, adapted from the Safe, Quick Clearance *TIM in Construction and Maintenance Work Zones Primer*,[17] provides several strategies and techniques that have been used to assist with information dissemination about incident response policies, procedures, and guidelines between incident responders.

Table 6. Strategies and Techniques for Information Disseminations Between Responders[17]

Strategies and Techniques	Description	Pros	Cons
Incident Response Manual	This strategy involves developing an incident response manual that collects all the policies, procedures, and guidelines for managing incidents.	• All information needed by incident responders • Contains contact information for responders in different response agencies	• May be difficult to keep contact information up-to-date
Communication Protocols / Frequency List	This strategy involves developing a listing of predetermined radio frequency assignments that incident responders can use to communicate with each other on scene.	• Provides a quick reference of all radio frequencies for responders	• May be difficult to keep contact information up-to-date
Identification Vests	This strategy involves adopting the use of identification vests to be used by incident command and emergency personnel.	• Makes it easier for late arrivals to identify individuals in charge at incident scene • Can be used to limit access by individuals within certain perimeter areas • Vests that follow National Incident Management System Incident Command Structure (ICS) can be purchased from private vendors	• Multiple vests may be required for same agency to accommodate shifts
Personnel Resource List	This strategy involves developing a comprehensive contact list of response personnel.	• Provides a quick reference for notifying responders • Usually part of incident response manual	• May be difficult to keep up-to-date
Incident Management Reviews / Debriefings	This strategy involves establishing regular meetings between incident responders to review and discuss coordination and tactical issues associated with responding to incidents.	• Many locations already have a process for doing incident reviews/debriefings • Allows agencies to discuss issues that affected response • Allows agencies to collaborate on modifications to improve responses • Facilitates dialogue between responders	• Some responders may view this as a personal attack on performance • May be difficult to get all field personnel together at same time because of shifts
Media Packets	This strategy involves developing packets that can be distributed to media to disseminate information during incidents.	• May include contact information for agency public information officer • Contains maps showing staging areas, detour routes, etc.	• Information may not be relevant for all incident conditions • Strategy valid for major incidents only

Information Dissemination

Once an incident is detected and verified, incident responders must share and disseminate this information, both amongst themselves and with the motoring public, for the incident

timeline phases of response, clearance, and recovery. As previously discussed, public safety and transportation agencies can share information with via remote voice, electronic text, or other media, such as integrated CAD systems. They must also disseminate incident information to the public. While public safety personnel may be limited to Web site updates, transportation agencies can make use of their ATMS and advanced traveler information systems (ATIS). With greater automation and integration, they have an opportunity to provide the most accurate, reliable, and timely information available as incident scene and congestion conditions change.

Identification of Relevant Stakeholders

Incidents occur on different scales and have varying impacts depending on time of day, location, and other factors. As such, the agencies involved and the impacts to the public vary. For example, a vehicle crash in an urban location can quickly cause congestion, impeding the ability of responders to reach the scene. In a rural location, a vehicle crash may not cause the same congestion, but will have issues surrounding site access. Information dissemination must, therefore, be adjusted accordingly, both in terms of which response agencies are notified and what type of information is provided to the public. A few elements to consider when identifying stakeholders include:

- Time of day
- Location
- Degree/seriousness of incident (property damage/injury/fatality)
- Scene safety (fire, hazardous materials)
- Impact to roadway facility (damage, environmental concerns, spill)
- Agency responsibilities (jurisdictional issues)
- Response protocols

These issues are best addressed in TIM team or other planning meetings so that when needed, resources and personnel can be effectively engaged.

Coordination between Public Safety and Transportation Agencies

Information dissemination is most effective when a centralized location, such as a TMC, is used as an information clearinghouse for response efforts. This reduces redundant notifications, improves accuracy, and keeps on scene responders from being distracted by repeated requests for information that detract from activities that require their attention. It allows responders to focus on their mission and adjust as scene conditions warrant until the roadway is finally reopened.

Inter-agency communication is critical to achieving effective on scene traffic incident management. Issues with intra- and inter- agency communications become more critical when the incident response is complex or spread out over a large area. Strategies used to improve communication include the following:

- Conducting traffic incident management preparedness training exercises,
- Adopting common communications and data transmission standards,

