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Incident Management Workshop

Reference Manual

National Highway Institute

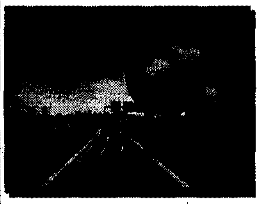
Module 1
Introduction to Incident Management

The goal of Module 1 is to characterize the wide-ranging impacts of incidents and to demonstrate potential benefits of incident management.

MODULE 1

INTRODUCTION TO INCIDENT MANAGEMENT

INCIDENT DEFINITION



Any non-recurrent event that reduces roadway capacity, or abnormally increases traffic demand.

INCIDENT FREQUENCY

Blocking Incidents	Per Mile Per Week
Houston, TX	2.2
Chicago, IL	2.7
Baton Rouge, LA	0.2 - 2.5

INCIDENT SEVERITY

Minor

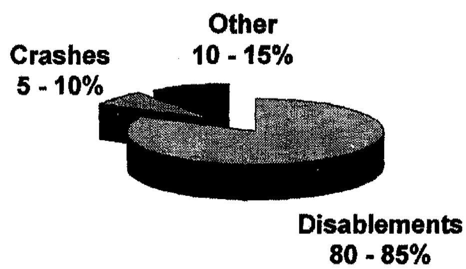
- Most frequent
- Affect shoulder
- Impact traffic locally
- Require few responders
- Require informal actions
- May be self-helped
- May not be reported

INCIDENT SEVERITY

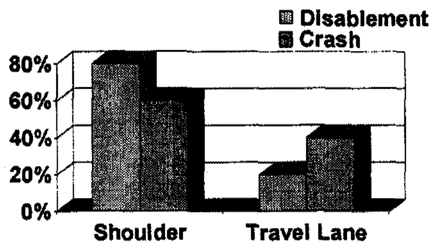
Major

- Occur infrequently
- Affect travel lanes
- Impact area/corridor traffic
- Require multiple responders
- Require formal actions/plan
- May involve fatalities
- May require investigation

INCIDENT TYPE



INCIDENT LOCATION



INCIDENT PREDICTABILITY

UNPREDICTABLE

> Crash
> Disablement
> Spill
> Road failure
> Act of nature[1]
> Weather[1]

PREDICTABLE

- Special events
- Maintenance/construction

IM DEFINITION

A planned, coordinated program to detect and remove incidents and restore traffic capacity safely and quickly.

Responding to incidents is not new - managing response to incidents is.

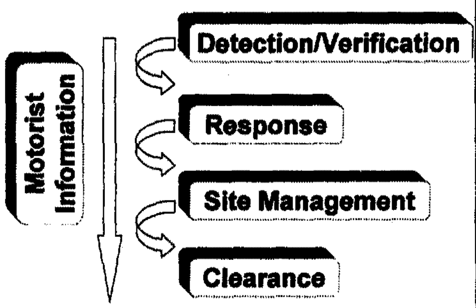
TRADITIONAL OPERATIONS

- **Sequential steps**
- **Minimal interdisciplinary coordination**
- **Minimal understanding of others' roles**
- **Actions governed by individual priorities**

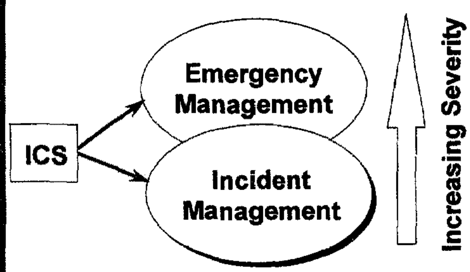
MANAGED OPERATIONS

- **Concurrent steps**
- **Interdisciplinary sharing of equipment and personnel**
- **Increased understanding of each others' roles**
- **Unified decision making and command**

IM FUNCTIONAL AREAS



IM / EM / ICS



IM OBJECTIVES

- To improve responder and motorist safety
- To improve operational efficiency
- To improve public image
- To reduce traffic congestion

IM BENEFITS

IMPROVED SAFETY

> Reduced public-borne costs

> ***Vehicle crash costs totaled $150.5 billion in the U.S. in 1994.***
> ***- NHTSA***

IM BENEFITS

IMPROVED SAFETY

> Reduced secondary incidents

7% of pedestrian fatalities follow first incident. -AAA

IM reduces secondaries by 18%. - Chicago, IL

IM BENEFITS

IMPROVED SAFETY

> Reduced road shoulder incidents

4.4% of fatalities occur on shoulder. - NHTSA

40% of pedestrians with disabled vehicles are killed on shoulder. - AAA

IM BENEFITS

IMPROVED SAFETY

> Reduced pedestrian incidents

543 pedestrians were killed on interstates in 1995. - AAA

"...as dangerous as hanging out on a railroad track."- AAA

IM BENEFITS

IMPROVED SAFETY

> Reduced HazMat injuries

HazMats up 34% from 1982 to 1991. - Parrish

HazMat injuries up 374% over this same time.- Parrish

IM BENEFITS

MORE EFFICIENT OPERATIONS

> Reduced resources at scene
> Reduced time resources in use
> Reduced exposure to danger
> Stunted insurance cost growth
> Reduced liability claims

IM BENEFITS

IMPROVED PUBLIC IMAGE

> Personnel remove a blockage, improve traffic flow, and reduce delay.

"What the Customer Had To Say" was positive (309 letters) after 3 years of IM in Virginia.

IM BENEFITS

REDUCED TRAFFIC CONGESTION

>Increased roadway capacity

Blockage	Expected Reduction	Actual Reduction
Shoulder	0%	26%
One Lane	33%	48%
One Lane	33%	50%
Two Lanes	66%	79%

- Houston, TX

IM BENEFITS

REDUCED TRAFFIC CONGESTION

>Shorter traffic backups

1 minute of blockage results in 5 min. of congestion, off peak

- Roper

IM BENEFITS

REDUCED TRAFFIC CONGESTION

>Reduced delay costs

•New York, NY	***$1.2 billion***
•Seattle, WA	***$250 million***
•Baton Rouge, LA	***$10 million***
•Des Moines, IA	***$22 million***

- various sources

Table of Contents

Module 1
Introduction to Incident Management

Definitions

What do we mean when we say "incident"?

For this course, an incident is defined as any non-recurrent event, such as a vehicle crash,[1] vehicle breakdown, or special event, that causes (1) a reduction of roadway capacity or (2) an abnormal increase in traffic demand. The term "incident" typically has a broader definition for fire and police personnel, including non-roadway and larger scale occurrences. It may be more difficult for these personnel to narrow their focus to only minor and major roadway incidents.

Some examples of incidents discussed as part of this course are listed below, categorized by their resulting impact (i.e., a reduction in roadway capacity or an increase in demand for the roadway).

- Reduces Roadway Capacity
- Vehicle crash
- Vehicle breakdown
- Spilled debris
- Inclement weather (e.g., rain, snow, ice)
- Acts of nature (e.g., flood)
- Roadway infrastructure failure (e.g., bridge collapse)
- Maintenance or construction activities
- Abnormally Increases Demand
- Special events

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[1]the term "crash" is used rather than the term "accident" because it is believed that the occurrences are preventable

What do we know about roadway incidents (i.e., incident characteristics)?

You may be asking yourself how we expect to tackle the problem of roadway incidents when their occurrence cannot typically be anticipated. The answer is to learn as much about what incident-related aspects can be anticipated. Previous studies that have carefully recorded and reported incident characteristics in various locales provide the basis for this information. Estimating the frequency of incident severity, incident type, and incident location on the roadway (e.g., shoulder), and estimating predictability can assist in dedicating, locating, and mobilizing the appropriate response personnel and resources.

<u>Incident Frequency</u>

Incident frequency can be expressed by comparing the number of incidents to (1) some time reference (e.g., day, week, or month), (2) some distance reference (e.g., mile), (3) some traffic-related reference (e.g., vehicle-miles of travel), or (4) a combination of references. In two of the larger urban areas in the country, incident frequency was determined to be

- 2.2 lane-blocking incidents per mile per week in Houston, Texas (1990 population 1,630,553)

- 2.7 lane-blocking incidents per mile per week in Chicago, Illinois (1990 population 2,783,726) (Freeway Incident Management Handbook, 1991).

Note that the reported figures are for lane-blocking incidents only; the frequency of total incidents would be higher. Lane-blocking incidents are estimated to be 15 percent of all incidents (Cambridge Systematics, Inc. 1997).

A study considering 20 miles of Seattle area (1990 population 516,259) urban freeway determined that an average of eight vehicle crashes and 12 vehicle disablements were reported daily (Jones, Mannering and Sebranke 1990). For comparative purposes, this roughly equates to 2.8 crashes and 4.2 vehicle disablements per mile per week

For smaller urban areas that have lower traffic volumes, the number of incidents is typically less. In Baton Rouge, Louisiana (1990 population 219,531), the number of reported crashes (not including vehicle disablements) ranged from 0.2 crashes per mile per week to 2.5 crashes per mile per week (Urban Systems, Inc. 1994). Again, the frequency of total incidents, including vehicle disablements, would likely be higher.

In considering all types of vehicle crashes, Zhou and Sisiopiku (1997) found that crash rates are highest when traffic volumes (volume to capacity ratio) are high and low. Moderate traffic volumes result in the fewest number of crashes. The result is a u-shaped relationship. Traffic conflicts likely contribute to high crash rates in high traffic conditions. Nighttime driving and inattention may contribute to high crash rates during low traffic conditions.

With single vehicle, fixed-object, and roll-over crashes, the crash rates decrease linearly as traffic volumes (volume to capacity ratio) increase. (Zhou and Sisiopiku 1997).

<u>Incident Severity</u>

"Minor" and "major" are the two most common classifications for incidents. An incident is typically categorized as "minor" or "major" on the basis of its expected duration, its location, the number of lanes blocked, and the length of blockage. However, the distinction between a "minor" incident and a "major" incident is not always clear. To illustrate, consider the following set of definitions for a "major" incident:

- any incident that occupies two or more lanes of traffic for two or more hours — Maryland State Highway Administration
- an incident that typically involves heavy vehicles and/or a spill that requires specialized equipment and an extensive cleanup effort — Massachusetts Highway Department
- a serious accident or incident that may cause a highway to be closed for six or more hours — Pennsylvania

- an incident that occurs on the Interstate System that requires multiple agency involvement to restore vehicular flow to normal volumes; an event that results in significant delay because of the removal of damaged property, roadway structure repair, or Hazardous Materials containment/cleanup; an event that involves closing a portion of the Interstate System for a significant period of time and rerouting the Interstate traffic onto primary or secondary roads — Northern Virginia District, Virginia Department of Transportation

- an incident that requires variable message signing (VMS) and/or blocks travel lanes — New York Department of Transportation

- any incident that closes one or more lanes for one or more hours — Northwest Region, Washington State Department of Transportation

Note that the minimum duration defining a major incident ranges from one to six hours. The difficulty in clearly defining the characteristics of a "major" incident exemplifies the wide range of incident types and the difficulty in categorizing all into two classifications. More realistically, a multi-categorical range of incidents should be considered, with "minor" and "major" as the extreme categories. In general, the two extreme categories can be defined as follows.

- Minor incidents typically affect the roadway shoulder area only, result in local traffic impacts, require response from a single agency or company, require informal actions to be taken, are often self-helped (i.e., cleared by the party involved before a responder arrives at the scene), and are often not reported to police agencies. Often all evidence of a minor incident is cleared before a motorist in the queue passes the scene. Among all incidents, minor incidents occur most frequently.

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

Incidents often do not occur singularly. Minor incidents, if not cleared quickly, can result in more serious, major incidents. A second vehicle may strike a disabled vehicle on the shoulder, seriously injuring the vehicle occupants, or a pedestrian changing a flat tire on the side of the road may be struck by a passing vehicle. Major incidents can also lead to multiple minor incidents. If a traffic queue forms behind a major incident, minor incidents such as fender-bender crashes, vehicle overheating, or gasoline depletion are likely to occur. Each of these minor incidents, in turn, needs attention from response agencies.

Incident Type

Disablements are estimated to make up 80 to 85 percent of all incidents. Crashes make up another 5 to 10 percent. The remaining 10 to 15 percent include other types of incidents (Cambridge Systematics 1996). The most common types of incidents include, in descending order of frequency, mechanical breakdowns, flat tires, crashes, overheated vehicles, vehicles out of gas, and abandoned vehicles.

Incident Location

While difficult to predict which routes or structures (i.e., bridges or tunnels) have the highest incident rates without a formal, site-specific study, one can apply estimates of incident location on the roadway (i.e., shoulder, lane) with some success. Of all vehicle disablements, 80 percent are estimated to impact the roadway shoulder and 20 percent are estimated to block lanes. Of all vehicle crashes, 60 percent are estimated to impact the roadway shoulder and 40 percent are estimated to block lanes (Cambridge Systematics 1996).

Incident Predictability

The range of incident types leads to variability in the predictability of various incidents. Incidents that are most difficult to predict include

- Vehicle crashes
- Vehicle breakdowns
- Spilled debris

- Inclement weather (e.g., rain, snow, ice) [2]
- Acts of nature (e.g., flood)[2]
- Roadway infrastructure failures (e.g., bridge collapse).

Again, the predictability of these events can be improved by considering incident-related aspects that are predictable (i.e., frequency, severity, type, location). Information from previous studies can be useful, or a formal, site-specific evaluation can be initiated in your area.

Some incidents are more easily predicted. These include

- Special events
- Maintenance or construction activities

Predictable incidents allow for the dedication, location, and mobilization of appropriate response personnel and resources to minimize the resulting incident impacts.

How do we begin to tackle the problem of roadway incidents?

Now that the nature of the problem has been described, let's consider some ways of handling the problem.

Incident management is defined as a planned and coordinated program to detect and remove incidents and restore traffic capacity as safely and as quickly as possible. By "planned" and "coordinated" we mean that the roles and responsibilities of all affected agencies or companies have been predetermined and agreed to mutually for both major and minor incidents. It is vital that each public agency or private company have input into the plan so that everyone comes away with what they need.

Responding to incidents is not new - managing response to incidents is relatively new. Unlike many new programs, incident management is not intended as an additional duty for already overburdened public agencies.

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[2]In some instances, inclement weather and acts of nature can be predicted with some certainty.

Summarized below are some of the implications of traditional and managed incident operations.

Traditional incident operations are often sequential. The police may do very little, if any, investigation while fire and medical personnel are on the scene. Likewise, the call to the transportation agency for sand or for investigation of road or structure damage may not occur until well into the incident. Similarly, tow trucks are often called out well into the incident. As a result, much time may be lost waiting for the right resources to arrive, and time is lost because concurrent operations at the scene are minimal.

Traditional Operations	**Managed Operations**
Sequential Steps	Concurrent Steps
Minimal or Forced Interdisciplinary Coordination	Interdisciplinary Sharing of Equipment and Personnel Resources
Minimal Understanding of Others' Roles	Increased Understanding of Others' Roles
Each Agency's Priorities Governs Its Actions	Unified Command
Results	
Risk to Responding Crews and to Motorists	Increased Safety for Responding Crews and Motorists
Inefficient Use of Personnel and Equipment	Efficient Use of Personnel and Equipment
Lengthy Clearance Times	Reduced Clearance Times
Long Traffic Back-ups	Reduced Traffic Congestion

An improvement over traditional operations is to perform duties concurrently. Many things can happen concurrently when responding agencies understand each other's capabilities and roles. Accident investigation (even for fatalities) can proceed while the injured are being removed and while towers are assessing how to remove a vehicle or even attaching rigging. The extent of concurrent operations must, of course, be governed by safety considerations. Under traditional operations, the extent of concurrent duties is governed by a lack of interagency understanding or by "turf."

Sequential approaches to incident operations typically resulted from an unwillingness to work closely together with other agencies. However, tremendous benefits can be realized by both responding agencies and the motoring public through increased interaction at the incident scene. The more closely agencies work together, the more they discover how they can mutually accomplish their objectives. A transportation agency may provide hand-held radios to key members of each agency on the scene to facilitate communication. Police and transportation agencies can share equipment and personnel when performing traffic control. Agencies can share funding sources to purchase equipment for incident management. The extent to which agencies can share equipment and personnel resources is limited only by creativity.

Working together is complicated by the fact that each agency or company has a different priority. Fire departments often close lanes in excess of the blockage to protect incident responders. Police departments may declare a fatal accident a "crime scene" and close the freeway to protect the integrity of the investigation. Although there is validity in both of these actions, both ignore the sense of urgency to keep traffic moving for safety reasons. It is possible to treat and remove injured persons, conduct accident investigations, and clear the incident in stages while maintaining traffic flow and properly protecting responders. But this can only happen with interdisciplinary understanding and close cooperation. When responders from one agency understand the roles, procedures, and abilities of the other agencies, significant misunderstandings and miscommunication at the scene of an incident are far less likely.

Usually the lack of interdisciplinary cooperation is not malicious in origin.

Police, fire, environmental, medical, transportation, and towing personnel are usually well trained and professional. It is quite common, however, for personnel in one agency to have little knowledge of the abilities, resources, and procedures of another agency. It is not reasonable to assume that all agency personnel become "experts" in other disciplines but instead have just a cursory knowledge of other agency roles and needs. One way to facilitate proper decision making without requiring everyone to be multidisciplinary experts is through unified command.

Unified command is a concept basic to the Incident Command System (discussed in more detail in Module 7 - Site Management) that asks not "who's in charge?" but "who's in charge of what?" A single point of contact is responsible for the overall handling of the incident, but decisions regarding specific actions needed by responding agencies are made through consultation with supervisors from other responding agencies. This "management by committee" can only be effective if there is a high degree of professional trust among the responding agencies. A major incident response team fosters this kind of cooperation; the same supervisory people appear at each major incident, and trust is developed through experience with each other.

More managed incident operations should result in the following:

- increased safety for responding crews and motorists by reducing the crews' exposure to dangerous traffic conditions and by reducing the potential for secondary incidents

- more efficient use of personnel and equipment through resource sharing agreements and reduced duplication

- reduced clearance times through concurrent duties

- reduced traffic congestion

The most important element for successful incident management is agency/company cooperation and awareness. For little or no capital outlay, improvements in incident management could result simply by improving agency and company relations. Equipment and new technologies can certainly benefit incident management operations but should not be viewed as the "simple solution." Larger and longer term benefits from incident management can only be achieved through improved agency and company cooperation.

What does incident management include?

For simplicity, incident management processes are typically categorized into five functional areas:

(1) detection and verification
(2) motorist information
(3) response
(4) site management
(5) clearance

Each of these functional areas are defined below.

Detection is the determination that an incident of some type has occurred. Incidents may be detected in person (i.e., motorists, aerial surveillance) or automatically (i.e., roadway loop detectors, video imaging systems). The occurrence of an incident is reported to the location where response is initiated (although the reporting process sometimes takes a circuitous rather than direct route).

Verification is the determination of the precise location and nature of the incident. Accurate and detailed information about the incident can help to ensure that the most appropriate personnel and resources are dispatched to the scene. As with incident detection, verification can be accomplished in person or automatically (i.e., closed circuit television, global positioning systems to indicate location).

Motorist information is the communication of incident-related information to motorists who are

(1) at the scene of the incident,

(2) approaching the scene of the incident, and
(3) not yet departed from work, home, or other location.

This information serves to reduce anxiety for motorists in the traffic queue, reduce the potential for secondary accidents for motorists approaching the scene, and allows motorists to alter their travel plans on the basis of current traffic conditions. Common methods of providing motorist information include commercial media reports, variable message signs, and "real-time" traffic reports via computer terminals.

Response is the activation of a planned strategy for the safe and rapid deployment of the most appropriate personnel and resources to the incident scene. Information management plays an important role in response; providing the necessary accurate and timely information to the appropriate personnel is critical.

Site management is the coordination and management of resources and activities at or near the incident scene, including personnel, equipment, and communication links. Successful site management relies heavily on agency and company cooperation and traffic management strategies.

Clearance refers to the safe and timely removal of any wreckage, debris, or spilled material from the roadway and the restoration of the roadway to its full capacity. Effective clearance relies on effective equipment utilization (i.e., appropriate towing and recovery vehicles, push bumpers) and an awareness of legal authority to speed clearance.

These five functional areas are not distinctly separate from one another but instead overlap. Processes or actions taken in any one of the five functional areas may be concurrent with actions taken in a different functional area. For example, media personnel may be continuously giving out motorist information while site management and clearance actions are being taken at the incident scene.

How does incident management differ from emergency management and the Incident Command System?

Emergency personnel, such as fire and police personnel, often question the distinction between incident management and emergency management. In addition, there is sometimes some confusion as to how both relate to the Incident Command System (ICS). The difficulty in distinguishing one from the others is understandable because there is some overlap.

Both emergency management and incident management rely on a formalized strategy to manage resources and perform necessary actions; the difference lies in the severity of the occurrence. Emergency management refers to a planned and coordinated program to respond to large-scale natural or man-made emergencies. Emergencies can include an earthquake or a hazardous material leak at a storage site. Involved in decision-making are high-level personnel from a multitude of agencies. Response actions may involve the evacuation of persons from the affected area. Only the largest roadway incidents would likely be considered an emergency. An overturned tanker truck carrying hazardous materials might qualify. Typically, in incident management, fewer agencies are involved in the response process, and decision making occurs at a lower personnel level.

Incident management in no way replaces the Incident Command System. Instead, the Incident Command System (ICS) can be thought of as a valuable site management tool for use under both emergency and incident situations. The ICS is a formalized system that lends consistency to the way personnel from various agencies function. The ICS is a modular system; its structure can expand to accommodate actions required at the scene of a minor or major incident up to large-scale emergencies. More detailed information about the ICS is provided in Module 7 — Site Management.

Why do we need incident management?

Consider the following real-life incident descriptions from Chicago-area roadways (Raub and Schofer 1997):

Educating the motorist. A two-car non-injury crash occurred at 4:00 p.m. in the intersection of two busy arterial roadways. One car was blocking a southbound and westbound lane. The tow service arrived after 25 minutes and drove the blocking vehicle off the roadway before towing it.

Improved site management/traffic control. A fire in a car parked along the shoulder of a four-lane divided roadway was being handled by the fire department. The fire truck was blocking one and a half lanes. A vehicle navigating around the fire truck stopped to look at the incident and was struck by a second vehicle. Both vehicles had to be towed and the first driver taken to the hospital. This second incident resulted in one direction of travel being closed for more than 60 minutes.

Interagency awareness. Drivers involved in a three-car, property damage only crash along a busy four-lane roadway waited at the spot of the crash for the police to arrive, blocking one lane for more than 20 minutes. The police officer, upon arrival, took the crash information without moving the vehicles. At one point traffic was backed up more than two miles. All vehicles were later driven from the scene.

Objectives/Benefits

Incident management strives to provide more effective involvement of all cooperating agencies. Effective involvement includes a high level of safety for response personnel, streamlined agency operations, positive public agency image, and improved service to roadway customers through reduced traffic congestion and improved safety.

The motivations and the methods for incident management vary depending on the time of day, the traffic environment, and the type of roadway.