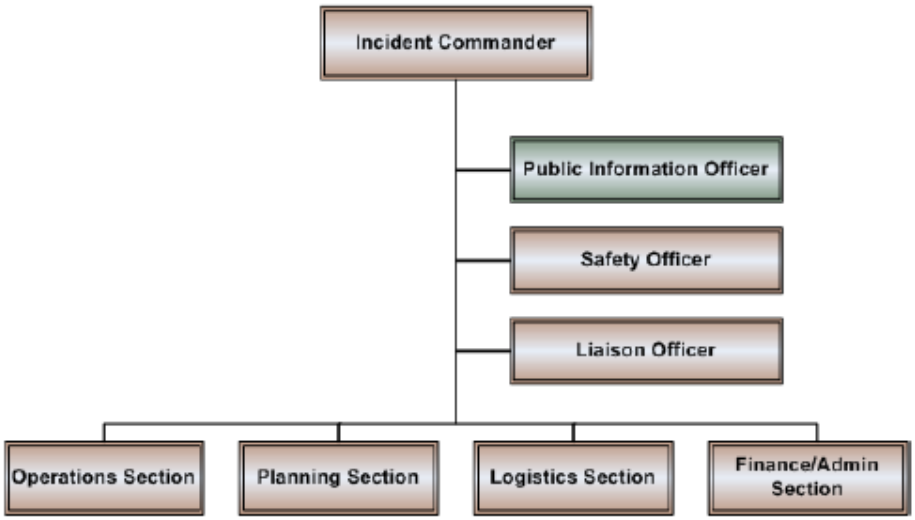
- Adopting and using ICS practices to manage traffic incidents,
- Establishing electronic paging or an email alert system for notifying incident responders, and
- Developing a matrix of radio frequencies used by scene incident responders.

One way to achieve coordination between agencies is to make use of a public information officer (PIO) as described in the National Incident Management System (NIMS). This person is a central point of contact, reducing redundant information requests made by the public, news media, and other entities regarding incident-related information. As shown in the ICS Organizational Chart in Figure 6, the PIO reports to the Incident Commander and communicates with the public, media, or other agencies regarding incident-related information. These efforts are critical to effectively help the response and public community as they navigate around the incident scene.

Key steps that a PIO (or other individual designated as a point of contact) follow are:

- Gather information from the Incident Commander and general staff who comprise the source of official outgoing information on response efforts
- Verify information by consulting with response specialists
- Internally coordinate the information
- Disseminate the information externally to the public, affected jurisdictions, private sector, media, and other impacted groups

Figure 6. ICS Organizational Chart [4]



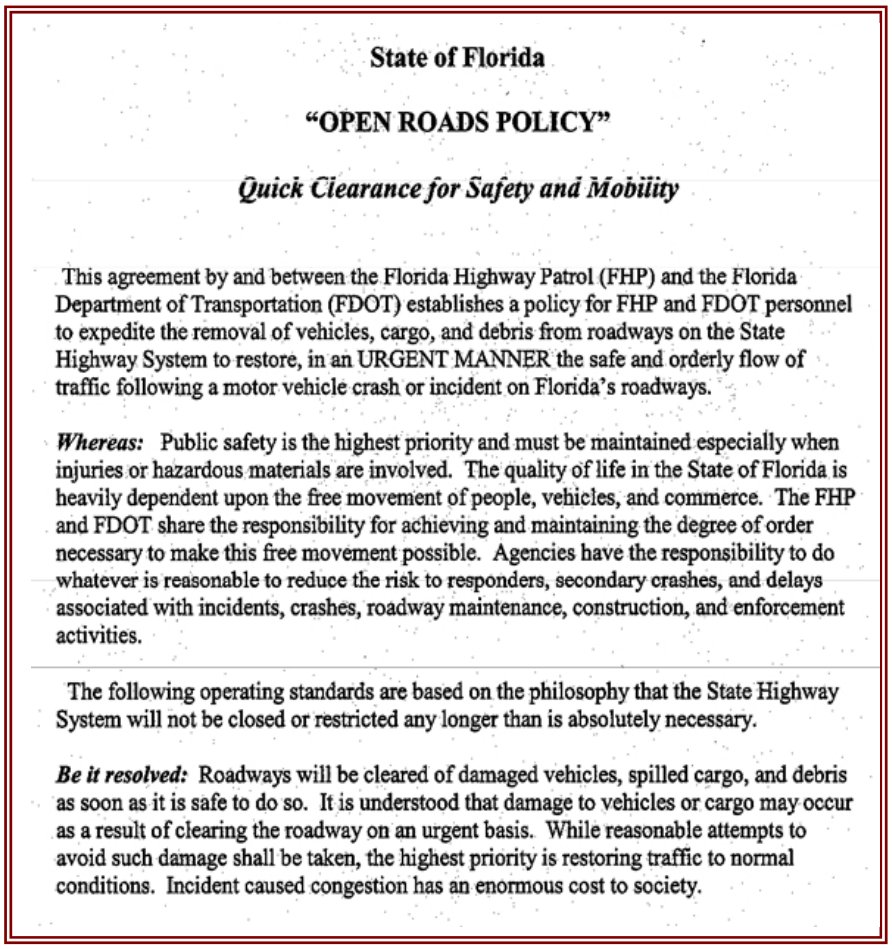
Another aspect to consider when coordinating between agencies is public outreach during non-incident situations. PIO staff can assist with education efforts about traffic incident management procedures, motorist assistance or courtesy patrols, “Move-It,” or quick clearance policies, etc., through public education campaigns and press releases. These activities can greatly enhance compliance with “Move-It” laws and, thereby, enhance responder safety.

The media should also be considered a partner in disseminating information about incidents and TIM procedures and policies as they can be a fast, reliable means of disseminating information about incident conditions and travel alternatives to the traveling public.

Institutional Arrangement and Agreements

Memoranda of Understanding/Agreement (MOU/MOA) provide the framework for incident operations and define responder roles and responsibilities. This framework helps to keep everyone involved in incident response clear and informed, especially when a response plan grows in complexity or is influenced by external factors. TIM becomes a cooperative and collaborative effort between multiple agencies and entities with a solid foundation of trust. Participants in the process know and understand their roles and responsibilities. A sample agreement between parties is Florida's *Open Roads Policy*,[18] signed by FDOT and FHP, in which the parties commit to quickly restoring the safe, orderly flow of traffic following an incident; an excerpt is shown below in Figure 7.

Figure 7. State of Florida's Open Roads Policy[18]



State of Florida

"OPEN ROADS POLICY"

Quick Clearance for Safety and Mobility

This agreement by and between the Florida Highway Patrol (FHP) and the Florida Department of Transportation (FDOT) establishes a policy for FHP and FDOT personnel to expedite the removal of vehicles, cargo, and debris from roadways on the State Highway System to restore, in an URGENT MANNER the safe and orderly flow of traffic following a motor vehicle crash or incident on Florida's roadways.

Whereas: Public safety is the highest priority and must be maintained especially when injuries or hazardous materials are involved. The quality of life in the State of Florida is heavily dependent upon the free movement of people, vehicles, and commerce. The FHP and FDOT share the responsibility for achieving and maintaining the degree of order necessary to make this free movement possible. Agencies have the responsibility to do whatever is reasonable to reduce the risk to responders, secondary crashes, and delays associated with incidents, crashes, roadway maintenance, construction, and enforcement activities.

The following operating standards are based on the philosophy that the State Highway System will not be closed or restricted any longer than is absolutely necessary.

Be it resolved: Roadways will be cleared of damaged vehicles, spilled cargo, and debris as soon as it is safe to do so. It is understood that damage to vehicles or cargo may occur as a result of clearing the roadway on an urgent basis. While reasonable attempts to avoid such damage shall be taken, the highest priority is restoring traffic to normal conditions. Incident caused congestion has an enormous cost to society.

Mutual aid agreements, common between fire and emergency medical responders, permit incident responders to provide emergency assistance to each other in the event of disasters or emergencies.[19]Similar types of agreements can be used to allow other governmental agencies to provide incident management functions outside their own jurisdictions.

Training and Debriefings

Training and debriefing sessions allow responders to share knowledge on practices and techniques and are, therefore, important aspects of developing and implementing TIM plans. Transportation and law enforcement agencies can partner with other incident responders to develop field exercises that allow responders to become familiar with various types of traffic incidents. TIM team meetings are an effective forum for such discussions as continuous improvement is a recurring theme at these meetings. TIM team members can gauge current TIM performance and then establish strategies for on scene operations, inter- and intra-agency protocols, communications, and outreach and training that meet and exceed performance expectations. As they learn from prior responses and one another, incident responders build relationships and trust that facilitate the refinement of incident response practices.

Improving Information Dissemination to the Public

Improving incident dissemination to the public helps to reduce the impact of incidents. Better information dissemination can facilitate this coordination and collaboration. Table 7, adapted from the Safe, Quick Clearance *TIM in Construction and Maintenance Work Zones Primer,*[17] provides several strategies and techniques that have been used to assist with information dissemination about incident response policies, procedures, and guidelines to the public.

Table 7. Strategies and Techniques for Information Dissemination to the Public[17]

Strategies and Techniques	Description	Pros	Cons
Dynamic Message Signs	This strategy involves using permanent or movable dynamic message signs to provide motorists with information in advance of, or at, the scene of an incident.	• Information provided directly to motorists affected by incident • Many locations will have devices as part of Transportation Management Plan (TMP) • Motorist familiar/expect to receive information from these devices	• Message content restricted to a relatively few characters • Does not reach travelers outside immediate vicinity of sign • Cannot display complex messages
Highway Advisory Radio	This strategy involves using a low-powered AM or FM radio system to provide travelers in the immediate vicinity with information about incidents.	• Allows operators to provide more detailed messages • Reaches a broader range of travelers in corridor	• Drivers must tune to radio station to receive message • Requires signing to alert motorists that a message is available
Broadcast Radio and Television Media	This strategy involves developing agreements with broadcast radio and television stations to provide incident information in a pre-established format for a specified period of time.	• Has potential to reach travelers before they enter corridor or begin trip • Can impact mode choice, routing, and departure time decisions	• Accuracy of information being disseminated difficult to control • Media agreement to information format may be difficult to obtain
Traffic Reporting Service	This strategy involves utilizing traffic reporting services to disseminate traffic and travel information for incorporation in in-vehicle displays	• Information can be tailored by traffic reporting service for specific users • Information can be integrated with in-vehicle travel information displays	• Agency does not control/influence diversion route of traveler • Agency does not control accuracy of information being disseminated
Email /Fax Alerts or Mobile Web Site	This strategy involves deploying a system whereby incident alerts are automatically distributed through electronic means, such as emails, faxes, pages, etc.	• Has potential to reach a wide distribution of travelers • Technology relatively easy to deploy • Users would need to subscribe to service • Many urban areas have systems	• Requires staff to manage system