<u>Daytime vs. Nighttime</u>

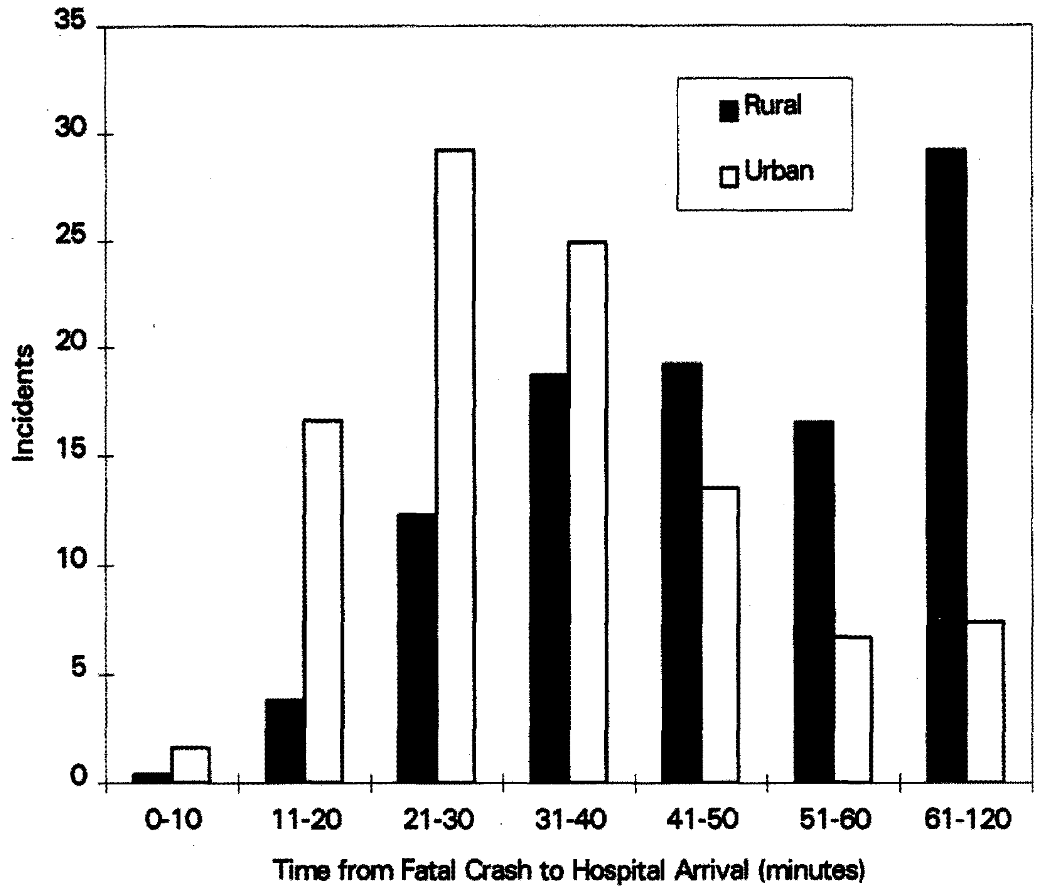
Emergency agencies, such as police and fire, operate 24 hours a day, and response is consistent no matter the hour. Emergency agencies are aware of the need for adequate response at all times of the day and, hence, have adjusted personnel and shifts to accommodate the need for continuous response readiness. On the other hand, support agencies, such as departments of transportation, are not typically prepared for continuous response readiness. The nighttime incident management process can be dramatically slowed if this response limitation is not recognized and accounted for. Many transportation agencies are dedicating on-call personnel and allowing response vehicles to be taken home in an effort to speed after-hours response. Unlike in the daytime, when traffic congestion typically motivates the speed with which the incident is handled, concerns under nighttime operations stem from personnel exposure under limited visibility conditions and a higher proportion of under-the-influence motorists in the traffic stream.

Peak Period vs. Non-peak Period

Certainly, the motivation for improving incident management efforts during peak traffic periods is to alleviate traffic congestion and reduce the potential for secondary incidents. If an incident occurs during the peak traffic period, often interim actions are necessary to mitigate the traffic congestion impacts. Incident responders can return during the non-peak traffic times to finish the incident clearance and clean-up. For example, if a large truck overturns in the morning peak, it may be pushed to the side of the road, allowing most lanes of the facility to be opened. When traffic volumes decrease (non-peak traffic periods), responders can then bring in the appropriate equipment to right the truck and tow it away without much additional disruption of traffic.

Urban vs. Rural

Traffic congestion is a primary motivation for improved incident management in urban areas but not necessarily in rural areas. Rural areas have very different incident management challenges. Low traffic volumes in rural areas result in slow incident detection times and slow response times. Incident verification is not always successful; automated verification methods (e.g., CCTV) are seldom available in rural areas, fewer report calls come in, and location markers are typically spaced farther apart. In some instances, if a vehicle travels off the roadway, it may remain undetected. Response vehicles must cover greater geographic distances to reach incidents. The figure below shows the relationship between urban and rural incident durations.



Freeway vs. Arterial

Incident management improvement efforts typically focus on limited access facilities rather than arterials or other streets. Non-limited access facilities have distinct advantages for incident management over limited access facilities. Although automatic methods for detection on arterials or streets is more challenging because of natural vehicle speed variations (e.g., traffic lights, stop signs), in-person detection is typically very successful.

Motorists, as well as adjacent business employees, are quick to report incidents. Public telephones are typically readily available for motorists to use if their vehicle becomes disabled. Motorists potentially delayed by an incident have multiple alternative routes to choose from. These same alternative routes can be used by response personnel to easily access the scene. Access onto and off of limited access facilities is much more challenging.

Improved Safety

Safety for both incident responders and motorists is of the utmost importance. The intent of improving incident management efforts is to reduce the amount of time that responders and motorists are exposed to traffic hazards and to provide better warning and guidance for motorists nearing the incident scene. A traditional reaction to a blocking incident is to close most or all of the roadway's lanes so that responders are adequately protected from passing traffic. This substantial disruption in traffic flow often results in additional incidents upstream of the initial incident. Safety problems can also occur downstream of the incident. Motorists experiencing lengthy delays may drive at excessive speeds or perform irrational maneuvers to make up for lost time after the roadway is opened again. Thus, this traditional operation style shifts the safety problem either upstream or downstream. A safer environment results if (1) traffic disruption is minimized (i.e., the minimum number of lanes is closed), and (2) adequate traffic control and management is in place to protect responders from passing traffic.

<u>Magnitude of the Problem</u>

From a humanistic perspective alone, improving safety for the motoring public and incident responders is a valid objective. Add to this, however, the economics of safety and the objective becomes indisputable. In 1994, the cost of vehicle crashes totaled $150.5 billion or, for perspective, $580 per person in the United States if those costs were solely the burden of private U.S. citizens. This astounding figure is a result of the 40,676 fatalities, the 5.2 million non-fatal injuries, the 3.7 million uninjured, and 27 million damaged vehicles caused by crashes in 1994. Fortunately, private U.S. citizens are not solely responsible for this burden. Private insurers and individual victims cover the majority of the crash-related expenses. Public revenues, including federal, state, and local taxes, cover only approximately 9 percent of the cost burden. Still sizable, 1994 crash-related costs paid for by public revenues amounted to $13.8 billion, or $144 in added taxes for each household. Crash-related costs typically include productivity losses, property damage, medical costs, rehabilitation costs, travel delay, legal and court costs, emergency services costs, insurance administration costs, premature funeral costs, and costs to employers. Although difficult to quantify in monetary terms, fatality crashes have been estimated to result in $830,000 worth of additional expense largely because of lost workplace and household productivity. Critically injured crashes result in only slightly less of a cost burden ($706,000, largely due to medical costs and, again, lost productivity) (NHTSA 1994).

According to NHTSA, minutes count. NHTSA has estimated that a reduction in incident reporting times from 5.2 minutes to 3 minutes (a time savings of 2.2 minutes) would result in a fatality reduction of 10 percent annually, or 212 lives. A reduction in incident reporting times from 5.2 minutes to 2 minutes (a time savings of 3.2 minutes) would reduce fatalities by 308 (1994).

New technologies that focus more on incident prevention and that are being introduced through the Intelligent Transportation Systems (ITS) program are estimated to, by the year 2000, reduce the number of fatalities by 1000, reduce injuries by 35,000, and save $1.8 billion. By 2010, reductions would include 11,000 lives and 440,000 injuries at a cost savings of $22 billion (FHWA 1992).

Secondary Incidents

Incidents can be considered secondary to a primary incident if the time and location of the incident can be correlated with the primary incident, including the queue dissipation times. Quantifying the actual number of secondary incidents is challenging; a high proportion of secondary incidents are likely minor and may never be formally reported to police agencies. This difficulty in accurately quantifying secondary incidents also makes it difficult to quantify the true benefits resulting from incident management efforts (i.e., traffic control).

A 1982 study by Lari, Adeel, et al., estimated that 13 percent of all peak period incidents on Minnesota's I-35 were caused by previous incidents. More recently it was reported that of all pedestrian fatalities on the interstate system, 18 percent of the deaths occurred while pedestrians were pushing or working on their vehicle and 7 percent of the deaths occurred when pedestrians were in the roadway following a previous incident (AAA Foundation for Traffic Safety

1997). Representatives from Chicago, Illinois' (1990 population 2,783,726) Emergency Traffic Patrol program report an 18 percent reduction in secondary accidents.

Vehicles on the Shoulder

Vehicles on the shoulder of the roadway are often viewed as non-hazardous because they do not block any portion of the traveled way. Fatality rates belie this assumption; 4.4 percent of all fatality crashes occur on the shoulder of the roadway (NHTSA 1993) and 40 percent of pedestrians killed while pushing or working on their vehicle are struck while on the shoulder (AAA Foundation for Traffic Safety 1997). Vehicles that are involved in a crash or that have become disabled are often moved to the shoulder as an interim measure until the vehicle can be more permanently removed from the roadway. If both the driver of the vehicle and response personnel are present, the vehicle typically does not remain on the shoulder for long. However, if the vehicle is abandoned on the shoulder (meaning the driver is no longer with the vehicle), the vehicle may remain on the shoulder for a longer period of time, exposing passing motorists to an added traffic hazard. Many state laws, unfortunately, allow vehicles on the shoulder for 48 hours or longer. With relatively high numbers of abandoned vehicles (Detroit, Michigan, estimates 4,000 abandoned vehicles per year), the traffic hazard risk is high. Through incident management efforts, the recognition of vehicles on the shoulder as a hazard is leading to "quick clearance policies" in which vehicles must be removed from the shoulder within typically two hours; vehicles must be removed immediately if deemed a hazard. More information on quick clearance policies is provided in Module 8 - Clearance.

Pedestrian-Involved Incidents

"Most people don't realize that stepping onto the interstate is about as dangerous as hanging out on a railroad track." — Chris Johnson of AAA.
"The shoulder is only a painted line." — Richard Retting of the Insurance Institute for Highway Safety

Pedestrian-involved incidents account for a relatively high number of fatalities on interstate highways. Pedestrians include persons illegally walking on the interstate highway, motorists out of a disabled vehicle, and construction or maintenance workers, and personnel providing assistance. In 1995, 543 pedestrians were killed on interstate highways. This accounts for 10 percent of all pedestrian fatalities even though the interstate system is only 1 percent of the nation's roadway mileage. Of those killed,

- 40 percent were crossing the roadway
- 18 percent were pushing or working on a vehicle
- 42 percent were standing near a vehicle, walking along the shoulder, or getting in or out of their vehicle

The majority of the pedestrian fatalities (75 percent) occurred at night. (AAA Foundation for Traffic Safety 1997 in USA Today, January 13, 1997) Response personnel should protect themselves by wearing reflective clothing at night. A police officer in a blue uniform at night takes a big risk.

<u>Hazardous Materials Incidents</u>

Large trucks carry a substantial amount of hazardous materials over the interstate highway system. The frequency of incidents involving hazardous materials, including the most common hazard, gasoline, increased nearly 34 percent from 1982 to 1991 (Parrish 1992). More frightening still, injuries to people as a direct result of hazardous material incidents soared 374 percent over this same time period (Parrish 1992).

Improved agency efficiency

Improving public agency efficiency is becoming increasingly important. Agency personnel are being asked to do "more and more with less and less." It is important that incident management not be viewed as an additional duty that requires additional agency commitment of personnel and resources. Instead, incident management should be viewed as a program whose aim is to streamline traditional styles of operating. Large improvements in incident management can be made with no additional expenditures if efforts are made to improve interagency or interdisciplinary relationships.

Traditional incident management procedures typically result in a duplication of tasks among agency or company personnel, duplicate or incompatible equipment among agencies or companies, and lengthy incident durations because of poor resource management and dispatch (not knowing who to call for a certain piece of equipment, not calling the closest available source). Multiple concurrent incidents, when handled in this way can strain an agency's ability to respond effectively. This traditional response to incidents likely sacrifices attention to other duties (e.g., maintenance, traffic enforcement). Incident management aims to improve efficiency so that incidents can be handled without sacrificing other duties.

Incident management can reduce both the number of personnel and pieces of equipment at the scene and the time that those personnel or resources are in use. This is important because personnel and equipment tied up at one incident can't perform other duties or respond to other incidents. If resources are available, having people dedicated to incident management allows them to gain experience, operate more efficiently, and develop good working relationships with other agencies, and it largely eliminates the need to pull others off the job to respond to incidents.

Reducing the time that response personnel are at the scene not only allows them to operate more efficiently but also reduces their exposure to dangerous traffic conditions. A consequent reduction in traffic-related personnel injuries or deaths may reduce or stunt the growth of agency insurance burdens. Shorter incident durations also reduce the potential for additional injuries or fatalities that would likely result in litigation. Substantial amounts of money can be saved through a reduction in liability claims. Liability issues are discussed further in Module 3 - Barriers to Effective Incident Management.

Reducing redundancy in equipment and resources among agencies not only saves unnecessary expenditures but also improves the working relationships among response personnel from different disciplines. Numerous examples exist of successful resource sharing.

In Salt Lake City, Utah (1990 population 159,936), the Utah Highway Patrol provided the Utah Department of Transportation (UDOT) with radar guns that were no longer certified for enforcement. UDOT incident management and maintenance personnel used the radar guns to slow traffic in and around incident scenes and work zone areas.

In Seattle, Washington (1990 population 516,259), the Washington State Department of Transportation (WSDOT) provided the Washington State Patrol's (WSP) Major Accident Investigation Team with total station surveying equipment. When this transaction was questioned by WSDOT administrators, it was pointed out that WSDOT, WSP, and the motoring public would receive equal benefit by speeding the process of accident investigation.

The Virginia Department of Transportation (VDOT) and the Maryland State Highway Administration (MDSHA) developed an agreement for snow plowing operations that allowed VDOT's trucks to plow and salt into Maryland, refill with salt in Maryland, and return, plowing and spreading salt, to Virginia. MDSHA's trucks operated in the same fashion. Through this resource sharing agreement, "dead heading" was eliminated, the job was completed more quickly, and better service was provided to the motoring public.

Improved public image

On the basis of often limited experience, the motoring public forms opinions and perceptions about public agency and private company personnel. These public perceptions can be very powerful and can actually influence policy decisions. It is important to take the opinions of the motoring public seriously and to not dismiss efforts of an agency or company to improve the public's opinion of it. Incident management can be a very effective method for improving public image.

With respect to roadway operations, transportation personnel are typically viewed as blocking the road, slowing traffic, causing delay. Police personnel are responsible for enforcing traffic regulations and consequently are typically met with negative response. The private sector is not immune to image problems. Towing and recovery personnel are thought to charge exorbitant fees for poor service (i.e., slow response, additional damage to vehicles). Incident management provides the opportunity for personnel to remove a blockage, improve traffic flow, and reduce delay.

Feedback from transportation and police personnel indicate that their involvement in incident management has helped to improve their public image. Transportation personnel involved in incident management commonly solicit feedback from the motoring public after being assisted. The response has been overwhelmingly positive. In fact, the Virginia Department of Transportation Safety Service Patrol recently compiled 309 positive letters from the motoring public in a "What the Customer Had To Say" report on its operation over the past 3 years. Washington State Patrol officers in the Seattle area responded positively to their motorist assistance role during the Goodwill Games in 1990. Patrol officers, in specially equipped motorist assistance vehicles, were met with positive responses from the motoring public. The towing and recovery industry is striving to change the current public image of its personnel through more training and professionalism (i.e., certification, uniforms).

Reduced traffic congestion

A simple analogy can be applied to better understand traffic flow in and around an incident. Consider water in the bathtub. The water poured into the bathtub represents the traffic volume. The bathtub outlet drain represents the roadway capacity. If the drain is not blocked, water will continue to run into and out of the bathtub without collecting. If the drain is blocked, water will begin to back up into the tub. The longer the drain is blocked, the more water will fill the tub. The more completely the drain is blocked, the more quickly the tub will fill. When the drain is unblocked, water will drain out. The water that is already in the tub, takes some time to drain. However, the water level will not go down if water is being added at the same rate that it is draining. This backup water represents the traffic queue. The more open the drain is, the more quickly the water will drain (i.e., opening as much of the roadway as possible without sacrificing safety will make the traffic queue dissipate more quickly). The best solution is to limit (1) the amount of time the drain is restricted and (2) the amount of restriction (not fully blocked).

The amount of traffic congestion caused by an incident is highly dependent on the duration of the incident, the number of lanes that are blocked, and the volume of traffic at the time of the incident. Reducing incident duration time reduces the number of vehicles affected by the incident and the resulting traffic queue. The extent of the roadway blockage also influences the number of vehicles affected by the incident. The actual reduction in roadway capacity has been found to be substantially greater than the portion of roadway blocked. Roadway capacity, remember, is similar to a bathtub outlet drain. Roadway capacity is affected both by physical blockages and by reduced vehicle speeds. On Houston's three-lane Gulf Freeway, researchers found that

- a one-lane blockage (stall) resulted in a 48 percent (not 33 percent) reduction in roadway capacity

- a one-lane blockage (non-injury accident) resulted in a 50 percent (not 33 percent) reduction in roadway capacity

- a two-lane blockage (accident) resulted in a 79 percent (not 66 percent) reduction in roadway capacity

- an incident on the shoulder resulted in a 26 percent (not 0 percent) reduction in roadway capacity (Dudek 1987).

This additional capacity reduction is the result of vehicles slowing to change lanes out of the blocked lane and to observe the incident ("rubbernecking").

Numerous other studies have attempted to quantify, on average, the impacts that result from incidents.

Incidents may account for 60 percent of urban congestion. By 2005, incident-related congestion may account for 70 percent of urban freeway congestion at costs in excess of $35 billion (Lindley 1986).

Incident-induced congestion cost the nation 1.3 billion vehicle-hours of delay at a loss of nearly $10 billion in 1987 (Cambridge Systematics, Inc. 1990). Given this estimate, a large metropolitan city like New York loses $1.2 billion per year, or $100 per person per year, because of incidents (Cambridge Systematics, Inc. 1990).

Studies conducted in California indicated that

- Every one minute of blockage during an off-peak period resulted in five minutes of congestion (Roper 1987).

- By reducing the duration of a one-lane blockage on Houston's Gulf Freeway from 18 minutes to nine minutes, vehicle hours of delay were reduced from 800 to only 200 vehicle hours of delay (Dudek 1987).

- Of the 18.4 million hours of delay Seattle motorists experienced in 1984, 58 percent were caused by freeway incidents (this number may rise to as high as 70 percent by the year 2000) (Jones, Mannering, and Sebranke 1990).

- A single accident that caused a 75 percent reduction in capacity and lasted 60 minutes during the afternoon peak period on Seattle's congested Interstate 5 in downtown Seattle would result in more than 15,000 hours of delay (based on traffic simulations) (Garrison, Mannering, and Sebranke 1990).

- Incident-induced delay resulted in over $250 million in lost travel time per year on the 20 miles of urban Seattle interstate studied (based on traffic simulations) (Garrison, Mannering, and Sebranke 1990).

Although the magnitude of these statistics illustrates how important it is to minimize the amount of time necessary to respond to and clear an incident from the roadway, the derivation of these statistics is not often understood.

To demonstrate how researchers derive these statistical values, consider this example describing conditions in Washington state. This example is remiss in that it uses broad estimations and ignores variations in traffic flow and incident characteristics. However, the intent of this example is to provide a greater understanding of incident-related statistics. Therefore, pay greater attention to the basic components and magnitude of delay resulting from incidents, rather than to the actual numbers used.

In Washington state, two to three accidents occur per every 1 million vehicle miles traveled, or vmt (WSDOT 1994). Vehicle miles traveled is a value based on the number of registered vehicles in the state and their respective annual mileage. The total vehicle miles traveled in the state of Washington is approximately 50 billion (WSDOT 1994). The combination of these two statistics indicates that approximately **125,000 crashes** occur in Washington State annually (2.5 crashes per million vmt x 50 billion vmt). Note that this estimation does not include unreported crashes, nor does it include vehicle disablements.

Of these crashes, only **20 percent result in a lane blockage** of any duration (the majority of accidents are minor; drivers can move the vehicles to the shoulder) (Cambridge Systematics, Inc. 1990). From this statistic, the number of lane blocking incidents in Washington can be estimated to be **25,000** per year (20 percent x 125,000 crashes).

Given the estimated frequency at which crashes occur in Washington State, considering a typical crash duration can determine the magnitude of vehicle delay statewide. Vehicle delay is based on a change (reduction) in the roadway's vehicle throughput. Vehicle throughput is dependent on the number of lanes available and the speeds at which the vehicles can travel. For urban, peak-period travel on the interstate, the vehicle throughput, or flow rate, is estimated to be 1800 vehicles per hour per lane (vphpl), assuming an average speed of 60 mph (Cambridge Systematics, Inc. 1990). Slower average vehicle speeds result in a lower vehicle throughput. For a four-lane roadway, 7200 total vehicles traveling an average of 60 mph will pass a point on the roadway after one hour (4 lanes x 1800 vphpl).

Vehicle delay typically comprises three components: (1) the lane that previously provided vehicle throughput is blocked, providing no vehicle throughput; (2) vehicles in the adjacent lane are traveling at reduced speeds (reducing vehicle throughput) because of the presence of emergency personnel or curiosity; and (3) vehicles upstream of the lane blockage start slowing and backing up as they try to change lanes.

Assume that a lane on the interstate is blocked during the morning commute for 30 minutes. Given 1800 vphpl as a base value, consider the three components of delay identified above. First, the blocked lane that previously carried 1800 vphpl can carry no vehicles for 30 minutes (0.5 hours). In other words, the flow rate in that lane changes from 1800 vphpl to zero vphpl, a difference of 1800 vphpl. Multiplying this change in flow rate by the amount of time the lane is blocked shows that **900 vehicles hours** of delay occur in the blocked lane.

In the adjacent lane, vehicles that previously traveled at 60 mph reduce their speeds to perhaps 30 mph (a typical value) because of the presence of emergency personnel, flashing lights, or curiosity. The flow rate in the adjacent lane is reduced from 1800 vphpl to approximately 900 vphpl, a difference of 900 vphpl. Multiplying this change in flow rate by the amount of time the lane is blocked shows that **450 vehicles hours of delay** occur in the adjacent lane.

After the blocked lane has been cleared, the traffic flow rate does not immediately resume to 1800 vphpl; instead, additional time is needed to accommodate the vehicles backed up behind the lane blockage. To better illustrate this phenomenon, consider the water in the bathtub. When the plug is inserted, water begins to back up in the tub. When, after several minutes, the plug is removed, the water in the bathtub does not drain immediately but requires time to empty. Similarly, time is needed for the traffic that collects behind the incident to clear. Before the blockage, traffic speeds in the affected lane were presumably near 60 mph. During the blockage, traffic speeds in the affected lane are zero. Immediately after the blockage has been cleared, time is required for traffic speeds in the affected lane to reach 60 mph. Assume that for 20 minutes after the lane has been cleared, traffic speeds are approximately 45 mph (a typical value). This speed results in a flow rate of approximately 1350 vphpl, 450 vphpl less than the typical flow rate of 1800 vphpl. Thus, for a 20-minute period, **150 vehicles hours of delay** occur (0.5 hours x 450 vphpl).

The sum of the three components of delay is **1,500 vehicle hours of delay** for a typical lane blocking incident. An extrapolation of this value to the estimated 25,000 yearly lane blocking incidents in Washington suggests that **37,500,000 vehicle hours of delay** occur statewide because of lane blocking incidents every year.

To express this delay in monetary terms, consider an average vehicle-hour value of **$10.00**; this value is based on a weighted average of motorist and trucker wages and an average vehicle occupancy of 1.2 persons per automobile (Cambridge Systematics, Inc., "Incident Management," October 1990). On the basis of this value, the monetary costs of incident delay are **$375,000,000** annually. This value is conservative in that it only considers delay costs associated with vehicle delay; clean-up costs are ignored.

Traffic congestion is obviously a strong motivation for improving incident management efforts in larger urban areas. However, the time delays and resulting costs are also staggering in smaller urban areas. Consider the following example from Baton Rouge, Louisiana. Computer simulation was used to estimate traffic impacts on a variety of roadway segments and for a variety of incident severities. The table below provide a description of the incident blockage (i.e., one, two, or three lanes), an estimation of the resulting delay, and an estimation of the resulting traffic queue characteristics (time to clear, length).

These estimates for incident-induced congestion involved only a single incident. Consider the extrapolation of these estimates to a one-year period. A conservative average estimate of delay per incident is 1,155 vehicle-hours based on the simulated incidents at the four locations described below. In 1992, 882 accidents were reported along I-10 that involved one vehicle colliding with another (Urban Systems, Inc. 1994). For this type of incident, one or more lanes would typically be blocked. In this case, the estimate of incident-induced delay jumps to 1,018,710 vehicle-hours of delay annually along I-10.

To express this delay in monetary terms, consider an average vehicle-hour value of $10.00; this value is based on a weighted average of motorist and trucker wages and an average vehicle occupancy of 1.2 persons per automobile (Cambridge Systematics, Inc. 1990). On the basis of this value, the monetary costs of incident delay would be $10,187,100 annually. This value is conservative in that it only considers delay costs associated with vehicle delay; clean-up costs are ignored.

Incident Impacts in Baton Rouge, Louisiana	BLOCKED	DELAY	QUEUE
I-110 On Ramp to Washington Off Ramp MP 155.49 to MP 155.84	1 lane	>1614 veh-hrs	>3 hrs
I-12 On Ramp to Essen Off Ramp MP 160.20 to MP 160.64	1 lane 2 lanes	895 veh-hrs >2888 veh-hrs	>2 hrs >6.5 mi
Mainline to Acadian Off Ramp MP 157.25 to MP 157.46	1 lane 2 lanes 3 lanes	no delay 356 veh-hrs >1236 veh-hrs	>90 min. >3.5 mi
College On Ramp to I-12 Off Ramp MP 158.53 to MP 159.59	1 lane 2 lanes 3 lanes	147 veh-hrs 1632 veh-hrs >1632 veh-hrs	>2 hrs >4.5 mi

As further evidence, incident-related delay was estimated to be 2,035,800 vehicle-hours annually at a cost of $22,323,450 along I-235 in Des Moines, Iowa (1990 population 193,187) (Wells 1994).

Further Reading

Parrish, Michael. "Spills from Rail, Truck Accidents on Rise." *The Sunday Oregonian*, September 20, 1992.

SOURCE: *The Sunday Oregonian*

September 20, 1992

Spills from Rail, Truck Accidents on Rise

By Michael Parrish

LA Times-Washington Post Service

Day and night, an intricate national transportation network hauls the commonplace poisons of modern Life across the countryside and through city neighborhoods.

Chlorine for water treatment, ammonia for fertilizer, pesticides, industrial acids, corrosives, explosives, and plain old gasoline are shipped in huge volumes along with dramatically expanding quantities of exotic new chemicals.

Small things frequently go wrong on trucks, trams, boats, and planes that carry these hazardous goods. Valves leak. Drums break loose. Trucks jackknife.

But big accidents happen, too. Then, the consequences can be enormous, as in two train derailments in California last year that brought environmental devastation to the Sacramento River and massive disruption to Ventura County.

Defenders say that significant improvements have been made in the transport of hazardous materials over the last 10 year.

Incidents rise 37 percent

But a Los Angeles Times computer study of nearly 68,000 hazardous materials incidents in that period confirms what anyone who has been injured, evacuated, stuck on a highway behind an overturned tanker - or worse, lost a friend or relative to a hazardous materials accident - knows:

While the U.S. transport system has yet to see the equal of Bhopal, India, or Chernobyl, people, land, and the economy have not been spared.

Hazardous materials incidents, ranging from a leaking 55-gallon drum to a tank car explosion, rose 37 percent from 1982 to 1991, according to U.S. Department of Transportation data analyzed by the Times.

Incidents involving trucks, which carry most of the hazardous materials, including the most common, notably gasoline, went up 34 percent. Injuries to people as a direct result of the truck spills soared 374 percent. On the nation's railroads, meanwhile, incidents large and small were up 36 percent. Among the most striking findings: Two workhorses of the transportation system, the non-pressurized rail tank car and the common truck tanker-trailer, were responsible for almost 85 percent of all damage reported.

Regulatory system blamed

Almost all of the deaths, 106 out of 108, involved tanker trucks.

Indeed, gasoline is the deadliest chemical transported around the nation, responsible for 52 of the deaths over the last decade. The category of flammable liquids accounted for the most hazardous materials incidents, almost 5,100, while sulfuric acid caused the most injuries and ammonia forced the most extensive evacuations.

Critics blame the federal regulatory system, which they say has too few inspectors, maintains haphazard records, performs little forward-looking research, and takes a weak approach to enforcement.

Government for the most part has left transportation companies free to police themselves in a system that may owe more to good luck than to foresight.

"Although we have been fortunate that more accidents have not occurred, there is no guarantee we will be as lucky in the future," James L. Kolstad, then-chairman of the federal National Transportation Safety Board, warned a House sub-committee last year.

Difficult questions face the public and policy-makers: How much risk should society accept in this commerce? How much regulation is appropriate? Should hazards to the environment be controlled as tightly as hazards to human life? How much can an industry be trusted to regulate itself?

HazMat: volume increasing

These issues are becoming critical because the volume of hazardous materials, or "hazmat," shipped across the country is increasing at an ominous rate. Every day, an estimated 500,000 shipments carry 4 million to 8 million tons; no one really knows how much.

The growth stems from industry's reliance on a grand new spectrum of manmade materials, many of them formed from dangerous compounds. Computer cabinets and lawn furniture, once made of steel, are molded from lightweight synthetics and composites. From ketchup to corn syrup, household commodities are sold in plastic bottles rather than glass.

Thirty years ago, biologist Rache Carson, in her landmark best-seller "Silent Spring," warned that the United States was manufacturing 500 new chemicals every year at what she described as the "impetuous and heedless pace of man."

Now, as many as 1,000 new manmade chemicals go into production every year.

Meanwhile, the transportation system is becoming increasingly complex.

Once, rail inspector, Leonard R. Keen, worried mostly about simple explosions, such as a fiery accident in Brownsville, TN., that killed three railroad workers in 1990. A truck driver hauling a common alcohol solvent used for dyes and paints tried to snake around the barricades at a railroad crossing and was struck. A small, yellowed photo of the locomotive, with the burned tanker truck flattened against its snout, is hung on a wall on Keen's office in Gardena, CA.

What troubles the National Transportation Safety Board inspector most these days, however, are the unknown cargoes hidden in containers and in piggyback trailers, which are increasingly popular methods of transportation.

As many as three different shippers or shipping consolidators handle such containers before loading them onto a raft car or truck. Each hand-off increases the chance that hazardous material will end up packed away without adequate warnings.

"It's a real problem," Keen says wearily.

In the view of Alan I. Roberts, a veteran Department of Transportation administrator who has developed most of the regulations that govern the shipping of hazardous goods, the last decade's statistics for deaths, injuries, and damage have been rather stable, despite the growing freightage.

The Association of American Railroads, the rail industry's trade group, says that major accidents in which dangerous materials are released are the lowest in a decade, though it estimates that hazardous cargoes have increased by almost 50 percent in the last five years. The trucking industry sees no basic safety problems either.

But critics contend that the transportation system cannot keep track of the chemicals it already carries let alone the rush of new materials to come.

The shortcomings of federal regulation of hazardous materials transport are not limited to keeping track of spills, critics say. Environmentalists, safety experts and congressional overseers say that too much power has been ceded to industry to oversee itself.

For most of this century, standards developed by the Association of American Railroads have been the basis of the federal regulatory system. And for the last 32 years, the trade group's Tank Car Committee, rarely challenged by DOT, which lacks the technical expertise, has controlled the design, constructions, and retrofitting of the nation's rail tank cars.

The spills, large and small, continue, almost 9,000 of them a year. Of these, about one incident a day could be considered significant, not just a leaky valve but an accident involving the transport of hazardous materials, according to the DOT.

Over the last decade, deaths from the shipment of such materials have averaged 10.8 a year. But that barely registers next to about 40,000 deaths annually of U.S. roads from routine auto accidents.

To Roberts and others, the hazmat figures hardly suggest a crisis.

Roberts said that rules should not be made "because some guy, somewhere, saw an accident and said, 'I think you should change every tank car in the United States because I saw this accident and I didn't like what I saw.'"

Rather, he said that the DOT has presided over major improvements in the transport network during the 26 years since it took over the job from the Interstate Commerce Commission. The DOT mandated that pressurized tank cars be made stronger and recently imposed industry-wide training standards and a commercial drivers' license program designed to ban dangerous truckers.

Now, Roberts says that he is "fine-tuning" the system.

Module 2
Incident Management and Intelligent Transportation Systems (ITS)

The goal of Module 2 is to define Intelligent Transportation Systems (ITS) and to clarify the relationship between incident management and ITS.

5. **Never stand** directly in **front of a stopped** vehicle.

6. To release traffic return to the shoulder of the road, turn the slow side of the sign to traffic, and with the free hand motion which lane *for* traffic to proceed in.

7. To slow traffic, hold the slow side of the sign facing traffic. If traffic doesn't slow enough move the free hand in an up and down motion with the palm facing down.

8. **Flaggers must plan an escape route in the event of errant or out of control vehicles.**

FLARES

Emergency road flares, or fusees, may be the only available warning device. Flares are not recognized as traffic control devices and should be used in conjunction with signs, cones, etc.

When using flares to close a lane or divert traffic they need to produce a long even taper. This can be done by setting the flares out at the designated speed limit in feet, i.e. 50 mph=50 feet spacing for flares, 35 mph=35 feet spacing for flares, etc.

Each flare is placed on a one foot offset. This means that it takes 13 flares to close a 12 foot wide lane.

Flares shall not be used at the scene of chemical or fuel spills, during windy conditions in dry brushy areas, or at other times when the flares may create problems.

SHOULDERS

When the traffic lanes are clear but the incident or equipment/responders

MODULE 2

INCIDENT MANAGEMENT AND INTELLIGENT TRANSPORTATION SYSTEMS

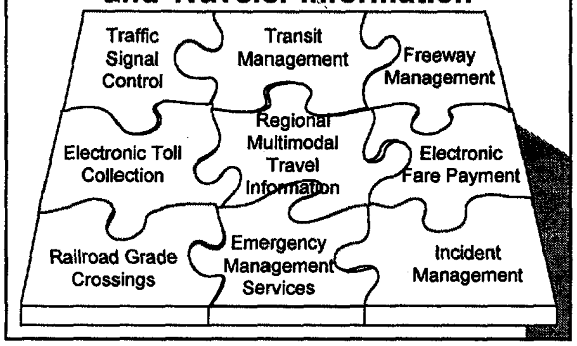
WHAT IS ITS?

Computer and communication technologies link vehicles, travelers and the roadway to improve efficiency and safety.

WHAT DOES ITS INCLUDE?

- Multimodal Travel Management and Traveler Information
- Commercial Vehicle Operations
- Advanced Vehicle Control and Safety Systems

Multimodal Travel Management and Traveler Information



ITS OBJECTIVES

- Easier, safer travel
- Improved traffic flow
- Quicker emergency response
- Better travel information
- Improved fleet management

IM-RELATED BENEFITS

Greatest potential for ITS benefit is in:

- Detection and verification
- Interdisciplinary communications
  - Voice
  - Data

IM-RELATED BENEFITS

Linked city's towers into roadway monitoring network for roughly $200

- Dispatched prior to request
- Response time reduced 5 to 7 mini
- Appropriate equipment is sent

- Richardson, Texa

IM-RELATED BENEFITS

Implemented "Traffic and Incident Management System (TIMS)"

- Incidents decreased by 40%
- Freeway closure reduced by 55%
- Incident severity reduced by 8%

- Pennsylvani

IM-RELATED BENEFITS

Expanding CHART to provide more automated traffic monitoring

- Anticipate 10:1 benefit/cost

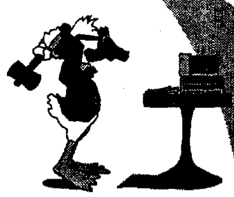
- Maryla

ITS ISSUES OR BARRIERS

- Lack of Cooperation and Coordination
- Antitrust Concerns
- Intellectual Property Considerations
- Inefficient Procurement Processes
- Limited Expertise

ITS ISSUES OR BARRIERS

- Lack of Design/Performance Standards
- Technical Issues
- Funding
- Liability
- Privacy Issues



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Module 2
Incident Management and Intelligent Transportation Systems (ITS)

Definitions

What is ITS?

Transportation engineers have been struggling with the problem of improving safety and mobility without relying on traditional methods of capacity expansion (i.e., building new or widening existing roads); the usual Intelligent Transportation Systems (ITS) is being touted as the solution. Instead of physically adding capacity to the roadway, advanced technology is applied, through ITS to help people use existing capacity more efficiently. More specifically, ITS involves the use of computer and communications technologies to address challenges in surface transportation. Computer and communications technologies enable the vehicle, the traveler, and the highway (infrastructure) to be linked to improve system efficiency and safety. Thus, a true system results where there was none before.

I'm not a transportation engineer, why do I need to know about ITS?

ITS may change the way non-transportation agencies operate. For example, using vehicle location technologies to track the locations of emergency response vehicles would ensure that the closest available vehicle was dispatched to the scene. In the long-term, this would improve the overall efficiency of the agency. As concepts and technologies like this emerge, it is important that non-transportation agency personnel have input to ensure that their needs are met. A second reason for non-transportation agencies to be aware of ITS is that ITS may provide you with resource opportunities that you would not normally have. Research and development, operational tests, and evaluations can all be funded through ITS.

What does ITS include?

ITS are not a single system but a composition of three major areas working together. These major areas have been identified as

(1) Multimodal Travel Management and Traveler Information
(2) Commercial Vehicle Operations
(3) Advanced vehicle Control and Safety Systems

Each is more fully defined below:

Multimodal Travel Management and Traveler Information

Multimodal Travel Management relies upon the collection and processing of real-time data to guide the management of various roadway functions, including freeway ramp metering and arterial signal control. Real-time data collected from vehicles on the roadway are sent to a traffic management center. Computers with advanced traffic control software process the real-time data and any other data (e.g., from vehicle probes) that may be available. After processing, adjustments are made to the roadway traffic control devices (e.g., ramp metering is adjusted). Dynamic traffic control systems respond to changing traffic conditions regardless of jurisdiction or type of road.

The goal of Multimodal Travel Management is to provide real-time traffic control capabilities that adapt to traffic movement, anticipating when and where traffic will be moving, so that signal and freeway control systems can provide optimum service. This maximizes the efficiency of the highway network and helps to maintain priority treatment for high occupancy vehicles (HOVs).

The real-time data collected and processed through the Multimodal Travel Management is then disseminated to travelers. Information is relayed as safety or warning messages in a variety of forms including in-vehicle navigation systems, informational kiosks, variable message signs, and highway advisory radio.

The goal of Traveler Information is to provide useful routing information that will move the traveler more safely and efficiently from origin to destination.

Commercial Vehicle Operations

Commercial Vehicle Operations include not only heavy trucks but also buses, vans, taxis, and emergency vehicles. More so than any of the other areas, Commercial Vehicle Operations afford ITS system users a tangible economic benefit.

Technologies to improve the safety and productivity of commercial vehicles include commercial vehicle electronic screening, automated roadside safety inspections, electronic commercial vehicle administrative processes, on-board safety monitoring, freight and fleet management, and hazardous material incident notification.

The goal of Commercial Vehicle Operations is to improve the safety of commercial vehicles by better tracking safety conditions and to improve the operational efficiency of commercial vehicles by sharing information electronically.

Advanced Vehicle Control and Safety Systems

Advanced Vehicle Control and Safety Systems assist drivers with various levels of vehicle control. Rudimentary functions include warning systems to alert drivers of obstacles or other vehicles. More advanced systems allow for limited vehicle control. Ultimately, Advanced Vehicle Control and Safety Systems are intended to provide fully automatic steering and distance control between vehicles.

Advanced Vehicle Control and Safety Systems have two goals: (1) to improve traffic safety by reducing human/vehicle interaction and consequently reducing the potential for human error, and (2) to improve capacity by reducing the traveling distance between vehicles.

ITS America

Serving somewhat as the catalyst for ITS development, deployment, and acceptance is the Intelligent Transportation Society of America, or ITS America. ITS America is a non-profit, public/private partnership that comprises more than 1,000 companies and corporations, associations, federal, state, and local government agencies, universities, international organizations, and other public and private organizations. ITS America is an official federal advisory committee to the U.S. Department of Transportation.

Where does incident management "fit" in ITS?

To describe how incident management "fits" in ITS, it is necessary to return to the discussion of Multimodal Travel Management and Traveler Information. Multimodal Travel Management and Traveler Information addresses a broad range of needs. These broad needs have been grouped into nine components:

- Multimodal Regional Traveler Information
- Freeway Management
- Traffic Signal Control
- Transit Management
- Electronic Toll Collection
- Electronic Fare Payment
- Highway Rail Intersection Safety
- Emergency Management
- Incident Management

Objectives/Benefits

The overall objectives for Intelligent Transportation Systems (ITS) are to provide

- better travel information
- quicker emergency response
- easier travel
- improved traffic flow
- fewer traffic jams
- improved fleet management
- faster freight deliveries
- easier, safer travel

The greatest potential for ITS benefit is in detection and verification and interdisciplinary communications (voice and data). Benefits in response, site management and clearance rely more heavily on the resolution of institutional issues. Some specific incident management-related benefits resulting from early ITS programs are described below:

The Institute of Transportation Engineers has estimated 10 to 42 percent decreases in travel time for incident management programs included in freeway management systems

The Minnesota Highway Helper Program estimated an incident duration reduction of 8 minutes for a minor incident (i.e., vehicle stall). This equates to an annual benefit through reduced delay of $1.4 million for a program that costs $600,000 annually to operate.

The City of Richardson, Texas, linked the operator of the city's towing concession into the roadway monitoring network for roughly $200. Using the information provided by the camera, the tow truck dispatcher can now position the appropriate equipment near the collision site prior to the request for service from the police department. This advance notice is estimated to reduce the tow truck incident response time by 5 to 7 minutes on average and greatly improves the ability of the dispatcher to send the appropriate equipment to the scene.

The Pennsylvania Department of Transportation reports that the implementation of their Traffic and Incident Management System (TIMS) has helped decrease freeway incidents by 40 percent, reduce freeway closure time by 55 percent, and reduce the incident severity rate by eight percent.

The Maryland CHART program is in the process of expanding to more automated traffic monitoring with lane sensors and video cameras. With these improvements, the program is expected to have about a 10:1 benefit/cost ratio, according to preliminary analyses.

INFORM (Information for Motorists), an integrated corridor on Long Island, New York, that provides (1) motorist information via variable message signs (VMS) and (2) traffic control using ramp meters has been estimated to

- decrease motorist travel time by 17 minutes during an incident
- decrease delay by up to 1900 vehicle-hours per incident
- decrease delay by up to 300,000 vehicle-hours annually

A survey in Marin County, California, showed that if regular commuters had been presented with alternative routes, including travel time estimates, 69 percent would have diverted and would have saved an average of 17 minutes in travel time.

A survey conducted for the Atlanta Advanced Traveler Information Kiosk Project indicated that 92 to 98 percent of the participants found information on accidents, alternative routes, road closures, and traffic congestion to be useful and desirable.

Benefits resulting from incident management and motorist information efforts vary greatly, depending on the size and type of program. Often, it is difficult to attribute benefits to a single effort because benefits resulting from incident management efforts are supplemented by overall freeway management efforts.

Issues or Specific Barriers

There are a number of potential barriers to the successful implementation and operation of an ITS system. However, none of these barriers are insurmountable and if they are identified and addressed early in the implementation process, they can prove to be of little consequence.

Lack of interagency cooperation and public/private coordination

Federal, state, and local public agencies must cooperate to successfully implement ITS. The current working relationships among the various public agencies is typically fragmented and confrontational rather than cohesive. The private and public sectors must also cooperate. ITS America is attempting to foster cohesion among various public and private entities. In addition, the clearly defined ITS architecture will describe appropriate working relationships among the various groups.

Antitrust concerns

Because ITS has the potential to significantly influence large-scale technology development and deployment, the ITS arena is ripe for antitrust violations. It is important to maintain a fair and competitive "playing field" for all private firms participating in ITS.

Intellectual property considerations

Whenever collaboration takes place, the potential for disputes over intellectual property rights is present. Concerns exist over a government agency's "control" over the development of new ITS technologies. Private firms need to recover costs and maintain their competitive edge by maintaining their intellectual property rights.

Inefficient procurement processes

Current procurement impediments include governmental inexperience with high-technology procurements, regulations for governmental contracting with private firms, and the potential for conflicts of interests.

Limited expertise for deploying, operating, and maintaining the ITS

The technical expertise needed to deploy, operate and maintain many ITS technologies may be beyond the current capability of many state and local transportation departments. Therefore, the private sector's experience in developing, marketing, and commercializing new products and services is essential to the success of the national ITS program.

Lack of design and performance standards

Industry design and performance standards are needed to effectively promote acceptability among users, limit liability, improve safety performance, and promote technological development.

Technical issues

Most of the ITS services depend heavily on the collection and/or generation, modification, and distribution of traveler and traffic information in a real-time environment. This presents numerous technical challenges, including the capture and integration of dynamic information from multiple sources; database maintenance to include only current, accurate, and reliable information; the selection of desired information for transmission to output interface devices; and the presentation of information via numerous user interfaces.