Strategies and Techniques	Description	Pros	Cons
		already in place	
Web Sites/ Kiosks	This strategy involves using Web sites and information kiosks in public areas to disseminate information about incidents	• Has potential to reach travelers prior to initiating trip • Can impact mode choice, routing, and departure time decisions	• Does not reach motorist already in area of incident • Requires integration with other systems
Dedicated Information Phone Number / 511 System	This strategy involves disseminating incident information through either a dedicated telephone call-in number or an existing 511 service.	• 511 services available in many metropolitan areas • Has potential to reach travelers prior to initiating trip as well as drivers who have already started trip	• Dedicated telephone number requires operator to staff • Requires driver to initiate call to obtain information

Performance Measurement and Continuous Improvement Best Practices

TIM Program-Level Performance Measures Focus States Initiative

Monitoring and measuring TIM strategy effectiveness is essential to continually evaluate progress and identify improvements. Through the efforts of the Federal Highway Administration's (FHWA) TIM Program-Level Performance Measures Focus States Initiative[15] participating states developed ten candidate freeway operations objectives through a series of regional workshops relative to TIM:

1. Reduce incident notification time (defined as the time between the first agency's awareness of an incident and the time to notify needed response agencies)
2. Reduce roadway clearance time (defined as the time between awareness of an incident and restoration of lanes to full operational status)
3. Reduce incident clearance time (defined as the time between awareness of an incident and the time the last responder has left the scene)
4. Reduce recovery time (defined as the time between awareness of an incident and restoration of impacted roadway(s) to "normal" conditions)
5. Reduce time for needed responders to arrive on scene after notification
6. Reduce number of secondary incidents and severity of primary and secondary incidents
7. Develop and ensure familiarity with regional, multi-disciplinary TIM goals and objectives and supporting procedures by all stakeholders
8. Improve communications between responders and managers regarding the status of an incident throughout the incident
9. Provide timely, accurate, and useful traveler information to the motoring public on a regular basis during an incident
10. Regularly evaluate and use customer (road user) feedback to improve TIM program assets

At the December 2005 National Workshop, objectives 2 and 3 were selected as candidates whose definitions were further defined for candidate performance measures. From 2005 through 2007, the participating states tested these two measures and discussed results at another national workshop help in October 2007.

All ten objectives have some relationship to information sharing; however, objectives 8 and 9 place particular emphasis on communications measurement and improvement. The concepts inherent in these measures require well-developed communications between response agencies as well as a strong commitment to an integrated TIM program. In addition to allowing agencies to track their progress toward meeting multiple agency goals, they may identify

- Areas where improvements are being made
- Areas where improvement is still needed
- Highly effective practices

This information can then be provided to decision makers to

- Improve allocation of existing resources to improve TIM practices
- Justify allocation of additional resources for future needs
- Assess how well agency goals and objectives are being met

Florida Results[20]

When reporting at 2007's National Workshop, Florida's TIM program highlighted its multi-tiered TIM teams and their commitment to improved communications between incident responders. One sub-team concentrates specifically on recommendations to ensure effective, accurate, and timely communications among incident response agencies and the public. In addition to reviewing past response actions, members explore ways that incident management can be improved. Florida TIM team members have identified challenges in collecting and archiving the data needed to support their communications objectives; however, they continue to strive for multi-agency and multi-level communications improvements.

Wisconsin Results[21]

Wisconsin discussed its Traffic Incident Management Enhancement (TIME) program at the October 2007 National Workshop. TIME members regularly conduct multi-discipline training sessions for transportation and public safety personnel. They produce a monthly report that provides performance measurement information on

- Total incidents
- Response time
- Incident clearance times
- Travel rate index
- Hours of delay
- VMS usage
- Maintenance average service time

- Freeway service and safety patrol assists
- High occupancy vehicle ramp lane usage

While not always easy to quantify, effective communication between response partners is crucial for TIME partners' success.