Funding

The development of an ITS program comprising various ITS user services may require substantial capital investment, depending on the type and extent of the services and technologies. The development of successful ITS programs requires monetary support at a federal level combined with other public or private sector matching funds. The USDOT budget for ITS for fiscal year 1997 is $235 million. This money has been allocated for research and development, operational tests, evaluations, the Automated Highway System program, and various "earmarked" projects across the country.

Liability

ITS services will continue to advance, providing more and more vehicle control and allowing for less and less human error on the part of the traveler. If ITS services should fail and serious or fatal injuries result, the liability responsibility will shift from the traveler to the public and private sectors responsible for the ITS.

Privacy issues

The public may be unwilling to provide personal information such as desired travel plans because of privacy issues. If consumers feel that input information required to support ITS services is a violation of their privacy rights, the result could be under-utilization of these information services and fewer consequent travel and transportation network improvements. In addition, the automated surveillance technologies used to collect traffic information necessary to support ITS services may appear to some consumers as "big brother" tactics, again lessening the potential success of ITS.

Further Reading

"Five Steps to Introduce New Technology." 911 Dispatch Services, In. 1990-1994

Zammit, Grant. "We have never done that before, but Cincinnati is going to do it anyway." ITS Quarterly.

DeBlasio, Allan J., and John P. O'Donnell. "ITS operational tests: lessons learned." ITS Quarterly.

Kraft, Walter H. "ITS operations and maintenance—issues and answers." ITE Journal, 1995.

SOURCE: 911 Dispatch Services, Inc.
1990-1994

Five Steps to Introduce New Technology

Your agency just spent several hundred thousand dollars on a new computer, telephone or radio system, and you expected your fellow dispatchers to be happy about the change. But instead, you're suddenly surrounded by a group of grumbling, surly employees.

It seems that whenever you introduce new technology into a communications center, your most reliable dispatchers turn into monsters and their performance suffers. Fortunately, this behavior is well-defined and can be counteracted by proper management and supervision.

Ironically, a dispatcher's reaction to the introduction of new technology is similar to learning that they have fatal illness. Now, no one would suggest that the introduction of CAD, trunked radio or other technology is as serious as dying. But the resulting stress can be just as destructive.

Psychologists have identified five distinct steps in the process of dealing with a fatal illness--denial, anger, bargaining, depression and acceptance. Dispatchers can behave like this, too.

When your best dispatcher learns he/she is going to have to learn new technical skills, they will deny it's occurring. They won't believe that technology is arriving and they'll be involved.

In this stage you notice a far-away look in their eyes when you talk about the new system. When you have meetings to explain your plans and ask if everyone understands, they say, "Uh-huh."

They believe the system won't work, that your agency will decide to get rid of it, and they can go back to life as it used to be.

"Awww, this thing will never get off the ground. Why learn all this new stuff and then it doesn't happen? If it really flies, then I'll figure out how to work it."

The introduction and explanation of new technology should be introduced in a regular fashion. First you tell them that it's coming and when. Then you give them an outline of what it all will mean. Then you set up formal training programs that require increasing levels of proficiency over time.

This process will help convince those in denial that the day is actually coming, and that they must be up to speed when it arrives.

Second, the dispatchers become angry. "Why do I have to learn something new?," they ask. When you're 45 years old, don't know anything about computers and feel that you're already performing perfectly, why should you change anything?

You notice a dispatcher sitting at his/her terminal fuming, muttering or pounding on the keyboard. You hear sarcastic remarks on the radio about how, "This new radio system won't let me do that!"

"They didn't get our input, they didn't train us, they don't really care if we know this new system or not. Why do we have to learn this anyway? The old way was working just fine. And we're not going to get paid any more money either. We'll just be working harder for nothing."

As a supervisor, the time to begin answering all these questions is before the technology arrives. Dispatchers should help screen, select and bring new systems on-line.

During this process, the answers to all of these questions will become obvious to them, and you'll avoid the anger that develops in this phase.

Third, dispatchers move to the bargaining phase. They begin to realize that the new system is inevitable, but they want a trade-off.

Sometimes they bargain with their supervisor or manager. Sometimes they will even bargain with God.

"Oh, please get me through this and I'll never hang up on an abusive caller again. I know I've been slacking off the past few months, but I'll do better-if You just help me remember the CAD commands."

To handle this phase, simply set equal expectations for learning the new system. Make it plain what personal effort you require, what the performance standards are, and the consequences of not meeting those standards.

If each dispatcher realizes that everyone is being treated equally and that no exceptions are being made, their attitudes will be more accepting to the new technology.

Fourth, the dispatchers realize the new technology is inevitable. They move to the depression phase.

They become less active and don't participate in group conversation. They have reduced enthusiasm for everything. They may perform effectively, but they're not doing anything extraordinary.

A supervisor sees this emotion frequently enough during normal times. It's a common human emotion and one that supervisors must learn to handle. The best way to handle it is lots of support and understanding.

Since supervisors have to learn new systems, too, it's a good opportunity to share your experiences with the dispatchers. Tell them what you're feeling as you learn the new system. Make them understand that what they're feeling is normal.

Lastly, dispatchers move to acceptance. They have reached the emotional and rational conclusion that the system's going to stay, that they have to learn it, and that it won't be that difficult. In fact, it may actually turn out to be a good thing.

"OK. I can bend with the times. This isn't really something I wanted to learn, but I guess it'll help us do the job better and easier. I just wish this training period would be over and we could get on with dispatching calls again."

If you're lucky, you may even have some dispatchers become experts. "Hey!

This is just like my computer at home. The keyboard's the same and the commands all make sense. Say, did you want me to help you train some of the other people? I'd be glad to help."

This can be a rewarding period but, like the other phases, it must be handled properly. You should consider how dispatchers in this phase will affect those who haven't reached this stage.

By the way, managers and supervisors must confront the possibility that some dispatchers may not adapt to new technology.

You should establish formal procedures for explaining the new system, training, question and answer follow-up, fine-tuning the system, update training, and formal performance evaluation--before the technology arrives.

After you establish these procedures, you can then decide how to handle those who don't measure up. Will you offer them other positions within the agency? Will you simply fire them? What are the union considerations?

If you understand all of these phases and what your fellow dispatchers are feeling, you're in a much better position to make new technology work successfully.

SOURCE: ITS Quarterly
Grant Zammit

"We Have Never Done That Before, But Cincinnati Is Going To Do It Anyway"

The Cincinnati Metropolitan Area is instrumenting 88 miles of interstate highway and freeways to integrate an interactive transportation management system. Once complete, this system will provide traveler information, increase mobility and improve air quality. Achieving this in a multi-state region posed a number of institutional challenges involving agencies and companies that are not accustomed to working with each other. This article reviews the challenges and strategies used to ensure that a valued project could be deployed on time and within budget.

In 1987 the Ohio Department of Transportation (ODOT), the Kentucky Transportation Cabinet (KYTC) and the Ohio Kentucky Indiana Regional Council of Governments (OKI - the Metropolitan Planning Organization for the Cincinnati Metropolitan Area) discussed the possibility of a Regional Traffic Management System for the Cincinnati Metropolitan Area. The goal was to increase mobility and improve air quality. To facilitate this discussion JHK & Associates was hired to develop a feasibility study. The final report for a Traffic Surveillance and Control System was presented to the OKI in 1989.

The OKI Regional Council of Governments then requested that JHK & Associates develop the preliminary design of a traffic management system for the regions' freeway system. This was completed in 1992.

In 1994 a contract was signed with TRW Inc. to be system manager for the final design, software development, integration and operation of the Regional Traffic Management System (RTMS). Later, Samaritania Inc. deployed freeway service patrols for weekday operation on the I-75 corridor. The preliminary design was modified to incorporate a Traffic Advisory Telephone System. A change order was executed, and SmartRoute Systems Inc. began operating SmarTraveler on June 28, 1995.

As the project took on a character of its own it was named the Advanced Regional Traffic Interactive Management & Information System (ARTIMIS). Full scale operation of ARTIMIS was scheduled for October 1, 1996. The system will cover 88 miles of the interstate highway and freeway system in the Cincinnati Metropolitan Area with an operations center in downtown Cincinnati. In addition to the operations center, the system includes:

- 60 closed circuit television cameras;
- 16 slow-scan phone controlled pan-tilt zoom cameras;
- 54 miles of single and multi-mode fiber optic cable;
- 1100 inductive loops, wide beam radar, and video detectors;
- 150 controller cabinets;
- 44 changeable message signs;
- 2 highway advisory radio (HAR) frequencies;
- 5 freeway service patrol vans;
- Fixed signs including HAR notification, and reference markers;
- Scanners and direct lines to local emergency response and transportation agencies;
- Fixed wing aircraft and vehicle probes;
- SmarTraveler traffic advisory telephone system (TATS); and
- Graphically-based operational control software.

This multi-state project is the direct result of the innovation, ingenuity, determination and cooperation of all of the project partners: the Federal Highway Administration (FHWA), KYTC, ODOT, and the OKI Regional Council of Governments. They have continuously been challenged to explore options for overcoming institutional barriers and for integrating common sense into system deployment.

THE PARTNERSHIP: HOW IT DEVELOPED

The Regional Council of Governments led the effort to organize the multiple agencies affected by, and funding, this project. The original contracts with JHK & Associates were administered by the tri-state metropolitan planning organization (OKI) with ODOT as the lead state agency. Upon completion of the preliminary design, it was suggested that the KYTC secure the engineering services of a system manager.

Due to the shared cost of the project, KYTC arranged for ODOT to participate on the selection committee, which had traditionally been a fixed pool of participants from Kentucky. The selection committee evaluated the proposals, invited a short list of interested consultants for interviews, integrated written and oral evaluation scores, and ultimately selected TRW Inc. A contract was executed on January 21, 1994.

Throughout development of ARTIMIS, the Ohio and Kentucky divisions of the FHWA have strived to eliminate redundancy in federal oversight and to speak with one voice.

DESIGN-OPERATE APPROACH

The OKI Regional Council of Governments, ODOT and KYTC requested that final design services, software development, system integration, and the two-year operation of the Regional Traffic Management System be provided by a system manager. Not being a "design-build" contract, the partners believed that the system manager should demonstrate the system's abilities. The benefits from this are that all of the "bugs" can be worked out before the system is turned over to the partners. Another possible result of this approach is that upon the completion of the two-year operations period, the partners may evaluate and conclude that privatizing ARTIMIS is the most viable option.

A byproduct of this design-operate approach has already been realized by the partners. The project has many subcommittees representing the participating public and private agencies. A team atmosphere has been instilled and each individual helps fellow partners. The deployment schedule has benefitted from this atmosphere and a unique relationship has been established with at least one consultant. This consultant has anticipated problems, is determined to stay on schedule and to hold down costs.

AN EARLY WINNER

During the final design process, the services of SmartRoute Systems Inc. were acquired to provide SmarTraveler, a Traffic Advisory Telephone System (TATS) capable of providing up-to-the-minute, route-specific traveler information. The partners realized that this service would provide an early winner to the overall program. The availability of TATS has fostered a public education effort, demonstrating what a future integrated transportation management system can provide.

Unlike traditional contractual arrangements, SmartRoute Systems Inc. has the option of repackaging and selling traffic data to other companies and to the public through various media with the stipulation that half the profit generated by SmartRoute Systems Inc. will directly reduce the public sectors' cost for the TATS Service.

There were initial concerns by elected officials and by the private sector regarding the procurement of SmarTraveler. These concerns focused on a government agency providing, at the public's expense, equipment for a private company. This was especially sensitive because of the pre-existence of at least one private company in the region that provides traveler information. A complete overview of the procurement process and a thorough explanation of ARTIMIS alleviated these concerns. Since operations began in mid-1995 a professional atmosphere and understanding has prevailed at all levels of the program.

PAYING FOR ARTIMIS

Metropolitan Cincinnati is a moderate nonattainment area for ozone. The state DOT's and the Metropolitan Planning Organization have committed Congestion Mitigation and Air Quality funds from the intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) to the ARTIMIS program. ODOT is leveraging toll road credit toward the state match of these funds, as permitted in Section 1044 of ISTEA. As a result, Ohio's participation in ARTIMIS has 100 percent federal funding.

The Regional Traffic Management System for the Cincinnati Metropolitan Area will cost $34 million. Approximately 75 percent of the funding is from Ohio, while 25 percent is from Kentucky.

REFERENCE MARKERS

The ARTIMIS partners determined early in the program that a reference marker system was needed. This will aid local emergency response agencies and ARTIMIS Control Center personnel in locating a freeway incident (route, direction and jurisdiction). This could also help in providing reliable information to the 911 communication centers in the region.

The need for this reference system was reinforced by the reality of the "Home Rule" in Ohio. This rule states that emergency response, and in some instances maintenance of the interstate system, is handled by local jurisdictions. Within Ohio's ARTIMIS area there are 51 separate jurisdictions. Another 20 jurisdictions are in the Northern Kentucky coverage area of ARTIMIS.

Following a survey through the American Association of State Highway and Transportation Officials and other reviews the KYTC and ODOT requested that a white on blue reference marker be used for incident management in ARTIMIS. The FHWA last year approved this experimental item. Initial acceptance and comments on this reference marker have been favorable among the local emergency response personnel. Because this is the first use of a reference marker the University of Kentucky is conducting a comprehensive evaluation to be completed for the FHWA by March 3, 1998.

CALL "311"

Last year Kentucky's Public Service Commission (PSC) ordered the Cincinnati Bell Telephone Company to assign the Kentucky Transportation Cabinet an N11 dialing code, 311, for two years. This dialing code will be used in the Traffic Advisory Telephone System (TATS) portion of ARTIMIS.

Just as the 911 dialing code is used for Emergency Response, the ARTIMIS project partners concluded that a 311 dialing code would benefit the TATS (SmarTraveler) component of ARTIMIS and add to the credibility of this public service project.

ODOT has submitted a similar request to Ohio's Public Utility Commission to obtain a 311 dialing code for the Ohio portion of the Cincinnati Metropolitan Area. A favorable finding by the PUC would mean that the public will only have to dial one number, 311, from any land-based or cellular telephone to receive traffic information.

During the first months of service in the Cincinnati Metropolitan Area calls to the ARTIMIS SmarTraveler reflect public favor. The partners attribute this success, in part, to the 311 dialing code. Calls to 311 are provided free to the motorist. The cellular telephone companies have worked with the public partners in achieving this service. KYTC and ODOT are negotiating with the local land-line telephone company to ensure that this will also apply to home and office calls.

THINKING MULTIMODAL

ARTIMIS provides a direct link between the region's transit providers and the SmarTraveler TATS. This is done by dialing 311 and entering the code for the desired transportation provider. In addition, the transit firms provide real-time traffic information to the program, a valuable component to the TATS service.

It is anticipated that ARTIMIS will expand information to the traveling public through other media, such as kiosks, cable television, and integrated public transit management.

CONSTRUCTION PROCESS

Roadway infrastructure for ARTIMIS is being constructed through individual contracts in each state. One concern was that if letting dates for contracts were different a contractor would have an advantage at a later letting. Coordination between the Kentucky and Ohio letting/sale date to ensure a common date and time alleviated this concern.

ODOT, in cooperation with the City of Cincinnati, is administering the architectural contract for the operations center. This is a first for both entities. The KYTC has contracted to procure the field devices for ARTIMIS, such as changeable message signs, closed circuit television, and the fiber optic network. This ensures hardware/equipment continuity throughout the system.

Kentucky and Ohio are working to employ a "seamless" program and in the process the technical services of in-house experts and in-house procurement procedures are at the disposal of the other state. As a result, implementation is streamlined and teamwork has been enhanced.

One example of such teamwork was the procurement of a phone switch to be installed in the operations center in downtown Cincinnati at a cost of about

$100,000. It was determined that the most expeditious and cost-effective procedure was to have the Kentucky Finance and Administration Cabinet (KYFAC) procure the equipment and install the switch through a facility management contractor. Having never done this before, the Kentucky Transportation Cabinet checked with counsel to ensure its legality. Once it was determined viable, a work order was executed to procure and install the equipment by the KYFAC.

NEW IDEAS, NEW THINKING

If the future is information-driven, it must be managed well. Transportation professionals must stay ahead of the curve by being creative, innovative and committed to providing the public with the most viable transportation system possible. Intelligent Transportation Systems (ITS) are one tool at their disposal.

With the decrease in federal funding and the resulting burdens placed on state and local transportation officials, new ideas and ways of thinking must be embraced, not fearing failure, but feeding off it. We must work with those who say "we have never done that before" and find a way to get the job done.

The partners in ARTIMIS have embraced this philosophy and continue to look outside the box. Time and again, when confronted with an issue or an unknown, the partners supported each other, reached a conclusion, and moved on. Because of this unique partnership the public benefits being created in the Cincinnati Metropolitan Area will be truly realized beginning October 1, 1996.

Acknowledgment

This article was made possible through the cooperative efforts of the Ohio Department of Transportation, the Kentucky Transportation Cabinet, the Ohio - Kentucky - Indiana Regional Council of Governments, and TRW Inc. Private companies were mentioned so as to provide a broader understanding of the institutional arrangements. Their inclusion does not endorse their services as a sole provider.

SOURCE: **ITS Quarterly, Summer 1996**
Allan J. DeBlasio and John P. O'Donnell

ITS Operational Tests: Lessons Learned

What are the issues that may constrain full deployment of intelligent transportation systems (ITS) and what can be done to overcome non-technical barriers? What lessons were learned which might expedite full deployment of these technologies? To get some of the answers the U.S. DOT's John A. Volpe National Transportation Systems Center reviewed 11 federal/y-sponsored operational test programs, one locally-funded ITS project, and conducted approximately 170 interviews with participants. The projects included in these comprehensive case studies were ADVANCE, Advantage 1-75, HELP/Crescent, TRANSCOM/ TRANSMIT, TravTek, FAST-TRAC, SmarTraveler TravelAid, Houston Smart Commuter, SaFIRES and Guidestar which included the Genesis and Trav/ink tests. The authors suggest that the institutional issues reviewed in this article are part of an education and learning process that should enhance, not deter, deployment of ITS.

The word education was mentioned many times during the Volpe Center's case study process as a solution to a range of issues. The project participants said, "Educate yourself, educate your partners, educate your management, educate your co-workers and subordinates, educate other possible players, educate government officials, and educate the general public." The project participants also encouraged learning. They said, "Learn from your partners, learn from the evaluation, learn from the general public and potential users, and learn from other operational tests."

When using the word education, the interviewees did not necessarily refer to a formal teaching process but rather identified the need to communicate openly with other participants, to discuss differences with them, and to make others not directly associated with the project aware of the specifics of the project. By using the word learning, they conveyed the need to better understand the goals and priorities of the other partners, to comprehend administrative and technical processes, to acquire training when needed, to understand the attitude and needs of the users, and to keep informed about what others are doing in the ITS arena. Several lessons learned emerged from these areas of education and learning:

MAINTAIN REALISTIC EXPECTATIONS

One interviewee put it very succinctly, "There's a lot to learn." Another commented, "The most important lesson I learned was patience. The project has come far, but it was a slow process." Potential ITS project participants must have a true commitment to the project, with a willingness to cooperate, and with an awareness that problems will arise. They must understand that the project does not proceed as perceived, and at times, the process does not go smoothly. Participants should not get alarmed if institutional issues are encountered because, as one interviewee noted, addressing these issues builds character. Some interviewees found that the start-up operations for ITS projects were more complicated and consumed more resources than they originally had anticipated.

Another participant volunteered this lesson: be prepared to make a large commitment. All participants must be prepared to invest a significant amount of time, effort, and financial resources in the project. They should assign staff full time and should expand the staff as the project grows.

PROMOTE A STRONG PARTNERSHIP

The most significant lesson in this area was that it is possible for public and private sectors to work together. Developing a partnership, however, is a difficult and time-consuming. The partners must establish a forum that will facilitate making decisions and building trust among the partners. Many interviewees suggested that this forum be established before the project is started. Interviewees also recommended that the members of this forum make a strong commitment that would last for the entire project.

Interviewees also strongly recommended that all stakeholders be identified as soon as possible and be included in the partnership and in the decision-making process. Some interviewees warned, however, not to force any organization to be a partner. A reluctant partner could be detrimental to the project.

The interviewees also felt strongly that all partners must understand the points of view of both the private and public sectors. Each sector must educate the other as to how it operates. Any suspicions or mistrust should be aired, discussed, and cleared early in the process so that a full understanding of other participants can be developed. The private sector must clearly understand that the major responsibility of the public sector is to ensure that funds are used to benefit the public interest. The public sector must understand that the private sector is in business to sell a product or service. Both the public and private sectors also must understand the agenda and priorities of the academic sector.

CLEAR GOALS AND OBJECTIVES

One of the most important lessons is that the project's goals and objectives must be defined clearly. This cannot be overemphasized. Many interviewees said that poorly defined goals or misunderstanding of goals by some partners was a major issue within their operational test.

Another important lesson learned was that the roles and responsibilities of the partners must be defined clearly. Several recommended that the partners develop and sign a partnership agreement or memorandum of understanding that clearly delineates each partner's roles and responsibilities.

The participants learned that there will be conflicts over partner selection, goals, and responsibilities, leading to delays and even partners leaving the project. Participants learned that the project will not fail if a partner leaves. They found new partners who would stay committed. Also, they recognized that some partners may be competitors and developed methods to address this issue. Interviewees stressed that partnerships must be assembled carefully, paying particular attention to each partner's compatibility and expertise.

The interviewees also stated that the contracting and auditing processes, the assignment of intellectual property rights, and the federal fund matching requirements must be defined clearly. Although public sector partners are more comfortable working with government requirements, such as the Federal Acquisition Regulation (FAR), than private sector partners, many interviewees admitted that the FAR and other requirements are complicated, confusing, and restrictive. Many interviewees recommended that the federal and state agencies responsible for project Oversight clarify their policies, processes, expectations, and interpretation of the various regulations and educate participants of ITS projects as to these items as early as possible.

PUBLISH GUIDELINES

Many individuals suggested that guidelines should be published, especially for the private sector participants who have not worked with federal or state transportation agencies. It was suggested that at least seven areas be covered: public-private partnerships, contracting procedures, intellectual property rights, auditing practices, funding and fund matching, termination clauses, and warranties. One interviewee suggested that project partners attend a five- to seven-day retreat early in the project to define goals and objectives, the partners' roles and responsibilities, the contracting and auditing processes, and the project schedule and milestones.

Although the interviewees recognized the need for formal contracting procedures, many stressed that flexibility is needed. Current procedures may not be appropriate for ITS projects because these projects contain major research and development components. They stated that both sides of the public-private partnership have to be open to new ways of doing business and that lack of flexibility could severely cripple a project. They said unanticipated changes to the contract schedule and scope of work should be expected and a process to handle these changes efficiently must be developed and put in place early in the project.

Some interviewees said partners must learn to communicate. They felt it was essential to establish a method by which all project participants would receive identical information and receive it in a timely manner. Some recommended that a staff person be assigned to coordinate communications. Other interviewees recommended Ways to make meetings more efficient. They suggested that formal agendas be followed and that attendees who are not committee members be prohibited from participating unless explicitly permitted by the members. They also suggested that, when appropriate, committees meet in executive session. Other participants recommended face-to-face communications and one-on-one meetings over letter and memo writing and large meetings.