Washington Results

Published quarterly, WSDOT's *Measures, Markers, and Mileposts* (aka "Gray Notebook")[22] provides details regarding department management and transportation programs. The Notebook reports, in detail, on WSDOT's and WSP's joint efforts to

- Reduce incident response program clearance times
- Debrief lane-blocking incidents exceeding 90 minutes in duration

A new feature includes analysis of Washington's new Major Incident Tow Program, a pilot incentive-based project intended to encourage local tow operators to respond more quickly to incidents. While details regarding information sharing are not discussed explicitly, the strong foundation for communications between incident response partners is the Joint Operations Policy Statement executed between WSDOT and WSP.[23]

Evaluation and Lessons Learned

When incident responders assess their communications effectiveness, as well as the results of their overall traffic incident management strategies, they may find it difficult to quantify specific metrics. Baseline information or data specific to information sharing can be extremely limited. Additional reporting capabilities and resources may need to be developed, so responders must be careful when working toward measures that exceed their current data collection and reporting system capabilities. Instead, they find may find it easier to qualitatively assess their actions regarding improved communications by answering a series of questions:

- Were resources engaged more quickly?
- Were proper resources brought to the incident scene?
- Was the incident investigation process improved?
- Was the response effort improved?
- Were traffic disruptions minimized?
- Were safety improvements realized, including secondary crashes?
- Did traffic congestion recover more quickly?
- Was roadway customer satisfaction improved?

Most officials support information sharing and the use of multi-agency teams as they result in improved coordination and cooperation between incident response stakeholders. This finding, however, tends to be anecdotal. Most locations do not yet have enough data to quantify their results. As agencies take steps to improve TIM practices, they must also work to document the effectiveness of their actions under the framework provided by the TIM Program-Level Performance Measures Focus States Initiative.[15]

Information Sharing Best Practices

This subsection highlights various best practices for information sharing between incident responders. Information sharing between multiple agencies clearly has advantages in the improved management of incidents as responders are aware of what is happening, and debriefing sessions allow for learning, improvement, and relationship building. Other successful practices include the development of TIM strategic plans that address communications and technical issues with the objective of improving overall traffic incident management through better communications and collaboration. Successful information sharing initiatives cut through organizational boundaries to involve entities from traditional public sector agencies as well as response partners from the private sector and other stakeholders such as insurance divisions, coroners' and medical examiners' offices, hazardous materials contractors, and the media.

Real-Time State Police CAD Data and Richmond District TMC – Virginia
In 2005, Virginia Department of Transportation (VDOT) documented integration issues encountered between the Richmond District Smart Traffic Center (STC) traffic management system ("OpenTMS") and the Virginia State Police (VSP) CAD system. The project, known as "VSP-CAD Implementation Effort,"[24] had two components:

- Integrate data arriving from VSP into OpenTMS
- Customize the OpenTMS incident management subsystem to use the integrated data

This project was seen as having significant benefits to integrating VDOT and VSP information; STC staff would be able to use VSP-initiated traffic incidents as part of their operations. The open exchange of ideas and information between the involved organizations (FHWA, VSP, VDOT, and their private contractors) was critical to the project's success. VSP and VDOT had an established common commitment for the systems' integration built upon prior relationships that led to rapid resolution of conflicts. They developed a common understanding of the project through the *Richmond Regional Data Sharing Concept Study*[24] that established goals that were then shared with new agency members as they were added to the team.

During the project, VSP and VDOT identified lessons learned relative to

- Data exchange standards for the VSP-VDOT interface
- Publish/subscribe services to distribute the CAD data to other state agencies
- Issues surrounding data availability and consistency
- Security of sensitive (non-traffic) data
- Deployment strategies and prototyping for quick implementation

Throughout the integration project, VSP and VDOT were able to identify and resolve information issues relative to incidents that were not meeting the project's intent. STC operators were then able to track more traffic incidents and there were significantly fewer redundant calls between VSP dispatchers and VDOT STC operators. Through the joint efforts of VSP and VDOT, this successful project was recommended for expansion into other traffic management facilities in Virginia.

Integrated Incident Management System – New York City

The Integrated Incident Management System (IIMS)[25] was deployed for freeways in the five-borough area of New York City to facilitate information exchange, data sharing, and coordination of incident response management activities. Results were also reviewed to document lessons learned, analyze "before" and "after" data, and identify benefits realized during field operational tests. The following table, taken directly from the Evaluation Final Report, summarizes IIMS's goals, hypotheses, and findings relative to activities undertaken by project participants, namely

- New York State DOT
  - Headquarters and Region 11
- New York City
  - DOT
  - Police Department
  - Office of Emergency Management
  - Fire Department
  - Emergency Management Services
  - Department of Sanitation
  - Department of Environmental Protection
- Metropolitan Transportation Authority Police

Table 8. IIMS's Goals, Hypotheses, and Findings [25]