The project participants also recognized that a public-private partnership may become strained when one partner becomes a vendor to another partner. One interviewee defined the roles of a partner and a vendor: "A partner is responsible for contributing resources, planning general progress of project, and concurring with project elements; a vendor is responsible for implementing a specific task within the project for a fee." A problem arises when a partner is also a vendor. Some interviewees felt that the private sector partner's legal status as a vendor created a problem within the partnership. Some interviewees were comfortable with this "partner as a vendor" relationship, but they were concerned that this issue may cause their relationship with a partner to change. The interviewees recommended that the definition of a partnership be defined more clearly. They also stated that alternate procurement and partnership agreements are needed which do not place partners in a subordinate role.

FOSTER CHAMPIONS AND LEADERS

Many interviewees agreed that one or more strong local champions are essential to an ITS project. Through their interaction with other partners, public officials, corporate executives, and the general public, project champions are the best educational and communications tool available. They need to be aggressive and push the project forward. If possible, they must be involved for the duration of the project. In several projects, the initiator and first champion left the project in the early stages. This left a void that was not filled immediately. Many interviewees stated that this lack of a champion slowed progress.

Interviewees also stressed that representatives of the partners should make a strong commitment to the project. Ideally, they should be able to represent their respective organizations for the duration, dedicate as much time to as required, and have authority to make decisions for their organizations.

Many stressed that having a good, full time project manager is imperative. They recommended that the manager be assigned on-site to the project, have clearly defined responsibilities, and be granted the authority to take independent actions or to consult with the partners in resolving problems. This manager must be supported by a staff dedicated to the project, whether it be full-time, in-house staff or consultant support. Interviewees from several projects mentioned that their projects suffered when they lacked a project manager or relied on staff working part time on the project.

Some stated that all project personnel should become knowledgeable in ITS concepts and practices. They must develop a standing and competence in the ITS area so that they can convince the appropriate persons, decision makers and potential users, of the benefits of ITS.

GAIN UPPER MANAGEMENT SUPPORT

Another very important lesson was that upper management support is crucial. Upper management must be convinced that participation in the project is beneficial to the organization. In a few projects, support from a governor's office or other upper management helped to overcome bureaucratic roadblocks and to resolve personnel issues. One private sector interviewee feared that too often the management of a company expected an ITS project to show a profit or sell more products in the next year. Private sector management must also understand that participation in an operational test does not mean that the company's product will be endorsed. Project participants must clearly present their management with realistic expectations.

If an agency plans to participate in an ITS project, the agency's management should analyze the availability and capabilities of their people. Management must understand the stress that the additional responsibilities will place upon the staff and the effect on its normal operations. They should decide in advance about what is required for project administration, the technical expertise that is needed internally, the ability of current staff to deploy, manage, and operate the system, and other resources to be committed. They must recognize that participation in a project may hinder day-to-day operations. Upper management must also understand that they must assign individuals who have authority to make decisions.

MOTIVATE COWORKERS AND SUBORDINATES

One public sector interviewee offered that "Involved employees become motivated and are a key to the success of the project." An interviewee from the academic sector agreed, "People are important. Pay attention to them and motivate them." ITS must be brought into an agency's everyday working environment and be promoted so other agency employees understand how IFS fits into their mission. The "big picture" must be explained to them and there must be a clear and concise commitment by any agency that wants to participate in an operational test. There cannot be opposing forces within an agency

When employees learn "new things," morale increases. Several interviewees recommended that a portion of the work be retained for the internal staff. They stated that adequate training is not a luxury; it is a significant and important element of a successful deployment. Organizations must identify training needs in administration, program management, and technical areas and provide this training up front and continuously. Some interviewees recommended that an agency build redundancy into the in-house administrative and technical skills to guard against a project crisis in case a key employee leaves.

The interviewees recognized that involvement in an ITS project may require agencies to change current and long-standing operating procedures. Be prepared to meet with some resistance. Some interviewees suggested that to expedite the project, lower level management needs to be empowered to make decisions. They also recommended that organizations that contain several levels of review and approval authority must identify one individual who has the authority to commit resources and make other decisions.

Participants recognized that individuals from other sections of their organization must be involved. The contracting, auditing, and procurement processes and the operations of the deployed system require involvement of the legal, administrative, and operations staffs. Interviewees stressed involving them in the process early to ensure that they understand the goals of the project and the interests of all the partners and that they have an opportunity to express their goals and priorities. Many interviewees stated that the "right" people were brought into the project too late. Several interviewees warned, however, that involving some individuals too early or too many individuals at one time may be self-defeating. An appropriate balance must be found.

REACH OUT TO NON-TRADITIONAL PLAYERS

During the course of the operational tests, participants recognized the need to involve other individuals and agencies. Transit agencies, truckers, law enforcement officials, highway and transit operations staff, and professional transportation associations were identified as key "non-traditional" players. Although the interviewees warned to be prepared to meet some resistance, they encouraged the involvement of these individuals and organizations by developing joint programs, and giving them meaningful roles.

INVOLVE GOVERNMENT OFFICIALS

Many interviewees stated that one of the best tools for educating public officials about ITS is a successful project. Politicians must answer to their constituents as to how their tax dollars are being spent and the benefits derived from these expenditures. More ITS projects need to be implemented successfully. Several stressed planning for an early success. An early success, even if small, will go a long way to build momentum, help obtain future funding, ensure greater public support, garner valuable participants, and set the stage for future successes.

Project participants have recognized that ITS must go beyond freeways and onto local streets. Some interviewees stressed that ITS proponents must reach out to local government officials and educate them on the benefits. Local officials often think of ITS as a highway program and that it will not benefit their constituents. The ITS planning process appears closed to them, and it is difficult to get representatives from the cities and counties to attend meetings when they do not see the projects as their own. The lack of vision in local government as to how to apply ITS to local streets and the lack of examples or models in ITS hinder local government involvement.

Many participants at the operational tests learned that funding for the operations and maintenance (O&M) of ITS systems is crucial. The current policy of most agencies is to fund capital improvements and not fund O&M over the long term. The participants were concerned that public officials would not realize that sub-optimal systems may be deployed to reduce the cost of O&M or full deployments would not be properly operated or maintained causing a degradation of the ITS service. They emphasized the need to explain this dilemma to the appropriate legislators and other officials and have the opportunity to obtain long-term O&M funding for systems involving advanced technologies.

EDUCATE THE GENERAL PUBLIC

There is a great need to educate the public about ITS. During the course of the reviews, only participants at one operational test experienced negative public reaction, but participants at many of the other tests saw negative public perception as a potential issue. One public sector interviewee stated that attention must be paid to the public, because they will be the biggest critic and are extremely vocal. Others said to be conscious of how the public perceives the project. The taxpayers are the ones who will ultimately decide if a project is going to work or not.

Some stated that a good public relations effort is required. They stressed keeping the public informed of the benefits of ITS. The traveling public must perceive that the project is acceptable and worthwhile and that the deployment of ITS technologies improves safety and mobility. Some recommended hiring a public relations officer to bring ITS to the forefront and to handle any public relations crises.

Several interviewees also cautioned do not oversell the system. Be accurate in the description of the system and its capabilities. Be realistic and do not overstate benefits. Successful deployments may not be perceived as successes if the public believes the ITS product or service should produce even greater results.

MARKET ITS ACTIVITIES

Participants at one operational test were especially concerned about properly marketing ITS services. They cautioned that one cannot assume that the traveling public will accept and modify their behavior in response to a voluntary ITS technology, such as an Advanced Traveler Information System (ATIS). Failure of the public to adopt the service may hinder the project from being a success and that inadequate marketing may hinder the public awareness of the system. One interviewee stated that the supply of traveler information will outpace the demand. Therefore, a market must be created by teaching consumers how to use ATIS effectively.

Participants in one operational test recognized that the public sector has little experience in marketing and that, nationwide, little is known how to market an

ATIS product. They suggested that the public sector should set marketing standards and not select specific marketing methodologies. They recommended getting the right mix between the public sector participants and marketing strategists, determining demand, and establishing a long-term marketing approach. Interviewees from this operational test also stressed that sufficient funds must be allocated to marketing.

EFFECTIVE AND TIMELY EVALUATION

Many interviewees stressed that one of the most valuable learning tools available to the project participants is the project evaluation. This must be valued by all the partners and be part of the fundamental plan of an ITS activity. As one interviewee stated, "It should be inextricably intertwined with the rest of the project."

The most important lesson was that the evaluation must be part of the project from the beginning. Interviewees from several tests stated that if the depth and scope of the evaluation were better defined at the start, the project would have proceeded more smoothly. Evaluation needs should be determined at the beginning of the project.

Some projects were not able to collect all of the required "before" data for the evaluation because the evaluation plan and the contract between the project partners and the evaluation team were not in place. Some interviewees felt that without good before-and-after data it will be more difficult to justify additional expenditures for ITS projects.

Participants in several tests experienced problems in defining the type of evaluation that would be performed. Some used terms such as test, evaluation, and demonstration, while others mentioned technical equipment testing, operational field testing, and evaluations system testing. The interviewees stated that evaluation goals, objectives, and type must be defined early in the project.

Most interviewees felt that the evaluation should be performed by a single and independent organization. They also said that a clear distinction of each partner's role in the evaluation is desirable. Several added that there must be flexibility built into the evaluation process. All agreed that the system needs to be implemented to have an effective evaluation, but in a couple of operational tests, delays in implementation caused delays in the evaluation. Other interviewees stressed that rigorous research methods are important. They felt that they could not claim any potential benefits of ITS technologies and services unless those benefits were determined by a valid evaluation methodology.

Some interviewees said that the evaluation is also a teaching tool. A good evaluation can be used to manage external perceptions and used to determine if future public and private investment is warranted. The partners also could use the evaluation to assimilate the lessons learned in their experience with the operational test and to share knowledge with others. One interviewee requested that a short course on evaluation based on the experience gained at the other operational tests be developed.

CONDUCT MARKET RESEARCH

Some interviewees believed that the full-scale deployment of ITS ultimately will be decided by the traveling public as measured by their willingness to pay for these products and services. Market uncertainty is an issue that could slow deployment. Surveys should be conducted and user willingness to pay should be assessed during evaluation.

A NATIONAL PERSPECTIVE OF ITS

Several interviewees recommended that project participants need to develop a national perspective of ITS and generate a "what's good for the nation" enthusiasm among transportation agencies and industry. Operational test players must interact at the national level, gain knowledge from that interaction, and apply that knowledge to the local project. The participants must understand what lessons have been learned at other ITS activities. At the same time, participants must be willing to share their knowledge with others at a national level. It is not in the national interest if participants are not open and do not discuss the knowledge gained from their ITS activities.

National interaction is also required to achieve the standards and seamless architecture required of ITS. Participants stressed that standards are very important and cannot be overlooked. Because private sector firms, especially smaller ones, are not sure what technologies will be used, they are reluctant to invest in research and development. Public sector agencies may be reluctant to implement ITS projects because, if the technologies they select do not meet the national standards, the technologies would have to be replaced. The lack of standards will also restrict the expansion of products and services to other agencies and geographical locations.

Some interviewees also recommended developing support for ITS by establishing local, state, or regional ITS organizations. They also stated that entrepreneurial firms, as well as established companies, must be encouraged to participate in ITS activities.

THE ITS "ADVENTURE"

The Random House College Dictionary' defines an "adventure" as an undertaking involving risk, unforeseeable danger, or unexpected excitement or as an exciting or remarkable experience. Based on this definition, participating in an ITS project is an adventure. Project participants assume risks when they commit resources and enter into new types of relationships. They face unforeseen hazards when they encounter institutional issues and non-technical impediments. They are engaged in an exciting experience. The hazards should not diminish the excitement of ITS, however.

Operational tests were designed to test Concepts in the real world and the results indicate that institutional issues will be encountered and can be overcome. Hopefully, potential partners will view discussions of institutional issues as part of the education and learning process associated with deploying ITS products and services and not as a deterrent to participation.

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SOURCE: ITE Journal, 1995
Walter L. Kraft

ITS Operations and Maintenance-Issues and Answers

One of the greatest challenges facing intelligent transportation systems (ITSs) in the United States might prove to be operations and maintenance. In a recent survey by ITE, transportation agencies reported a 20 percent to 25 percent shortfall in funding and personnel needed to effectively operate and maintain traffic control systems in place today. More than 40 percent of urban agencies rated their ability to operate existing advanced traffic management systems (ATMSs) as fair or poor, and two-thirds of state agencies rated their ability to maintain freeway ATMSs as fair or poor.

At the same time, the number of signals that are part of coordinated signal systems is expected to increase by 28 percent over current levels in the next five years. Indeed, over the same period an increase of 300 percent to 400 percent in the number of major freeway ITS elements (variable message signs, cameras, detectors and so forth) is projected.

If ITSs are not maintained and operated properly, their benefits will be lost and the public's investment wasted. However, operations and maintenance should not be an impediment to ITS deployment. We only need to apply our resources to be successful.

This article presents a discussion of the ITE Operations and Maintenance Conference, challengers of operations and maintenance, and recommended innovative approaches to operations and maintenance.

Conference on Operations and Maintenance

As a result of the research performed by ITE and the Federal Highway Administration (FHWA) concerning operations and maintenance, ITE conducted "ITE Operations and Maintenance," a conference held Oct. 15-16, 1994, in Dallas, Texas. Eighty-eight engineers, operators and maintenance personnel attended.

The conference's purpose was to address the challenge of operations and maintenance as it relates to ITS. White papers on selected operations and maintenance topics were commissioned and discussed during the morning plenary sessions of the conference.

Four workshops were conducted each afternoon to discuss the white papers presented during the morning sessions. The objective of each workshop was to identify issues and present prioritized recommendations with identified champions (white paper and workshop topics are listed below).

White Paper and Workshop Topics

- Introduction and Overview
- Education, Training and Technology Transfer
- The Need for National Standards for Operations and Maintenance
- Organizational Structure
- Opportunities for Institutional Cooperation
- Legal Aspects of Traffic Control Systems and ITS Maintenance
- Procurement Issues and Approaches
- Funding, Costs and Financial Benefits of the Operation and
- Maintenance of Traffic Control Systems
- Budgeting, Staffing, Equipment and Spare Parts

Underlying Themes

A number of themes were common to all sessions and workshops. These were identified initially in the reporter sessions and repeated in the workshops. The four most often repeated themes were:

- Where is the leadership?
- Where is the money?
- Whom do you trust?
- Is there existing information on operations and maintenance?

Issues and Recommendations

Issues were identified and discussed in the conference plenary and workshop sessions. They were grouped into the following six categories:

- Definitions
- The Knowledge Base
- Learning From Others
- Linkages Within the Transportation Profession
- Outreach (Reaching Outside the Transportation Profession)
- Changing Current Practice

Recommendations were developed based on the identified issues in each category. The recommendations were prioritized (high, medium and low) and a champion was identified. It should be noted that the recommendations in all three priority levels need to be addressed. Priorities were developed to provide a framework for addressing the recommendations and are not intended to minimize their need. The following sections discuss the issues and recommendations identified during the conference.

Definitions. It was determined in the sessions that several aspects of operations and maintenance are not defined clearly. In particular, there is no clear definition of operations and maintenance, a good example of operations and maintenance, or design standards that will reduce ongoing costs. Identifying the customer is another definition issue.

To resolve these issues, it was recommended that a high priority be given to 1) identifying the customers and their needs and 2) how to match project scope and objectives with realistic and obtainable goals. Champions for the former include FHWA, ITE, and state and local agencies; FHWA championed the latter. Of medium priority, it is recommended that intellectual property rights be defined and championed by ITS America. Low priority was given to defining operations and maintenance for the purpose of guidelines, with recommended champions being FHWA, AASHTO and ITE.

The Knowledge Base. Knowledge base issues ranged from costs to job requirements and included:

- No hard data on costs.
- Separation of maintenance and operations.
- Timely dissemination of information to the profession about educational opportunities.
- Establishment of skills/knowledge requirements and job descriptions for traffic control system staff.
- Development of a formalized program to identify professionals with specialized areas of expertise.
- Life cycle costs for operations and maintenance.
- Evolution of the procurement process.
- Intellectual property rights.
- Availability of guidelines for operations and maintenance.

- Case law on operations and maintenance of ITS.

Many high-priority recommendations were identified for this category:

- Develop a comprehensive national database of training opportunities that would include interdisciplinary training for both professional and technician/ paraprofessional consistent with the long lead time needed for budgeting (ITE).

- Identify unique/successful training and educational programs and publicize the success and value of the training. Disseminate information to system managers and administrators to promote support and use (ITE).

- Form regional task forces as originally recommended by the FHWA Expert Panel to revisit existing systems to evaluate performance (FHWA and State DOTs).

- Perform a bench marking study to define good maintenance and operations to meet desired performance objectives (FHWA, AASHTO, ITE).

- Develop a synthesis of actual agencies that have good transportation operational units, and develop a list of recommended functions found in a successful transportation operational organization (FHWA, ITE).

- Develop a body of knowledge on procurement practices, including legal issues, resulting in a white paper (FHWA, AASHTO, ITE).

- Form a task force or team with groups--such as ITE, AASHTO, TRB, ISMA, ITS America and FHWA--to develop guidelines. This task should subdivide the guidelines into different operations categories, such as a freeway system, a traffic control system and so forth. Requirements should be based on the size and complexity of system elements. Ways to reduce ongoing operations and maintenance costs should be developed. Staff and equipment levels should be based upon TOC functionality and system size (ITE).

- Determine liability of new technology deployment (ITS America).

- Maintain an ongoing database on costs of systems (FHWA). • Share successful strategies and techniques (ITE).

- Develop standard evaluation methodology for benefit/cost analyses to include benefits due to safety, air quality, reduced delay and travel time, reduced fuel consumption, impact on local businesses, impact on delivery of goods, military job conversion, reduced liability, public convenience and user costs (FHWA).

- Continue research on new innovative approaches and related issues, including software procurement, life cycle costs, design-build, RFP process for equipment, professional services, partnering and privatization (TRB).

Medium priority recommendations were:

- Review issues that affect software and define the need for documentation (ITE, ITS America).

- Hold traffic forums for technology transfer to increase knowledge and expertise and to build trust (ITE).

- Research new technology to reduce costs (TRB).

Learning from Others. The major issue in this category was "We have not learned what other industries are doing with operations and maintenance of similar systems." Much of the technology that we are using originated in other industries, such as fiberoptic communications in the communications industry and video imaging in the manufacturing industry. What procurement methods have been successful? As more defense contractors enter the transportation field, the opportunities and cross-fertilization should become greater.

A high-priority strategy recommended to solve these particular issues was to investigate and develop a synthesis of organizational structures of other decision support systems--such as the Federal Aviation Association and the military--and be championed by TRB. Of medium priority, the guidelines used by others for the maintenance and operations of systems including other industries and other countries should be determined and examined for possible application. U.S. DOT was recommended as the champion.

Linkages' Within the Transportation Profession. The issues raised in this category pertain to the relationships among agencies and entities within the transportation profession. Some of the issues that were identified include:

- Uniform nationwide legislation concerning liability.
- Interagency agreements.
- Liability considerations.
- Lack of incentive.
- The academic community's role.
- Internal institutional barriers
- External institutional barriers.
- Learning to be flexible.
- Interdisciplinary approaches.
- Combining small groups within various agencies for greater efficiency.
- • The transportation engineer as system integrator and the link with others.
- • Keeping professors, students and teachers up-to-date.
- • Selling ourselves within our own agency.
- • Maintaining interest.
- Sharing successful strategies and techniques for operations and maintenance.

High-priority recommendations for "Linkages Within the Transportation

Profession" were:

- Get a buy-in from all involved or potentially involved parties, such as police, fire, local agencies and so forth, when establishing a TOC (state and local agencies).
- Staff a new TOC; personnel may be obtained by privatizing other traditional traffic operations activities (state and local agencies).
- Develop interagency agreements that are comprehensive, formalized and contain hold harmless clauses (state and local agencies).
- Develop model intergovernmental agreements (FHWA, ITE).
- Identify incentives for cooperation, including political and administrative "must have" elements in the system (ITE, state and local agencies).
- Identify means to maintain cooperation (state and local agencies).
- Develop a team approach (state and local agencies).
- Make the transportation engineer the system integrator and the link with others (state and local agencies).

Medium priority recommendations were:

- Learn how to coordinate and combine agency efforts to share expenses (state and local agencies).
- Determine means for the regional agency to facilitate the overall system (state and local agencies).
- Promote the joint use of the technical infrastructure and tie in environmental sensors to the traffic management centers, share communications lines, monitor all roadway electrical systems, and so forth (U.S. DOT).
- Permanently (or at least temporarily) bring disciplines together to work

system development. One way is to have operations ,red maintenance personnel to work on design (state and local agencies).

- Encourage universities to use practitioners from industry for teaching students/graduates in specialized transportation disciplines and develop funding to support this effort (U.S. DOT, ITE, universities).

- Develop a short course for training transportation and traffic engineering principles to nontransportation professionals and technicians involved in supporting operations and maintenance of ATMS and ITS projects (U.S. DOT, universities).

Low priority recommendations included:

- Determine how small maintenance units can be combined for greater efficiency to reduce overhead costs (state and local agencies).

- Develop a technical engineer/executive loan program (FHWA, ITE).

Outreach. This category, although similar to "Linkages Within the Transportation Profession," is essentially different in that outreach deals with linkages outside the profession. Outreach issues that were identified include description of our mission; public benefits and activities; relationships with our partners (such as police, fire, sanitation and EMS); maintaining interest; benefits to the community; availability of deliverables; and how to reach out.

High-priority recommendations include generating information and materials that agencies can use to communicate the benefits of traffic operations and maintenance (FHWA, ITE); encouraging transportation agencies to lobby their respective states for legislative changes in liability laws to reduce and limit lawsuits (AASHTO); agencies requiring private Sector suppliers, contractors and manufacturers to carry adequate product liability insurance (state and local agencies); and developing a public education process to communicate the benefits of traffic operations (state and local agencies).

Under medium priority, it was recommended that information be gathered on the benefits and cost-effectiveness of operating systems to obtain agency, decision-maker and legislative support for budgeting and staff requests

(FHWA).

Changing Current Practice. Issues related to changing the current practice included:

- Knowing who is in charge.
- Having a champion.
- Hiring necessary technical expertise.
- Realistic project scope and attainable goals.
- Agencies becoming more adaptable to change.
- Deploying more proven technology.
- Supplementing in-house and apprenticeship programs.
- Processional development to help retrain and enhance the skills of practicing engineers.
- Stabilizing funding. Recommendations for this category will require us to change our present procedures and operations. Those with a high priority are:
- Redefine system maintenance for ITS projects to be included in operational support to ensure full functionality (FHWA).
- Expand allowable warranty periods for ITS system components and include funding for operations and maintenance activities during that time (FHWA).
- Propose to Congress the removal of the two-year limit on operations on the National Highway System and Congestion Mitigation and Air Quality Improvement Program (FHWA, ITE, AASHTO, ITS America).
- Propose to Congress that 10 percent of project funding be set aside for operations and maintenance (FHWA, ITE, AASHTO, ITS America).

- Make ITS deployment sustainable by using life-cycle analyses to determine project costs and benefits (FHWA, state and local agencies).

- Make greater use of innovative funding, with a percentage dedicated to operations and maintenance (state and local agencies).

- Identify critical system components and include provisions for spare parts when designing to ensure system dependability and interoperability (state and local agencies).

- Have joint requirement contracts for signal maintenance, equipment purchasing and so forth. (state and local agencies).

- Develop risk management programs that encompass emergency plans, incident management plans, preventive maintenance plans, training, staffing and record-keeping programs (state and local agencies).

- Form a committee on operations and maintenance of ITS (ITE).

- Encourage federal/state flexibility and experimentation in innovative approaches to procurement (FHWA, AASHTO).

- Develop a plan of systematic funding sources for operations and maintenance (AASHTO, ITE).

- Increase the emphasis on preparation and commitment to the current requirement for system implementation plans, with emphasis on long-term employee training and development (FHWA).

Medium-priority recommendations are:

- Have a full-time project manager oversee development of all elements of a system (state and local agencies).

- Develop educational and outreach programs for states and locals on procurement alternatives (ITE, ITS America).

- Set up procedures for open software and hardware standards (FHWA, ITE, ITS America).

- Assemble an outside expert panel to review FHWA's Implementation Plan (AASHTO).
- Review funding sources for operations and maintenance (ITE).
- Link guidelines to actions (FHWA).
- Establish stable funding sources for ITS training, including classroom training, internships/co-op and short courses (U.S. DOT).
- Develop programs to train and certify technicians to operate and maintain ITS systems (IMSA).
- Provide funding to universities to support co-op programs, internships and assistantships for on-the-job training at operating ATMS-ITS projects (FHWA, universities).

Low-priority recommendations include:

- Establish civil service career paths for nontransportation professionals (federal, state and local governments).
- Consider effective operations in planning transportation systems (state and local agencies).
- Overcome institutional issues through legislation (federal, state and local governments).

Summary

This conference brought together experts from different organizations and geographic areas of the country. Their active participation identified the issues that should be representative of those that we face in this country. These owners, designers, implementors, operators and maintainers of ITS have shown us a path to the future by their recommendations. Our challenge is to use their recommendations to plan for, be prepared for, and influence the future. Deployment of ITS may well depend on the implementation of these recommendations.

FHWA and ITE Project Activity

FHWA and ITE have initiated a multifaceted project to address many of the issues and recommendations generated by the conference. The purpose of the overall project is to provide support to traffic engineers in meeting current and future challenges, including the alleviation of traffic congestion, the improvement of traffic safety, and the deployment, operation and maintenance of ITS. The project activities will include:

- Developing guidelines and models for use by agencies in operating and maintaining traffic control systems.
- Providing input from the traffic engineering community into the development of current and future ITS standards and protocols.
- Presenting professional development seminars on ITS and other issues.
- Conducting tours of national and international ITS sites.
- Developing an education and training curriculum for traffic engineers.
- Developing a traffic engineering certification program.
- Enhancing the ITE information clearinghouse and technical request service.
- Developing information for decision-makers and the general public on traffic engineering issues.

Challenges

The major challenges in operating and maintaining ITS are providing the needed levels of funding, skill and expertise. Surveys and research performed by ITE and FHWA have revealed that traffic control systems and other elements of ATMS are in poor condition. In addition, budget shortfalls are a common occurrence at the federal, state and local governmental levels. ITS operation and maintenance requirements place an additional burden on transportation agencies.[2]

Other challenges faced in operating and maintaining ITS are institutional in nature. Implementation of ITS requires cooperation within agencies as well as between separate agencies or organizations.[3] This is true for operations and maintenance as well. Policies and procedures must be established to determine who will be operating or maintaining which components, especially in the case of multijurisdictional systems. Pooled maintenance of equipment may be required.

Let's Be Innovative

So, let's be innovative in our approach to operation and maintenance of ITS. There are several approaches to operations and maintenance that can be taken to minimize costs, improve facilities management and increase efficiency. The three approaches presented here are resource sharing, incentive programs and contracting for services.

Resource sharing involves the cooperation of several agencies within a county or community. These agencies can pool their resources to operate and maintain all facilities within an area, reducing overhead costs, direct costs and labor. Resource sharing-also can improve coordination of traffic signal systems in adjacent jurisdictions and communications between agencies.

Incentive programs have the potential to maintain interest and improve the efficiency and performance of operations and maintenance staff. By providing some type of incentive, such as monetary bonuses, there is an additional reason for operations and maintenance staff to perform at the highest level possible. For example, sometimes during construction activity, a monetary bonus is awarded if the agency finishes the work prior to the target date.

The third approach is contracting private organizations to perform operations and maintenance of traffic systems. For example, a long-term (five-years) contract can be awarded to a private agency, which is then responsible for the operations and maintenance of the system according to specified standards for that time period. The benefits to the public agency include reductions in overhead costs, labor costs and management time. In many cases, it takes a considerable amount of time and money for public agencies to acquire the materials they need for operations and maintenance. Contracting for these services allows the private agency to procure the necessary materials in considerably less time. There is also a possible reduction in liability costs associated with contracting services if the governmental agency is not the operating unit. For many government agencies facing budget and personnel cuts, contracting for operations and maintenance currently presents an attractive alternative.

Conclusions

We have a shortfall in funding and personnel needed to operate and maintain traffic control systems effectively. In the future we will have more to operate and maintain. The challenge is to do more with less.

Although ITE, FHWA and other organizations created a much needed awareness on the issue of funding for operations and maintenance, implementation of many of the recommendations made at the ITE conference may be hampered by the current environment. Therefore, it is imperative that the ITS community at large remain active in creating conditions for implementing the recommendations.

At a time when budget cuts are a common occurrence at all governmental levels, we have to be more innovative in our approach to ITS operations and maintenance. Institutional issues must also be addressed to clarify the responsibilities of each transportation agency involved in the deployment of a particular ITS facility.

In addition to implementing beneficial recommendations, policy-makers must address some of the operations and maintenance issues early on in ITS deployment. Failure to do so could result in a poor state of intelligent transportation systems from the beginning, hurting the public's acceptance.

The future is not as bleak as it seems. By being innovative, we can succeed.

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Module 3
Challenges to Effective Incident Management

The goal of Module 3 is to introduce typical challenges to effective incident management so that they may be addressed early in incident management efforts.

MODULE

CHALLENGES TO EFFECTIVE INCIDENT MANAGEMENT

IM CHALLENGES

- Awareness among responders
- Administration/funding
- Operations a...
  - Communications
  - Liability
  - Training
  - Documen...

RESPONDER AWARENESS

MISSION	Secure incident scene, collect evidence, prevent secondary incidents, and ensure safety
CONFLICTS	Lengthy investigation duties may inhibit quick clearance
SOLUTIONS	Total station surveying equipment, electronic documentation

RESPONDER AWARENESS
FIRE

MISSION	Provide first response emergency medical and rescue services
CONFLICTS	Block lanes and are reluctant to follow other responders' directions
SOLUTIONS	Sensitizing fire personnel to the larger IM goal

RESPONDER AWARENESS
EMS

MISSION	Preserve life through prompt emergency treatment and rapid transport to hospital
CONFLICTS	May unnecessarily block lanes
SOLUTIONS	Sensitizing EMS personnel to larger IM goal

RESPONDER AWARENESS
DISPATCH

MISSION	Quickly and accurately convey information to responders, media, etc.
CONFLICTS	Detail may get lost, different 10-codes cause confusion
SOLUTIONS	Dispatcher training, CAD

RESPONDER AWARENESS

TRANSPORTATION

MISSION	Restore the flow of traffic as quickly and safely as possible
CONFLICTS	Not all operate 24 hours a day, after hours response suffers
SOLUTIONS	Establish on-call procedures, take response vehicles home

RESPONDER AWARENESS

TOWING/RECOVERY

MISSION	Remove and recover vehicles to clear the roadway
CONFLICTS	Slow response, inappropriate equipment
SOLUTIONS	Taxi-stand style dispatch, describe nature of incident rather than request equipment

RESPONDER AWARENESS

MEDIA

MISSION	Uncover and report stories of public interest to attract the largest possible audience
CONFLICTS	May hinder the management effort, may condense information, omit details
SOLUTIONS	Follow chain of command for communicating with media

RESPONDER AWARENESS
CORONER

MISSION	Investigate and pronounce death
CONFLICTS	Slow response to the incident may delay incident clearance
SOLUTIONS	Have qualified EMTs conduct required exam

RESPONDER AWARENESS
COMMONALITIES

- All serve public safety
- All exposed to danger
- All presented with emotionally charged situations at incident scenes

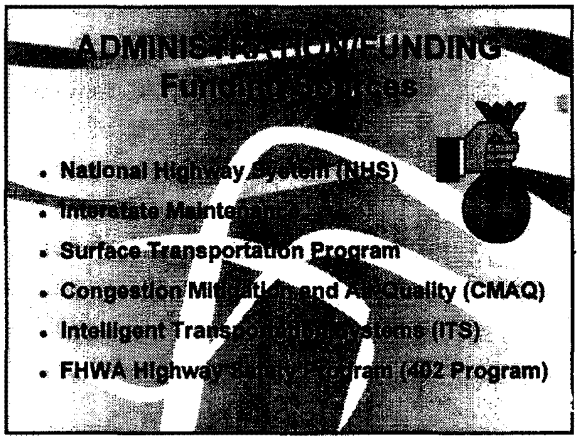
ADMINISTRATION/FUNDING
Organizational Structures

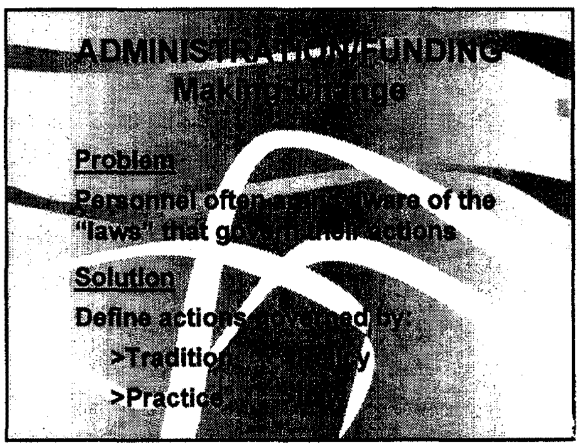
Problem

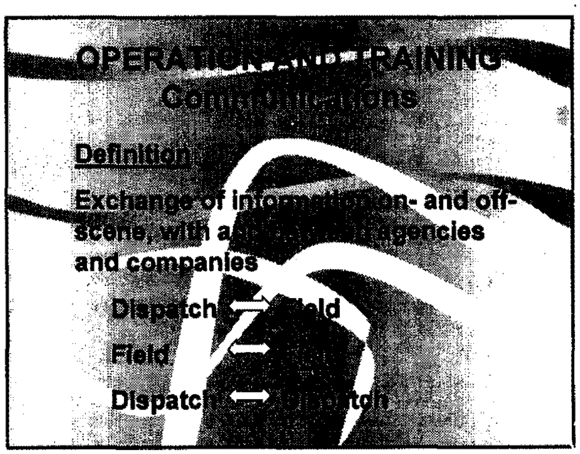
Difficult to coordinate multiple disciplines, jurisdictions - troubles related to lack of awareness and "turf"

Solutions

Form administrative traffic management team to secure resources, implement procedures, [illegible] for change


ADMINISTRATION/FUNDING
• National Highway System (NHS)
• Interstate Mainte
• Surface Transportation Program
• Congestion Mi and Air Quality (CMAQ)
• Intelligent Trans Systems (ITS)
• FHWA Highway ram (402 Program)


ADMINISTRATION/FUNDING
Problem
Personnel often are aware of the
"laws" that govern their actions
Solution
Define actions governed by:
>Tradition
>Practice


OPERATION AND TRAINING
Definition
Exchange of information on- and off-
scene, with a agencies
and companies
Dispatch ⟺ Field
Field ⟺
Dispatch ⟺

OPERATION AND TRAINING
Communications

- What are the:
  - > essential links?
  - > weak links?
  - > missing links?
- Are problems:
  - > institutional?
  - > procedural?
  - > equipment-related?

OPERATION AND TRAINING
Liability

The more state funds spent on liability compensations, the less funds available for [illegible] programs

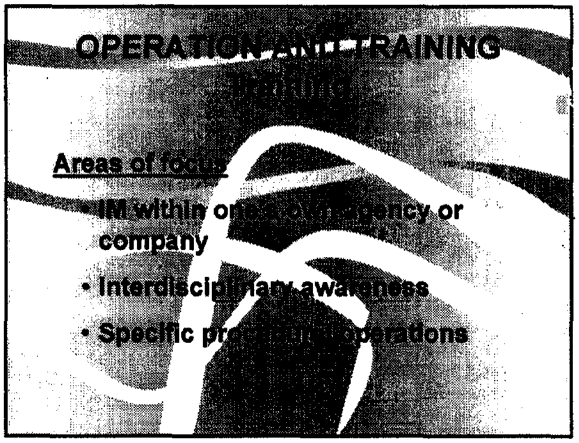
CalTrans spends $28-30 million in liability-related costs annually

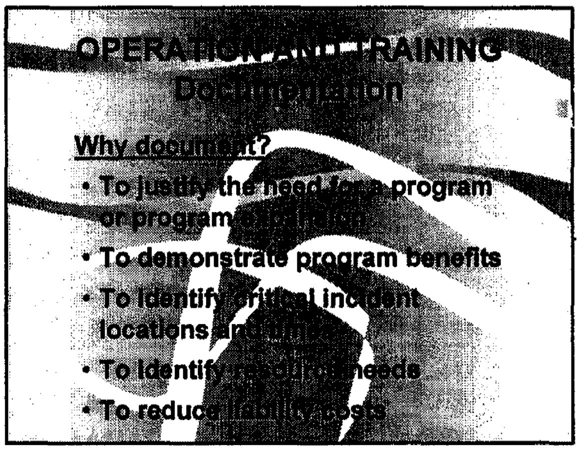
Liability costs from 40 states totals $[illegible] billion annually - Baca

OPERATION AND TRAINING
Liability

The following is needed to prove negligence:

- A duty or standard
- A breach of that duty
- An actual loss or harm
- A connection between breach of duty and resulting harm


OPERATION AND TRAINING
Training
Areas of focus
• IM within one's own agency or company
• Interdisciplinary awareness
• Specific procedures/operations


OPERATION AND TRAINING
Documentation
Why document?
• To justify the need for a program or program expansion
• To demonstrate program benefits
• To identify critical incident locations and times
• To identify resource needs
• To reduce liability costs

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Module 3
Challenges to Effective Incident Management

As many incident management agencies and companies around the country have found, establishing and maintaining an effective incident management program is not simple, nor can the process be accomplished quickly. In some areas, initial organizational efforts go back decades, and programs have begun modestly, with perhaps a single roving patrol and one part-time coordinator.

The reason for the often slow and difficult development of incident management programs is that important challenges, if not recognized and addressed early in program development, can inhibit success. The intent of this module is to (1) prepare you for potential roadblocks that may be encountered when improving incident management efforts, and (2) arm you with a variety of strategies that have proven successful in overcoming these challenges.

The challenges discussed here are generally grouped into three large categories with various sub-categories:

1. awareness among incident management personnel
   - emergency personnel
   - support personnel

2. administration and funding
   - organization structures
   - funding outlook and sources
   - formal processes for changing current operations

3 operation and training
   - communications
   - liability
   - training
   - documentation

Awareness Among Incident Management Personnel

Despite the fact that agencies and companies with very different missions and roles are expected to work together smoothly at incident scenes, surprisingly little training has been provided to explain to field personnel the roles of other responders. It seems that such a perspective would be helpful in promoting on-scene coordination and communications among responders. In addition, a broadened perspective would improve relations at administrative levels.

Many observers, including the National Incident Management Coalition, have noted that although "each agency/company has a legitimate role in incident management, all too often duties overlap, authority is fragmented, and priorities differ." The intent of this discussion about the roles and training of the various types of agencies and companies involved in incident management is to help each in appreciating another's expertise and in coordinating overall incident management efforts more effectively.

Incident management personnel can be subdivided into two basic categories: emergency responders and support responders. Emergency responders are "first responders," field personnel trained to arrive on the scene and preserve human life until advanced medical care is available. Police and fire personnel, as well as other emergency medical service personnel, fall into this category. Examples of support personnel include dispatch, transportation, and towing and recovery personnel; the media; and the medical examiner. The differences among incident responders in terms of their missions, roles, and perspectives.

Emergency Responders

Emergency responders include police, fire, and emergency medical personnel.

<u>Police</u>

The mission of police personnel in the context of incident management is to secure the incident scene, collect evidence, prevent secondary accidents, and protect the safety of the pubic at large and on-scene incident responders. Police personnel involved in incident management likely come from state patrol or police agencies, local police agencies, or county police agencies.

Police personnel maintain a constant presence on most roadways, patrolling continuously. Among the many responsibilities of police officers are the following (which may vary among areas):

- prohibiting criminal activity, including the apprehension of intoxicated drivers, drivers of stolen vehicles, and other fugitives

- enforcing state and federal commercial vehicle regulations

- investigating traffic collisions

- rendering assistance to disabled motorists

- controlling traffic at an incident scene, during adverse weather, at construction sites, and in other hazardous traffic conditions

- rendering aid to collision victims

The roles of police personnel and other incident response personnel overlaps in several cases:

- Because they are often the first on the scene, police officers may administer basic first aid to injured motorists, creating some overlap with emergency medical and fire personnel.

- Insofar as police personnel may aid disabled motorists and control traffic in unusual or hazardous conditions, their role may overlap with that of transportation personnel.

Nevertheless, the priorities of police agencies are quite distinct from those of either fire or transportation agencies. Whereas fire personnel seek to protect life and property by providing emergency medical services, rescue, and fire suppression, and transportation personnel seek to safely restore traffic flow, police personnel are responsible for investigating the incident thoroughly, accurately, and competently.

A potential conflict with other incident management personnel arises from police investigation duties. Police officers know from experience and training that lawyers and insurance companies will scrutinize their investigation reports in civil and criminal cases, especially those related to major incidents. Police agencies therefore have an interest in investigating and documenting the incident carefully--regardless of how long that might take or its effect on traffic. As one officer pointed out, officers in some areas are evaluated primarily on the neatness and completeness of their reports, despite the hectic work environment and the constant pressure of additional calls for service.

Potential resolutions for this conflict include the following:

- Incorporating criteria for efficiency in clearing incident scenes into performance evaluations for police personnel may provide an incentive to balance the need for careful investigation and documentation with the need to restore traffic flow.

- Total station surveying equipment, a technology that allows police personnel to take measurements related to scene investigation for later analysis, offers a way to speed accident investigation.

- Other electronic means of documenting incident scenes are emerging. These tools, some of which are provided in the Advanced Law Enforcement Response Technology (ALERT) system, covered in Module 8, are expected to increase the speed and accuracy of on-scene investigation.

Fire

The mission of fire agencies, to save lives and property, hinges on arriving at the scene of an incident in the least possible amount of time (a common standard is within 4 to 6 minutes). In the context of roadway incidents, a fire agency's primary role is to provide first response emergency medical and rescue services, which may include the following situations:

- extrication from vehicles with the jaws of life
- water rescues (as when vehicles crash into bodies of water)
- suppression of vehicle fires
- HazMat response and cleanup (in some cases)

It's notable that somewhere between 65 to 85 percent of calls to fire departments are now for emergency medical services, as opposed to fire suppression, because of a 34 percent reduction in fires nationwide between

1980 and 1992. This reduction is likely attributable to the efforts of fire agencies around the country to improve fire prevention education and fire inspection, as well as smoke detection and automatic sprinkler system laws.

Fire personnel may be trained in diverse rescue techniques, depending on their particular agency and area of the country. The following rescue training expertise has incident management applications:

- swift water rescue
- confined space rescue
- dive team rescue, including scuba operations
- high angle/rope rescue (e.g., if a car has crashed over a cliff)
- rescue operations during civil disturbances, such as riots

Fire personnel duties may be physically demanding. Because vehicles may crash into, over, or under any range of objects, fire fighters must be able to carry victims with or without assistance in sometimes dangerous conditions.

In critiques of several incident management programs around the nation, fire agencies have generally been praised for their professionalism and rapid response to roadway incidents. However, these same evaluations have also noted that fire personnel sometimes have a compartmentalized view of their role within the overall incident management effort. For example, they may park their fire trucks in traffic lanes beyond the point at which it is necessary to protect incident victims and response personnel, causing in unnecessary lane blockage. In addition, fire agencies have been criticized for their reluctance to respond to direction from other incident management personnel. This is probably due to their "in charge" status and a lack of appreciation as to what "unified command" means for transportation incidents. Fire personnel may also feel that other responders don't understand their needs very well.

Sensitizing fire agencies to the larger goal of effective incident management may be helpful in resolving these issues. Once fire agencies accept other agency or company perspectives and needs at the incident scene, formal agreements can help to solidify that acceptance.

Emergency Medical Services (EMS)

The mission of emergency medical service personnel is unique: to preserve life through prompt emergency treatment and rapid transport to hospital facilities. Emergency medical personnel must be ready to respond to incidents immediately, 24 hours a day. Both emergency medical technicians (EMTs) and paramedics are trained to provide basic life support, but paramedics are trained at a higher level and can perform specialized procedures such as starting IVs and administering emergency medications.

The provision of emergency medical services varies nationwide, in terms of both training and the entity that personnel work for. One observer has called the provision of EMS services in the U.S. "a muddled mix of public, private, volunteer, hospital-based and hybrid systems." Emergency medical services may be provided by

- local fire agencies
- private ambulance services
- volunteer ambulance services
- area hospitals.

Many people are confused about why both a fire truck and an ambulance sometimes arrive at the scene of a single injury or illness. This is because "tiered" service is often the fastest, most cost-effective way to provide emergency medical service. In the case of a medical emergency, the victim must be helped as quickly as possible. Fire stations are located and staffed to achieve this goal. Fire agencies, most of which are staffed by some combination of EMTs and paramedics, can often get to the victim fastest, at which point their job is to keep the person alive or stable until he or she can be taken to the hospital. Why don't fire personnel just transport the victim? In some areas they do, but when they don't, the reasoning is that transporting a victim would be too costly (i.e., the fire vehicle would be "tied up" for upwards of 30 minutes, which would diminish its ability to serve other victims within the 4- to 6-minute standard without additional personnel and vehicles).

The provision of emergency medical services has become a political issue, as the large ambulance companies have begun to compete with fire agencies for the job of responding to EMS calls and transporting patients.

As with fire agencies, emergency medical service agencies or companies are most often criticized for creating or maintaining unnecessary lane blockages. In some areas, ambulances have remained parked in a travel lane for the duration of the incident while personnel have conducted evaluations and taken vital signs, whereas traffic flow could have been restored more quickly had they moved to the shoulder or off the main roadway.

Emergency medical personnel also must be sensitized to the larger goal of effective incident management. Once emergency medical services have accepted other agency or company perspectives and needs at the incident scene, formal agreements can help to solidify that acceptance.