Goal	Hypothesis	Finding
Evaluate the incident management effects of the IIMS	IIMS will result in improved incident response.	Finding 3: The IIMS case studies successfully identify situations where the use of IIMS has the potential to improve incident response operations.
	IIMS will result in improved communications.	Finding 8: IIMS improves the post-incident assessment/evaluation process.
	IIMS will result in improved coordination of resources.	
Evaluate the transportation system Performance effects of the IIMS	IIMS will result in improved mobility.	Finding 4: The case studies identify how the use of IIMS has the potential to substantially improve mobility.
Evaluate the energy and environmental effects of IIMS	IIMS will result in energy and environmental benefits.	IIMS will result in energy and environmental benefits.
Evaluate the safety effects of IIMS.	IIMS will result in increased traveler safety.	Finding 5: IIMS has the potential to improve traveler and responder safety.
	IIMS will result in increased worker safety.	
Assess the process improvements and institutional impacts of the IIMS.	IIMS will result in better incident management documentation.	Finding 7: The use of IIMS has resulted in better Incident management documentation.
	IIMS will improve evaluation and assessment of the process and its performance.	Finding 1: IIMS has been considered a successful deployment (by stakeholders). Finding 2: IIMS was deployed in a cost-effective manner.

Through the efforts of the various stakeholders, IIMS has been integrated into normal and sustainable operations for several years. In addition to requiring high-level management support, system users were regularly asked for feedback to allow for continuous improvement. Regular communications were maintained, ensuring the system would meet all users' needs and ultimately lead to a high-level of system usage by all stakeholders. IIMS deployment benefited from inter-agency collaboration and strong relationships between users. IIMS began with a more an informal organizational structure to allow for greater flexibility, and as system enhancements were tested and accepted, stakeholder buy-in allowed for definition of a more formal organizational structure defined in various MOUs.

The final system evaluation report noted the following conclusions:

- IIMS provides interoperable real-time communications that allows stakeholders to communicate directly and use the system to coordinate incident response activities
- IIMS is a successful deployment that is used by multiple users from multiple agencies to managed thousands of incidents annually
- IIMS has been "mainstreamed" as an operational system whose operations and maintenance support have dedicated sources of funding and technical support

Combined Transportation, Emergency, and Communications Center – Texas

The Austin District of Texas Department of Transportation (TxDOT) has implemented a Combined Transportation, Emergency, and Communications Center (CTECC) as part of its evolving ITS. This facility has three primary purposes:

- 911 and 311 (non-emergency) call-taking and dispatch for City of Austin and Travis County
- Transportation management for TxDOT and Capital Metro area
- Emergency Operations for City of Austin and Travis County

In 2005, TxDOT reported on the progress of the CTECC to the CAD-ITS User Group at a meeting in Seattle, Washington.[26] The facility's key objective related to real-time, inter-agency traffic information sharing have accomplished

- Reduced congestion
- Improved response routing recommendations
- Enhanced coordination
- Earlier incident detection, notification, and response

TxDOT has performed significant ITS integration work to standardize TMC and center-to-center communications to allow multiple users to access and respond to traffic information. Continuing efforts include sharing video images and addressing conflicts in emerging/conflicting communications standards.

Portland Dispatch Center Consortium – Oregon

Portland, Oregon's Dispatch Center Consortium CAD Integration Project[27] was undertaken to address issues of interoperability, quality of service, performance, and manageability between nine agencies in the Portland area:

- Oregon DOT
- Oregon State Police
- City of Portland
- Clackamas County
- Washington County
- Lake Oswego Communications
- Clark Regional Emergency Services Agency
- Airport Communications Center
- Columbia 911 Communications District

The project integrated state and local traffic information centers and seven metro area CAD systems. By migrating to a standards-based, secure system, Consortium members were able to ensure a highly reliable, accurate, and scalable system that effectively shares incident and road condition information between its members.

CAD – CARS Integration – Washington

Before the project to integrate CAD and TMC information, WSP and WSDOT communicated primarily via telephone or radio by transferring data to read-only monitors in the northwest region radio room. There was no linkage between the CAD and TMC systems. Through a highly collaborative effort, this project has created an automated link to WSDOT's Condition Acquisition and Reporting System (CARS).[28] TMC operators are now alerted to every crash reported in WSP's CAD system; they are then easily able to include these crashes into the CARS. In addition to demonstrating a successful technology integration effort, this on-going operational project has had specific benefits and results:

- Proven use in urban and rural settings
- Rapid operator response through minimized keystrokes and ability to quickly update system
- Virtual functionality wherein operators can view, edit, and accept events statewide

Through the detailed FOT, clear goals and objectives were established by participants in this project that related to system performance, system impact, institutional and technical challenges, lessons learned, and benefits. The evaluation found that functional specifications were met, with the linked data and improved integration decreasing reliance on prior methods for data exchange. Communication between responders, both on scene and within the TMC/dispatch facilities, increased and became more effective.

This project demonstrated not only how integrated CAD and TMC systems could improve response capabilities, but also how institutional barriers could be overcome. This project resulted in an integrated transportation and public safety incident management information network that allowed enhanced information-sharing between multiple agencies across multiple jurisdiction.