Support Responders

A variety of public and private entities lend support to incident management efforts. Below is a discussion of some of the more involved or common support agencies or companies. These include dispatch, transportation, and towing and recovery services; the media, and the medical examiner.

<u>Dispatch</u>

The mission of dispatchers is to quickly, accurately, and completely convey the necessary information to the proper agencies, companies, and field personnel to get the right people and equipment to the scene as quickly as possible. Although dispatchers are removed from the incident scene, located at the central offices of police, fire, traffic operations centers, and other agencies, they are crucial in incident management. As a point of interest, about 90 percent of 9-1-1 calls are for law enforcement, 7 percent for EMS, and 3 percent for fire. Dispatchers, who may receive calls from land-line or cellular phones, citizen band radios, teletypes, and field personnel radios, must be able to accurately obtain, condense, and relay the right information to the right people. Complex, wordy messages must be translated and delivered to field personnel concisely and understandably, without losing the necessary detail. Therefore, dispatchers are in a continuous decision-making mode, having to determine the following:

- Which jurisdiction should handle the call?
- How urgent is the call?

- Which information is critical to convey?
- How many and what type of field personnel should be dispatched?
- Which field personnel are available, and where are they located?

Dispatchers must be familiar with local geography and that of neighboring jurisdictions; fluent in the specialized jargon of their profession, including the use of 10-codes (developed in the 1930s as a way of speeding up, standardizing, and clarifying emergency communications); and have a grasp of the following:

- What to do in the event of a major power outage or equipment failure
- How to utilize strategically placed mobile units as relay points
- How to obtain and use portable radios

In addition to these "hard" or technical skills, dispatchers must be skilled in dealing with a range of interpersonal communications challenges, such as the following:

- Emotional callers, including people who are frightened or hysterical
- Calls from young children, the elderly, and hard of hearing
- Anonymous callers
- Suicidal callers.

Some confusion has arisen with the use of different 10-codes by different agency or company personnel. This problem can be dealt with by not using 10-codes when speaking with a dispatcher or field responder from a different agency or company.

Transportation

The mission of transportation agencies in the context of incident management is to serve public safety and preserve resources (including air quality and time) by restoring the flow of traffic as safely as possible, to the greatest extent possible, in the least time possible. Transportation agencies' unique mission derives from the fact that they are responsible for building, maintaining, and operating the roadway system. This is the public's single biggest infrastructure investment and one on which of the public's quality of life, as well as the nation's economic viability, directly depends.

Transportation personnel serve this mission in the context of incident management by carrying out the following activities:

Assisting stranded motorists, which may entail

- providing gas
- moving a vehicle to shoulder
- jumping batteries
- changing tires
- lending tools or making small repairs
- allowing motorists to make cellular phone calls
- transporting motorists to a safe place
- providing water for radiators.

Acting as first responder when they arrive first on the scene, which entails

- quickly evaluating the situation and calling for appropriate resources
- rendering basic first aid (if so trained)
- establishing an effective operating position.

Transportation personnel may also be involved in the following incident-clearing activities:

- pumping diesel out of overturned semi-trucks

- removing spilled loads or accident debris from the roadway

- sanding oil slicks

- mopping non-hazardous liquid spills with absorbent materials

- establishing traffic control

- closing lanes or facilities safely and in a coordinated fashion

- establishing alternative routes by placing appropriate cones, barrels, barricades, flares, signs, and lights

- assisting fire, EMS, and/or police personnel as requested

- communicating information about the incident to central communications centers.

In some areas, incident management has not yet become a 24-hour-per-day operation for transportation agencies. This leaves some major incidents understaffed and makes it more difficult to establish working relationships with emergency personnel such as police and fire, who are available around the clock.

In an effort to improve relationships among emergency agencies and support agencies, and to improve the overall incident management process, many transportation agencies are moving toward 24-hour-a-day availability. Indeed, one means of evaluating incident management efforts around the country is the speed with which all responders are able to react to the incident, regardless of time of day or location.

Towing and Recovery

The towing industry's basic mission is to remove and recover vehicles--from motorcycles to tractor trailers--that move along the roadway; to assist the public with their vehicle needs; and to clear the roadways to keep them passable and safe. The tower's particular expertise lies in the ability to use specialized equipment to move vehicles safely and efficiently, with a minimal loss of property or hazard. Towing equipment may be used in rescue operations--as in cases in which one vehicle must be removed from the top of another in order to extricate victims.

Towing companies are competitive private firms. Police or transportation proposals to manage public vehicle clearance programs (i.e., publicly owned tow trucks) have been met with much resistance from the towing and recovery industry. One way in which this public/private conflict has been addressed is through agreement: if first on the scene, public agency personnel may tow vehicles to the shoulder or to another safe place out of the travel lane; private towers can then tow the vehicle to its final destination. In Seattle, Washington (1990 population 516,259), for instance, tow trucks owned by the Washington State Department of Transportation are stationed at either end of two floating bridges across Lake Washington, major commute routes, throughout the peak periods. These tow trucks are able to respond immediately to disabled vehicles and incidents on the bridge, but they may bring the disabled vehicles no farther than a designated point just off the bridge, where the vehicle must wait until a private tow truck can be dispatched.

Most tow trucks are dispatched on a rotating basis according to agreements forged between police agencies and the towing companies. Such agreements usually specify the time frame within which the tow companies agree to provide an operator at the scene.

In some areas, there have been difficulties with such rotational agreements. For example, the towing company whose turn it is on the list may not be the best choice from an incident management perspective--because it doesn't have either the equipment or personnel best suited to the nature of the incident. Moreover, whereas tow company next in the rotation might not be able to respond for, say, 40 minutes, the company two spaces down might be able to respond in 10 minutes because an available truck is near the scene.

Agencies such as the California Department of Transportation (CalTrans) are experimenting with new ways of managing tow company agreements. For example,

- contracting with tow companies on the basis of freeway segment
- contracting with the private sector to provide dedicated towing services with response time limits
- instituting a "taxi-stand" style of towing dispatch in which the tow truck operators stand in line at designated locations near freeway on-ramps, enabling them to respond most quickly to freeway service calls on a first-come, first-served basis.

All too often, response time requirements are defined but not enforced. Police personnel or other public agencies that enter into agreements with towing and recovery companies should solicit input from towing personnel to ensure that response time requirements are reasonable and that suitable "punishments" for not meeting the time requirements are discussed.

The towing industry has also asked that when tow trucks are requested, they not be told what equipment is needed, since fire, police, and transportation personnel are not typically as knowledgeable as the towers themselves in the range of equipment available and what would be most useful for a given type of incident. The solution to this issue is straightforward: give towers information on the nature of the incident, allowing them to decide what to bring, unless of course the caller's suggestions are solicited. Getting the right equipment and personnel to the incident in the first place, without having to make later calls, can save valuable time and possibly lives.

Another issue among both incident management and towing industry leaders is the professionalization of tow truck operators. Although a call to a towing agency might may result in response by a well qualified professional with years of expertise, that call might also produce a new employee whose skills are not up to the job.

The towing industry has embarked upon a national-level training and certification program for tow truck operators. Upon completion of nationally standardized training, tow truck operators will be eligible to earn levels of certification from 1 to 3, corresponding to (1) light duties, (2) medium and heavy duty, and (3) recovery specialist. This certification program should benefit incident management efforts in that specifying the type of incident (e.g., a two-car incident vs. a tractor-trailer incident) should elicit the dispatch of an appropriately certified operator.

The towing industry is intent on improving its professionalization, which its leaders believe will allow it to provide better public service. The industry would like to replace the image of the disheveled, greasy tow truck operator with that of a trained professional who operates equipment of ever-increasing technological sophistication in support of public safety and efficient incident management.

<u>Media</u>

The mission of the media in the context of incident management is to uncover and report stories of public interest in order to attract the largest possible audience. Major incidents often fill this need. Although incident responders may at times wish that the media would go away and let them do their jobs, it is the media's job to cover incident management activities. Another aspect of the media's role in incident management is to provide traffic information to travelers over the radio and television.

Potential conflicts may arise between media personnel and other incident management personnel.

- In their drive to get a story, the media may hinder the management effort.

- The media may condense information, omit details, and simplify an event or issue, inadvertently making the incident management effort look ineffective.

Knowing something about the role of the media and the constraints within which reporters must operate may help incident responders deal effectively with the press, which will accomplish two purposes:

- Giving the media what it needs to do its own job will help keep reporters from "getting in the way" and preventing incident responders from doing their jobs.

- Dealing with the media effectively will allow incident responders to project a positive image through the media to the public and to decision makers. Such a positive image will ultimately make it easier for incident management programs to compete for resources.

Tips for dealing with the media include the following:

- At the scene of an incident, follow the established chain of command for communicating with the media.

- Provide a single point-of-contact for the media so that only one story gets told. This can be done through coordination of the various agency public information officers (PIO's) on the scene.

- Think of the media as fellow professionals and treat them with the same respect you would other professionals. Realize that both incident responders and the press have the same client: the public. Maintain a friendly, non-adversarial relationship.

- If possible, anticipate their needs and give them information before they ask for it.

- Keep the information you provide concise, simple, and to the point. A significant factor that contributes to media distortion is that the reporter does not understand what has been said, either because the reporter is unfamiliar with the subject or because the speaker has failed to communicate clearly.

- Be honest. Do not try to fool the media by not revealing the complete story or by distorting the facts. The media have more information than you are aware of, and they can use it to your detriment. The worst thing you can say to the media is, "No comment."

<u>Medical Examiner or Coroner</u>

The Medical Examiner's mission is to investigate sudden, unexpected, unexplained, suspicious, and violent deaths. "Violence" includes accidental deaths resulting from vehicle crashes. The rationale behind the Medical Examiner's participation in fatal vehicle crash investigations is that such accidents may be staged or set up to cover a murder.

In most areas, pronouncement of death by the Medical Examiner or the Medical Examiner's deputy is required before a body can moved from its position or removed from the scene. This is to allow the Medical Examiner's office to establish the cause of death and to work with the police in investigating the incident to whatever extent deemed necessary.

This requirement can cause much delay in clearing an incident scene. Because most Medical Examiner's offices are not staffed or funded to provide rapid response to roadway incidents, it can take the Medical Examiner hours to respond to the call for assistance.□

In some states, efforts are under way to address this delay by adopting one of the following strategies:

- upgrading staffing and field communications in Medical Examiner's offices so that they can respond to roadway incidents more quickly

- training and authorizing paramedics, EMTs, and/or police personnel who qualify as EMTs to conduct the required exam so that the victim can be released from the scene, or at least be moved, once pronounced dead, to a location that would allow traffic flow to be restored before the Medical Examiner's arrival. Before the body was moved, photos could be taken for use in the forensic evaluation.

Public Safety: The Common Thread

Although much can and should be made of the differences among the types of personnel that respond to roadway incidents, it seems equally important to identify their commonalities.

- They all serve pubic safety, which can be defined as the public's right prescribed by law, and they act to protect and preserve life, property, and natural resources and to serve the public welfare.

- Exposure to danger is shared by everyone who must work in the difficult field conditions of a roadway, which is often characterized by high-speed traffic that fails to slow down, despite the obvious presence of □vulnerable field personnel. The threat of fast-moving traffic, often exacerbated by low visibility at night, in inclement weather, or under poor environmental conditions, makes the work of all incident responders hazardous. In serving public safety, personnel from all responding agencies or companies put their lives on the line.

- Incident scenes, which may involve traumatic injuries and fatalities, present all responders with emotionally charged situations. They must keep their own feelings in check in order to provide services as professionally as possible, and they must be able to deal with anger, grief, and confusion at the scene. The emotional stress that incident responders must eventually handle as a normal part of their work is something that the rest of the population is grateful to not have to face.

Administration And Funding

When incident management programs suffer administrative or organizational weaknesses, it is difficult to deliver services effectively and to secure support for the program — from within the agency, from other agencies and jurisdictions, and from state and federal funding sources. Incident management programs have come under criticism for what some see as administrative weaknesses. "Despite recent growth in the number of programs, the scope of most incident management programs remains limited. In many areas, incident management involves a patchwork of agencies and activities, cobbled together on an ad hoc basis with little in the way of strategic focus, dedicated funding, or clear lines of authority. With few exceptions, incident management programs are not visible to the public, and the perception often is that they are not doing the job" (NIMC 1996). No single model can guide incident management programs in organizing for effective service delivery; individual strategies must be crafted on the basis of statutory relationships, personalities, and the allocation of financial, technological and human resources.

Without sufficient structure to facilitate decision making among agencies or companies, improvements to incident management will be slow in coming and often singular in benefit, focusing on one participant's needs and objectives. Additional funding cannot be viewed in isolation as a solution to incident management problems. However, adequate funding can help to support incident management efforts by providing program equipment, personnel, or further research. Related to both administration and funding is a lack of awareness about the process of change. Few incident management professionals fully understand the "laws" that govern their actions or the actions that are required to change their current operations. All of these issues are discussed in more detail below.

Organizational Structures

Organizing and overcoming administration problems in providing effective incident management are complicated by the fact that government in the U.S. is highly fragmented. Estimates put the number of separate governmental units in the U.S. at around 83,000.

Metropolitan areas, where most incident management programs operate, generally consist of a central core city, or cities surrounded by a patchwork of smaller, separate incorporated communities, as well as unincorporated suburban or rural areas. This miscellany of governments, each with its own police, fire, and transportation departments, not to mention private companies, greatly complicates coordinated incident management.

Fragmentation and overlap complicate incident management by making it difficult to determine who is responsible for a given incident, particularly when the incident occurs at or near a jurisdictional boundary. The boundary may be a formal municipal, county, state, national, or some combination of borders or an informal "response" boundary set by an individual private company.

Incidents do not respect jurisdictional boundaries. An incident may affect multiple jurisdictions along a single roadway or the entire roadway network as traffic backs up and spills into arterials in many contiguous municipalities.

Some facilities may be patrolled by local police, state-level law enforcement, or some combination at different segments, again, making it difficult to determine which agency is responsible.

Jurisdictions may have trouble integrating operations among contiguous jurisdictions for reasons related to under-staffing, lack of interest, or "turf."

Perhaps the best way to overcome administrative problems is to form an administrative traffic management team. Administrative traffic management teams ideally comprise members from all incident management agencies or companies. Their primary objectives, through improved interdisciplinary contact, communications, and awareness, are to secure resources, including funding for incident management efforts, and to implement procedures that benefit overall operations. These tasks can be accomplished by sharing information, writing cooperative agreements, and pushing together for change. In essence, an administrative traffic management team provides "formal, continuing mechanisms for program planning, oversight, support, and evaluation. Formal teams may evolve from an early working group or partnership into a permanent institutional entity. Specific tasks and functions of an administrative traffic management team include the following:

- select equipment or recommend compatible standards across jurisdictions
- provide for personnel training
- build staff expertise
- create standard response plans for most incidents
- define responsibilities
- facilitate agency coordination
- guide overall program design and direction.

How Do We Form an Administrative Traffic Management Team?

The following step by step approach for establishing an administrative traffic management team is recommended in the "Freeway Incident Management Handbook" (1991):

1. Identify officials and agencies that are likely to have a vested interest in improving incident management efforts. These may include elected officials; transportation agencies at the state, county, and city levels; transit operators; police agencies at the state; county, and city levels; fire and rescue; emergency services; environmental protection agencies; and towing services.

2. Prepare and circulate a memorandum that summarizes the problem and emphasizes the need for a more formalized incident management program.

3. Gain the support of the highest elected officials.

4. Have the highest elected officials call a meeting of the previously listed agencies.

5. Prepare an agenda for the meeting that includes a summary of the problem, an identification of incident management issues (i.e., multi-jurisdictional coordination, definition of responsibilities, resource allocation), a list of action items, and a date for the next meeting to check progress.

6. At the meeting, obtain a consensus regarding action items. Typical early action items may include defining agency roles and responsibilities, identifying legal issues and the need for interagency agreements, establishing interagency communication contact points, prioritizing tasks, inventorying available resources, identifying improvement areas in current incident management procedures, and identifying new incident management tools or strategies.

For a full description of administrative traffic management teams as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management

Systems" included in the back of this notebook.

Further guidance is provided below.

- Recruit support for incident management from public agency leadership

  - State transportation agencies
  - State emergency management agencies
  - Fire agencies
  - Law enforcement agencies
  - State legislators

- Means of recruiting support from public agency leadership may include some or all of the following activities:

  - Sponsorship of educational conferences regarding the benefits of incident management for public agency leaders, such as the National Incident Management Coalition efforts

  - Dissemination of information about the benefits of incident management through conferences, reports, newsletters, and other sources.

  - Making personal visits to the senior administration of each relevant public agency to discuss the benefits of incident management and what they gain through participation. These visits are most effective if they are preceded by development of targeted sales pitches that emphasize the benefits of incident management for specific constituencies. For example, fire and police may be less interested in the value of reducing congestion than in the value of improving highway safety or improving the safety of their response personnel on the scene.

- Identify a lead facilitating agency. Encourage proactive leadership by a single public agency. Most often it is the state transportation agency, but it can be the state police, the metropolitan planning organization (MPO), or a local government. The role of this agency is to initiate and facilitate meetings and program development, and to follow up with other participants; it is not to dictate to other agencies or to manage their work. Below are examples of the different agency types that may take the lead in organizing incident management efforts.

- State transportation agencies in California, Florida, and Virginia, and Washington have the lead in incident management program development. State transportation agencies make natural leaders in many states because they have statutory responsibility for maintaining and operating the state roadways and have a broader range of concern than does law enforcement.

- State police in Massachusetts and New York have the lead in incident management program development. The state police may have greater power over traffic management issues in some states and may have statutory responsibility for incident management, but they may lack the resources needed for a broad-based program.

- The Metropolitan Planning Organization (MPO) in Atlanta is a good facilitator because it provides a neutral turf and level playing field. However, MPOs often suffer from limited financial resources and technical expertise, and they may view incident management as an operational issue with limited planning implications.

- Develop public/public partnerships. Partnerships can be formed between divisions of the same agency, such as traffic operations and highway maintenance units of a state transportation agency; among agencies within the same jurisdiction, such as the state transportation agency and the state police; or among jurisdictions, such as several city governments and/or state transportation agencies.

- Establish a Traffic Operations Center (TOC), a central information processing and control site, to collect and analyze information and to manage communications during an incident. Staffed by a single agency or by multiple agencies, or even operated privately, a TOC can greatly enhance incident management. TOCs may provide additional structure for an incident management program by housing multiple agencies or companies under a single roof, or by formalizing the institutional relationships among incident management agencies or companies.

TOCs are often expensive to construct and operate and require a high level of information sharing and agency cooperation.

A successful and continuing administrative traffic management team requires

- a will to get things done on the part of a critical mass of agencies, companies, or jurisdictions. This requires a lead agency to take the initiative in setting up meetings and opportunities for discussion. However, it is important that this lead agency not be perceived as overly controlling, or other parties may become alienated and refuse to "buy in."

- patience and persistence. Establishing and cultivating cooperative interdisciplinary relationships is often a slow process. Traditional relationships and ways of thinking will not change overnight.

- a sense of ownership among the team members.

- a set of functional requirements for the effort, to reassure team members that a hidden agenda won't be forced on them as a result of their participating in the effort.

- momentum. Regular meetings need to be neither highly formal nor terribly time-consuming. In some areas, team members meet over breakfast at a local restaurant once a month.

<u>Case-in-point: Administrative Traffic Management Teams in Maryland</u>

The success of the Chesapeake Highway Advisories Routing Traffic (CHART), Maryland's Advanced Traffic Management System, is due largely to the oversight of an administrative traffic management team and other agency partnerships. The CHART Steering Committee is chaired by the state highway administrator and comprises representatives from the Transportation Authority (toll facilities), Maryland State Highway Administration, Maryland State Police, Federal Highway Administration, Montgomery County, and local traffic reporters. The committee meets regularly to discuss the overall direction of CHART, local efforts, and national and international ITS-related efforts.

Through the work that CHART has pursued, other partnerships have developed across state borders between Maryland and Virginia; among Maryland agencies, including the State Highway Administration and the State Police; and within the Maryland State Highway Administration (MDSHA) between the traffic and maintenance divisions.

Transportation agencies in Maryland and Virginia cooperatively focused on improving safety and reducing incident clearance time along the Capital Beltway. This effort resulted in formal incident management plans and emergency traffic patrols for Maryland.

A full-time ranking officer from the Maryland State Police (MSP) is assigned to the CHART program for planning operations, training, and to act as an interagency liaison. This effort has resulted in a dramatic decrease in incident clearance time because of a formal agreement between the two agencies that permits the immediate use of MDSHA heavy equipment to "push, pull, shove, or otherwise relocate large tractor-trailer rigs off the roadway, without undue regard to damage to the vehicle or its contents" when they are blocking the roadway (assuming no hazardous materials or personal injury are involved). This eliminates the need to close the road and spend hours off-loading and up-righting the vehicle.

Another important partnership is within the MDSHA between the traffic and maintenance divisions. Traffic and maintenance personnel must bring all of their resources together in a coordinated way to be efficient as an agency. Traditionally, communication and coordination was limited between the traffic and maintenance divisions. CHART is a 50/50 partnership of traffic and maintenance personnel (Kassoff 1992).

Funding Outlook And Sources

To establish, maintain, and improve incident management programs, adequate resources must be secured on an ongoing basis. Not only must managers understand the funding process, they must also be able to identify specific sources of money for incident management, and they must compete successfully for it. Incident management is one among many competing claims for limited transportation dollars. Transportation funding from federal and state levels pits incident management against better known, big-ticket funding items such as interstate maintenance and rehabilitation, transit improvements, and other worthy claims. Given increasing resistance to both taxation and the scope of government, this competition will only get stiffer.

In this section, sources and processes for obtaining of government funding will be described, followed by a discussion of the need for program promotion in competing successfully for transportation funding.

How Do Federal, State, Regional, And Local Governments Affect Funding?

An aspect of U.S. government that people often find confusing is the multitude of overlapping units and levels of government. Decisions are made at the federal, state, regional, and local levels that affect incident management funding.

By far, the largest source of Federal funding for incident management is the Federal-aid Program. On an annual basis, Congress appropriates Federal dollars to various transportation categories (i.e., safety, congestion management, etc.). Once these appropriations are determined, different amounts of Federal-aid dollars are distributed to the states on the basis of a funding formula. The states, with approval from the various Metropolitan Planning Organizations, must then decide how the Federal-aid dollars are spent. Specific Federal-aid programs are discussed in detail later in this module.

The federal government also plays a major role in providing states grants with which to fund their transportation programs, including incident management. A federal grant-in-aid is the transfer of funds from the federal government to state government for some loosely or tightly specified purpose. From the state level, monies may then be passed on to local governments depending on the needs and circumstances. Typically the recipient governmental has been required to abide by certain terms and conditions of the aid. Such conditions include the requirement that the recipient match the sponsor's contribution with one of its own, as well as a series of 'strings' or stipulations regarding what the funds may be spent on, how the program will be managed, and how the recipient will report to the sponsor.