4.0 BARRIERS TO INFORMATION SHARING

While information sharing is generally accepted by incident responders as a positive and desirable practice, a number of barriers exist to effective information exchange. The foundation to overcome any such barriers is organizations' willingness and dedication to work cooperatively with one another. While information sharing practices used in one area may not necessarily be successfully adopted by another jurisdiction because of location-specific constraints, formal frameworks for response activities and close working relationships at all organizational levels increase the opportunities for effective and efficient information sharing.

Administrative/Institutional Barriers

Information sharing is most effective when it is supported by strong administrative and institutional foundations at multiple levels. Transportation and public safety agencies have a mutual interest and common goal in resolving traffic incidents quickly: maximizing the safety of responders and motorists. Partner agencies that have successful information exchanges use formal agreements (typically memoranda of understanding/agreement [MOU/MOA]) to detail responsibilities and accountability structures. These documents can range from statements of support and cooperation to commitments of agency funds to achieve traffic incident management (TIM) goals and objectives.

Another aspect of information sharing that must be considered is how public records laws relate to information regarding traffic incidents. States have public records laws that range from varying degrees of restriction to completely transparent, and agencies must be careful to meet the intent of these laws. With the advent of technologies that allow real-time transmission of traffic data and incident response information, laws, policies, and procedures have not necessarily addressed at what point in time the information may be made public: during the response/investigation or after the event? As to the information itself, limitations to information sharing (privileged versus non-sensitive) must be considered; there may be differences between what may be shared between agencies for effective response and what can be shared with the public. And does the information availability change as the investigation proceeds from open to closed? Additionally, shared information must preserve the dignity of the deceased in a way that transmits incident information without sensationalizing information being shared with public. Another area that has not been well documented is the recording and retention of internally captured (via a closed-circuit television [CCTV] camera system) video images; most agencies tend to avoid video retention because of storage and liability issues. This is an area that continues to evolve without a consistent pattern of execution outside a consensus to not record video images.

Operational Barriers

Successful TIM information sharing often begins through strong personal relationships between response stakeholders at various levels within the organizations. These key staff can find innovative ways to overcome barriers and develop effective operational procedures that support incident response activities. Trust between these stakeholders is critical, since their actions and attitudes provide incentive for others to participate actively.

More formally, co-location and pooling of resources can support improved information exchange. Proximity allows responders to understand the information they receive, how it is best used and shared, and how decisions are made. There are inter-agency language barriers where specialized terms may not be understood by other professions; using clear speech and a common set of terms is helpful. Cross training and joint operations are two means by which staff from different agencies can learn to communicate more effectively.

Technological Barriers

The ability to communicate and share information across various media, particularly when technological updates outstrip agencies' ability to keep pace with changes, is critical for effective traffic incident management. Communications media are not always interoperable, or costs to allow information sharing may be prohibitive. By sharing proprietary communications or data systems, relying on commercial communications services, and finding ways to build communications linkages, successful TIM response agencies have found ways to overcome technological barriers. Technological barriers have often been overcome by addressing administrative/institutional and operational issues rather than by solely trying to keep up with technology changes.

Some specific technological barriers include

- Inability to communicate across a common platform
- Communications equipment not available in emergency response vehicles
- Communications mechanisms not available during non-office hours
- Proprietary communications systems
- Insufficient redundancy for some communications systems, making them vulnerable to loss of functionality
- Insufficient training, coordination, and planning between agencies to establish usage parameters

Sample Solutions to Administrative, Operational, and Technological Barriers

A solution to one type of information sharing barrier can resolve another. The representative examples below cross over from one type of barrier to another with the result being a best-practice type example of information sharing.

Washington Department of Transportation (WDOT)/Washington State Police (WSP)

In Washington, the WDOT and WSP have developed a joint operations policy statement (JOPS).[23] This working agreement describes both agencies' missions and organizational alignment and then goes on to state their intent to share information needed to facilitate joint highway operations. Examples of information sharing include:

- CAD access and user training
- Real-time traffic flow, road, collision, and weather information
- Video from traffic monitoring cameras
- Video road inventories
- Speed data
- Geo-spatial data, including interchange drawings

WSP and WSDOT have created a standard for data sharing that addresses:

- Data content and formatting
- Data documentation and meta-data
- Data collection and update methods and procedures
- Data accuracy
- Data update cycles
- Third party data
- Stewardship

Florida Department of Transportation (FDOT) District Four

Another example of a commitment to share data and resources is FDOT District Four's MOU[29] that provides the initial framework and guidelines to promote collaborative efforts between TIM team members for decision making and information sharing in efforts for TIM planning, design, deployment, operations, funding, and evaluation. Team members consist of transportation and public safety personnel as well as private sector partners. This team's vision is to develop an institutionally integrated, fully cooperative association of public agency and private industry TIM stakeholders to improve the safety and reliability of the transportation system. Agencies that have agreed to the terms of this MOU include:

- FDOT District 4, Florida's Turnpike Enterprise, and FDOT Motor Carrier Compliance Division
- Florida Highway Patrol
- County Sheriff Departments
- Local Police Departments
- County and Local Fire Departments
- Local and County Traffic Engineering Departments

- County Departments of Environmental Protection
- County Metropolitan Planning Organizations
- County Medical Examiner Departments

Utah Department of Transportation (UDOT)/Utah Department of Public Safety (UDPS)[14]

While the UDOT/UDPS-led team had a history of working together, when they worked to integrate their CAD-TMC system, they encountered a varied set of challenges:

- Consensus about type and amount of information available for sharing
- Fully engaging participants at all levels to maintain communication flows and staff involvement
- Minimizing impacts on agency business practices
- Inconsistent data sets and emergent data standards
- Different legacy systems
- Staff workload concerns
- Reluctance to change to an automated system

Team cooperation was vital to the project's success, and this was built on strong existing relationships between agency partners. While the agencies had different areas of focus (scene management versus traffic control), understanding each other's needs, roles, and motivations as well as committing to support at all levels and use of project standards helped to successfully navigate these various challenges.

5.0 REFERENCES AND SUGGESTED READINGS

References

1. United States (USDOT), *Traffic Incident Management Handbook* (2000).
2. USDOT, *Manual on Uniform Traffic Control Devices*
3. National Cooperative Highway Research Program (NCHRP) Report 520, *Sharing Information between Public Safety and Transportation Agencies for Traffic Incident Management* (2004).
4. United States Department of Homeland Security (USDHS), *National Incident Management System* (2004).
5. USDOT, *Simplified Guide to the Incident Command System for Transportation Professionals* (2006).
6. USDOT, *Common Issues in Emergency Transportation Operations Preparedness and Response* (2007).
7. USDOT, Traffic Incident Management Program Web site. Available at http://ops.fhwa.dot.gov/incidentmgmt/index.htm.
8. Kentucky Office of Homeland Security, Kentucky Intelligence Fusion Center Web site. Available at: http://homelandsecurity.ky.gov/fusion.htm.
9. Florida Department of Transportation (FDOT) SunGuide™ Disseminator, Road Rangers and Statewide Law Enforcement Radio System 800 MHz Radio Network (2007).
10. USDHS, About SAFECOM. Available at http://www.safecomprogram.gov/SAFECOM/about/default.htm.
11. USDHS, About SAFECOM, Frequently Asked Questions. Available at http://www.safecomprogram.gov/SAFECOM/about/faq/.
12. USDHS, Interoperability Continuum Brochure.
13. USDOT, *Computer-Aided Dispatch – Traffic Management Center Field Operational Test: Washington State Final Report* (2006).
14. USDOT, *Computer-Aided Dispatch – Traffic Management Center Field Operational Test: State of Utah Final Report* (2006).
15. Traffic Incident Management (TIM) Focus States Initiative on TIM Performance Measurement, SAIC, TIM Program-Level Performance Measurement Focus States Initiative Update (2007).
16. North Carolina Department of Transportation, *Incident Management Best Practices* (2007).
17. USDOT, Safe, Quick Clearance Primer Series, *Traffic Incident Management in Construction and Maintenance Work Zones* (2008).
18. Florida, *Open Roads Policy* (2002).

19. Federal Emergency Management Administration, *Mutual Aid Agreements for Public Assistance and Fire Management Assistance,* Available at http://www.fema.gov/government/grant/pa/9523_6.shtm.
20. Traffic Incident Management Focus States Initiative on TIM Performance Measurement, Cambridge Systematics, *Florida ITS and TIM Performance Measures* (2007).
21. Traffic Incident Management Focus States Initiative on TIM Performance Measurement, HNTB, *Wisconsin DOT Performance Measures* (2007).
22. Washington Department of Transportation (WSDOT), *Measures, Markers, and Mileposts*, published quarterly.
23. WSDOT and WSP, *Joint Operations Policy Statement.*
24. Virginia Department of Transportation (VDOT), *Challenges Faced and Tactics Used to Integrate Real-Time State Police Computer Aided Dispatch Data with the VDOT Richmond District Smart Traffic Center* (2005).
25. USDOT, *New York Integrated Incident Management System Evaluation Project Final Report* (2007).
26. Texas Department of Transportation, *Combined Transportation, Emergency, and Communication Center* (2005).
27. Oregon Department of Transportation, *Portland Dispatch Center Consortium CAD Integration Project* (2005).
28. WSDOT, *CAD-Traffic Management Center Integration in Washington Statement* (2006).
29. FDOT, *Memorandum of Understanding for Traffic Incident Team within FDOT District Four*, updated as new agencies are included.

Suggested Reading

1. Federal Emergency Management Administration, *Basic Guidance for Public Information Officers* (2007).
2. Texas Transportation Institute, *2007 Urban Mobility Report* (2007).
3. USDOT, *Freeway Management and Operations Handbook*, Chapter 10 (2003).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