The Federal Highway Administration (FHWA) a division of the cabinet-level Department of Transportation, disburses such grants-in-aid to state departments of transportation. The National Highway Traffic Safety Administration (NHTSA) can disburse grants-in-aid to state-level Governors Highway Safety Programs who can then assist local governments. Other federal agencies such as the Federal Transit Administration can disburse grants-in-aid to local governments, including cities, counties, and metropolitan planning organizations. There are other non-transportation Federal grant sources that may be used for incident management efforts as well.

The federal government is not an actual builder, not a hands-on operator of transportation facilities. Rather it is an information source, a source of broad policy direction, and most importantly, a sponsor (distributor of federal-level taxes). The federal government's role in transportation, by means of legislation passed by the Congress, is to set broad policy objectives for mobility, safety, and environmental quality, which it implements by means of its control over federally gathered transportation dollars.

The states' role is to use considerable discretion in distributing the federal grants-in-aid, and they also raise and distribute a large percentage of transportation dollars on their own.

Thus, both federal and state levels of government play critical roles in setting policy and allocating resources. In addition to these functions, state governments have the additional responsibility of actually delivering transportation programs, projects, and services — from building interstate highways to equipping incident management vehicles and paying incident responders' paychecks.

What Are Some Specific Sources Of Funding?

A distinctive feature of transportation projects and programs is that they are funded from dedicated revenue sources, primarily motor fuel taxes. In fact, at both the federal and state levels (there is variation among states) the vast bulk of resources for transportation projects and programs is raised from motor fuel taxes.

People all over the country pay both federal and state sales taxes on fuel. The federal tax is 14.1 cents per gallon, whereas state sales taxes range from about 20 to 40 cents per gallon. The U.S. Congress and state legislatures decide whether and how much to raise or otherwise adjust motor fuel taxes.

Other federal sources for transportation include sales taxes on tires, truck and trailer sales, and heavy vehicle use. At the state level, motor vehicle excise taxes and driver licensing fees are among the major contributors to transportation trust funds.

Broad federal transportation priorities are implemented in the form of transportation funding legislation. Transportation funding legislation is unique in that it is not passed annually but periodically, about every five to seven years. The original Intermodal Surface Transportation Efficiency Act (ISTEA) was passed in 1991, and the reauthorization bill of the continuance of ISTEA is named NEXTEA (National Economic Crossroads Transportation Efficiency Act).

Federal transportation funding legislation typically takes the form of a single bundle of laws, provisions, and authorizations for the expenditure of millions of dollars assigned to specific titles and categories. The most important title for incident management programs, and by far the largest in terms of dollars, is the Federal Aid Highways Act which is further subdivided into a number of programs, including Surface Transportation Program, Interstate Maintenance, and Congestion Mitigation and Air Quality (CMAQ).

Congress authorizes a certain amount of money for each category. Money from each category is then allocated to the states according to formulas also established by Congress.

An important advancement in Federal transportation funding legislation was in flexibility, which translates to the fact that there are few federal line items for any particular type of project, including incident management. There is no federal line item dedicated to incident management. While federal money can be used for incident management, decisions about which projects to spend the federal money on are made at the state level. States have much flexibility in how they choose to distribute this federal funding among competing claims.

National Highway System (NHS) - $21 billion nationwide over 1992-1997

The National Highway System program funds major activities along segments of this network. The NHS is a system of about 160,000 miles of major highways in the U.S., which includes the interstate system, the defense strategic highway network, and strategic highway connectors, including some urban and rural principal arterials. Total authorized NHS funding is $21 billion over fiscal years 1992-1997. Funds from the NHS program may be used for the following incident management related activities:

- traffic surveillance and control equipment
- computerized signal systems
- motorist information systems
- integrated traffic control systems
- incident management programs
- transportation demand management facilities strategies and programs.

Competing project types in this category include traditional, big-ticket projects such as highway construction and reconstruction.

Interstate Maintenance - $17 billion over 1992-1997

The Interstate Maintenance program covers resurfacing, restoration, and rehabilitation of the Interstate Highway system, excluding the construction of new travel lanes other than high occupancy vehicle or auxiliary lanes. Funds from the incident management program may be used in conjunction with major maintenance projects along the Interstate system. This means that some of the project funding may be allocated to support some traffic management operations, such as incident management in construction zones, which may continue even after a project has been completed. Eligible traffic management activities may include traffic signal control, freeway surveillance, highway advisory radio, and temporary service patrols. According to the FHWA's Federal-Aid Policy Guide, "We view a major reconstruction project as an excellent opportunity to initiate continuing traffic management strategies that provide improved traffic operations long beyond the completion of the project."

Competing project types in this category include traditional, big-ticket items such as interstate resurfacing, restoration, and rehabilitation.

Surface Transportation Program - $24 billion over 1992-1997

The broad Surface Transportation Program (STP) encompasses construction, reconstruction, rehabilitation, and operational improvements on federal-aid highways and bridges; highway research and development; capital and operating costs for traffic monitoring, management, and control facilities and programs; and development of management systems and transportation plans. The National Incident Management Coalition (NIMC) notes that this program has perhaps the widest latitude for incident management application. The NIMC reports that "the broad uses available for STP funds suggest that all phases of incident management--from planning through operations--could be funded through this program."

Competing project types in this category include highway construction and rehabilitation.

Congestion Mitigation and Air Quality Improvement Program (CMAQ) - $6 billion over 1992-1997

CMAQ funding is distributed on the basis of each state's share of the population in air quality ozone nonattainment areas. Projects eligible for CMAQ funding receive priority according to the extent to which these projects will reduce emissions. Specific examples of such activities include development of congestion management systems, as well as capital and operating costs for traffic monitoring, management, and control facilities and programs. According to these criteria, the planning capital and startup costs of incident management projects may be funded through the CMAQ program if it can be demonstrated that these projects will help a region attain air quality standards.

Intelligent Transportation Systems - $660 million over 1992-1997

Intelligent Transportation Systems (ITS) funds, similar to most other federal aid programs, are provided to state-level departments of transportation. Many types of ITS projects tie in with incident management. For example, Traffic Operations Center-based technologies such as automated detection and surveillance technologies, real-time adaptive traffic control, and automated motorist information all have roles in incident management.

The FHWA Highway Safety Program - $117 million over 1992-1997

The FHWA Highway Safety Program, also known as the 402 Program, is jointly administered by the FHWA and the National Highway Traffic Safety Administration (NHTSA). This is a grant program handled by the Governor's Highway Safety Program office in each State. The grant program is an annual program and funds are usually made available to locals for specific projects on a Federal fiscal year basis, although other arrangements are possible.

Funds from this program can be used for non-construction activities that support the selection and implementation of safety construction and traffic operational improvement, such as data collection, engineering studies, development of technical guides and materials, provision of technical highway safety training, and development of highway safety construction programs. This program has been used to develop incident response manuals and training.

Competing Successfully For Limited Transportation Resources

Although a transportation program such as incident management may clearly reduce congestion, thereby improving mobility and air quality, decision makers may balk at the necessary expenditures. Decisions makers (who include elected and appointed officials) are also subject to scrutiny from the public at large, which has grown more conscious of transportation issues at the same time that it has become increasingly wary of new or higher taxes in any form. Resource constraints in transportation are particularly tight, as programs such as incident management must compete for state and federal funding with more traditional, better understood items such as interstate construction, pavement rehabilitation, and transit improvements.

The upshot is that incident management administrators, as well as every employee who serves the public, should be acutely aware of the need to promote incident management in the most favorable light. It is probably not realistic to assume that programs that provide useful public services will be funded on the basis of their merit alone.

How Do You Apply For A Grant?

Sponsoring agencies typically provide guidelines for grant applications or proposals. In general, grant applications contain a description of why a project or program is important; the specific actions through which the project will be performed or the program will be implemented, operated and maintained; a budget; and a description of your agency's or company's qualifications. Further guidance for grant writing is contained in the further reading of this module. Be creative in your reasoning behind the need of your project or program, and be clear about how your project or program is linked to the sponsoring agency. For example, if the sponsoring agency is the National Highway Traffic Safety Administration, a proposal describing potential improvements in traffic congestion and air quality may not be convincing. Rather, benefits related to improved safety should be emphasized.

Who Can Encourage The Successful Funding Of Incident Management Programs?

Incident management administrators need to promote their programs among key decision makers and the public at large, to whom decision makers ultimately report. Probably the most important element to being a successful incident management administrator is to present yourself to the public and politicians in a friendly, professional manner. Formulas don't count, numbers don't count; only people count in getting programs successfully funded and carried out.

Elected Officials

Although this group includes mayors, city and county council members, governors, members of Congress, and special district representatives, state legislators usually have the greatest ability to directly influence an agency's operation through its budget and through legislative review or "oversight." State legislators review the operation of agencies and have the authority to set budget and staffing levels. For this reason, their impressions of incident management within transportation programs are extremely important. Because they are ultimately accountable to the public, they are sensitive to the public's wants, needs, and demands. Consequently, incident management administrators must let politicians know that they are willing to help them respond to citizens' concerns responsibly and professionally.

Legislators' main mission is to get reelected. To do this, they strive to assure their constituencies that services are being provided and to obtain the media visibility needed to generate recognition. They will be particularly attentive if you can demonstrate that your program is in high demand. Note the following when dealing with legislators:

- Make a concerted effort to understand the influence patterns and power position of specific legislators, legislative committees, and legislative staffs. Pay close attention to the methods, political clout, and constituencies of the interest groups active in your policy area.

- Elected officials frequently demand special attention. They may see themselves in a different league than appointed officials and other administrators. To get them to treat your program favorably, let them know that you think they are important. Treat their requests respectfully and respond quickly.

- Perhaps the best way to impress a legislator is through positive contact with his or her constituents. If legislators do not hear complaints, or, even better, if they hear positive remarks about your service, they may be satisfied that you are doing your job well. Therefore, it is important to keep legislative representatives informed about your program's activities. Keep files of letters of thanks sent by people who have been served in the field.

More on legislators and the legislative process is provided later in this module.

The Media

Get acquainted with the media so that you can speak to them as someone they know and not as a bureaucrat they have never heard of. Effort should be made to get media (i.e., traffic reporting media) involved with the incident management process. By talking to the media on a regular basis you will be able to establish a good relationship. Remember not to overshadow your superior.

The Public

If your customers are unhappy with your product, they will eventually find a way to voice that view within the political process. Members of the public influence government decisions through organized community efforts, and they often have close contact with the legislators that represent them. Being aware of the relationships between public groups and their representatives can help you win support for your program. Develop good working relationships with community groups; they may be able to use their influence to support or oppose legislation or funding decisions on your behalf. Some tips on dealing with the public are provided below.

- As often as possible, volunteer to appear before groups and civic clubs to explain what your incident management program is doing. Explain the program, its needs and resources, and why certain improvements can't be instituted because of a lack of funds. At those meetings ask for questions, gripes, and comments.

- Although most citizens are not traffic professionals, they do perceive real problems and sometimes feel that they can offer a real solution. Listen to their input, which may, in conjunction with a solid professional approach, actually solve a problem.

- Expect members of the general public to have a limited understanding of the complexity of most issues. Even community leaders, who may be well informed about the issues, are probably not well informed about the scope of your incident management program or your agency's other responsibilities.

- Keep information simple. Avoid jargon, acronyms, and vagueness. No issue cannot be broken down into its essential elements and explained to a general audience. It isn't necessary that the public understand all elements of an issue. Your job is to identify the most important aspects and educate the public about them.

- Don't present a superior or condescending attitude. Rather, explain your incident management program's goals and services clearly and simply. The simple act of taking members of the public seriously will greatly enhance public relations.

- In promoting your incident management program, you have to be accessible. Nothing is worse to a citizen than not getting a response to a request or phone call. Sometimes, even a negative response is better than none at all.

Formal Processes For Changing Current Operations

Often a barrier to improving incident management relates to legal authority.

Personnel often don't understand the "laws" that govern their actions. Often, actions are thought to occur because of policies or laws but instead are based only on tradition or practice. Below is a list of related terms that you should be familiar with.

- Tradition - any time honored practice or set of practices.
- Practice - any habitual or customary action or way of doing something.
- Policy - any plan or course of action designed to influence and determine decisions, actions, and other matters, especially adopted by an agency or business organization.
- Bill - a proposed law presented for approval to a legislative body.
- Amendment - any change in a bill, recommended before a bill is approved as a law.
- Act - a law enacted by a legislative body.
- Ordinance - a law enacted by a legislative body, especially enacted by a city government.
- Law - specifically a statute law, a governing action or procedure approved by a legislative body.
- Statute - a law enacted by a legislative body.
- Code - a systematically arranged and comprehensive collection of laws.
- Citizen involvement in the law making process is typically solicited through initiatives or referendums. Each is defined below.
- Initiative - the right and procedure by which citizens can propose a law by petition
- Referendum - recently passed legislation referred by the legislature to the voters for their rejection or enactment

What "Laws" Govern An Agency's Actions?

If it becomes apparent that current incident management operations could be improved through change, it is important to first determine what is motivating current operations: tradition, policy, or law. Only after the motivation behind current actions has been identified can the appropriate steps be taken to change operations. Good sources of information about laws include federal, state or local codes, or your state's Attorney General's Office. The administration within your own agency can provide you with information pertaining to its policies. Anything not governed by law or policy is likely governed by tradition.

How Can Changes To Existing Operations Be Made?

Changes to operations that have originated and continued because of tradition typically require multi-agency consensus. To achieve this consensus, evidence of the benefits resulting from change is often necessary. The ability to change operations that are based on tradition is often impeded, not by a complex and confusing change process, but by individual or agency attitudes that may be resistant to change.

Actions governed by policy may follow a more complex process for change. In general the procedure is as follows:

- A suggestion is offered by someone within the agency or company
- The suggestion is put into writing
- Draft policies are submitted to the administration for review, approval, or denial.
- Approved policies are printed and distributed to agency and company employees.

To determine the exact process for policy change within your agency or company, request information from your agency's or company's administration.

Laws are often thought to be too complex or difficult to change; the legislative process for change is not well understood. Some of the more common terms are defined below.

- Unicameral legislature - a legislative body that has only one unit. Nebraska's state legislature is unicameral, and most city legislatures, where the city council is the legislative body is unicameral.

- Bicameral - a legislative body that has two units. Most states have a bicameral legislature comprised of a Senate and a House of Representatives patterned after the Federal legislative branch.

- Legislation - the act or procedure of law making

- Legislature - an officially selected body of persons vested with the responsibility and power to legislate for a political unit such as a nation or state.

- Rules - regulating principles used in the conduct of legislative business

Your success in changing laws relies heavily on your relationship with the legislature. The keys to success include

- knowing how to prepare legislation that will gain approval
- being prepared to work with legislators and legislative staff
- knowing the steps that legislation goes through.

Preparing Legislation

There are a number of important factors to consider in preparing and proposing legislation. Thoroughly research the issue, including the pros and cons. Make sure that a statutory change is necessary. Make sure that the proposed legislation is written in a clear manner. Closely follow the prescribed time schedules and signature processes; don't miss important deadlines because of a minor oversight. Carefully choose a sponsor to represent the proposed legislation. Be cognizant of other influences such as the general public, lobbyists, and special interest groups. Consider their position on any proposed legislation and be prepared to agree with or refute their position.

The Uniform Vehicle Code and the Model Traffic Ordinance, prepared by the National Committee on Uniform Traffic Laws and Ordinances, is a set of vehicle laws reflecting the "best" local, state, and federal laws and regulations. This document can be useful when preparing and updating motor vehicle laws. The Model Traffic Ordinance is a similar document for use by municipalities (e.g., cities, counties).

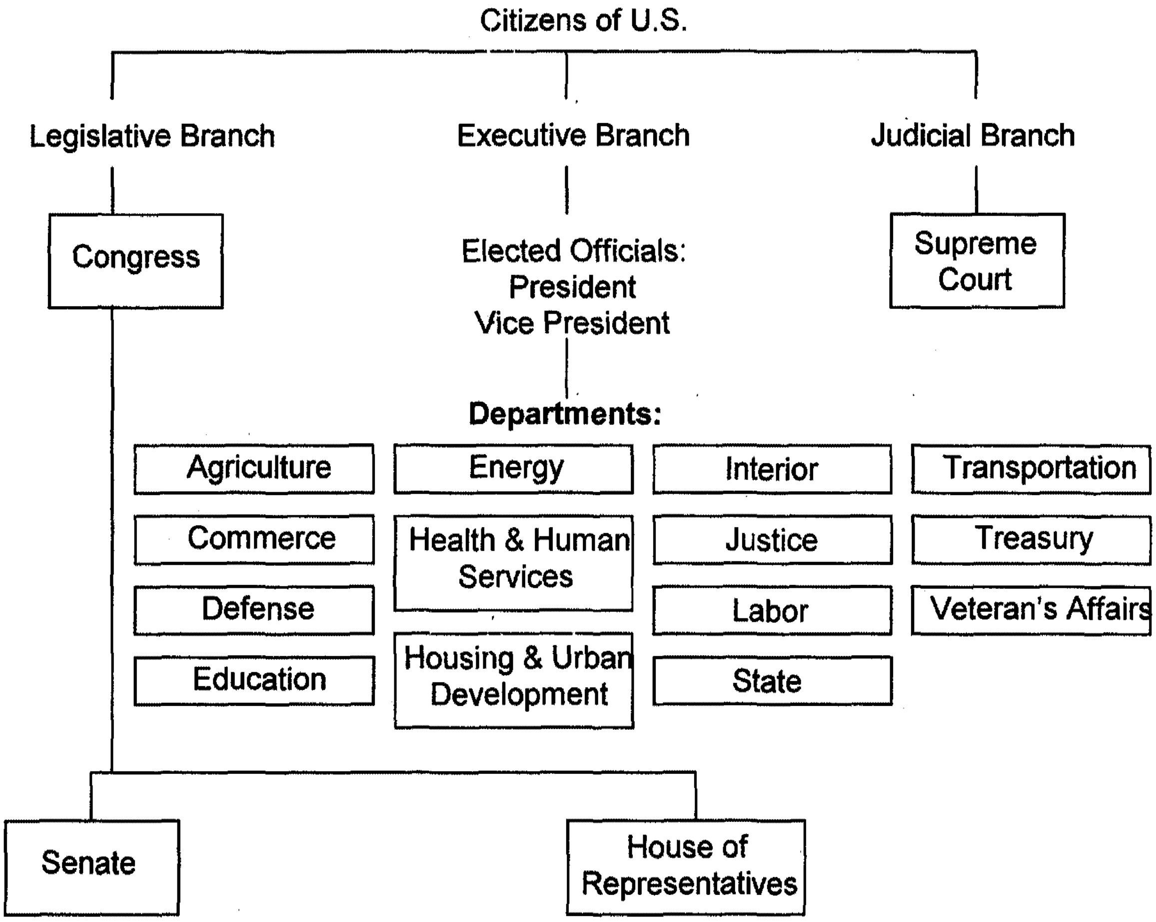
Working with Legislators and Legislative Staff

You understand the issues at hand; legislators and legislative staff understand the legislative process. Be sympathetic to each other's background and role in the legislative process. Identify key staff persons and build a credible reputation with them. Keep them regularly informed but do not overload them with information. Think of them as your liaison with the Legislature.

The Legislative Process

Governmental organizational structures and legislative processes differ somewhat among areas at the state, county and city levels. Governmental organizational structures and legislative processes at the federal level are applicable to all areas. Below are examples of government organizations and the legislative process for the U.S., Washington State, and the City of Seattle.

United States Government Structure



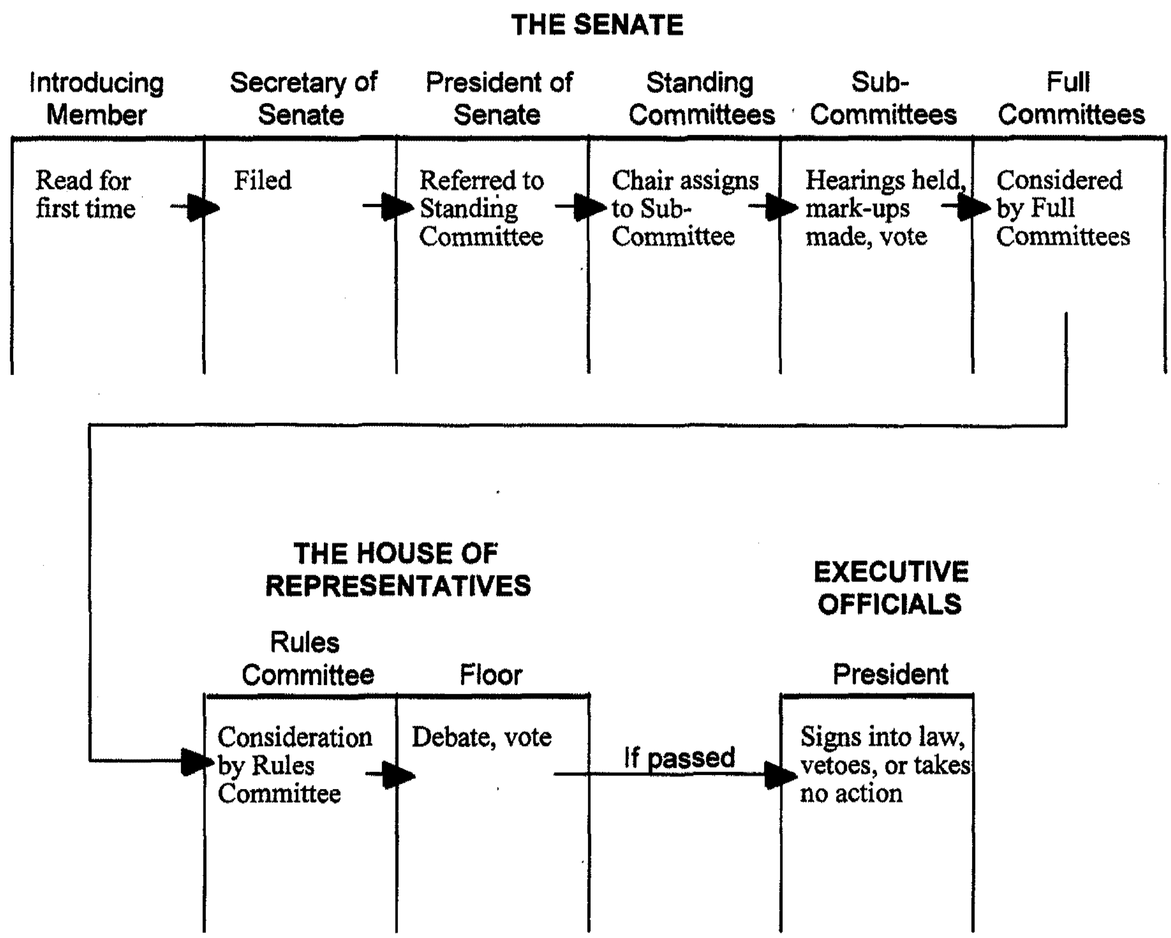
Committees: (Senate)

Agriculture, Nutrition & Forestry
Appropriations
Armed Services
Banking, Housing & Urban Affairs
Budget
Commerce, Science & Transportation
Energy & Resources
Environment & Public Works
Finance
Foreign Relation
Governmental Affairs
Indian Affairs
Judiciary
Labor & Human Resources
Rules & Administration
Select Ethics
Small Business
Special Committee on Aging
Veterans Affairs

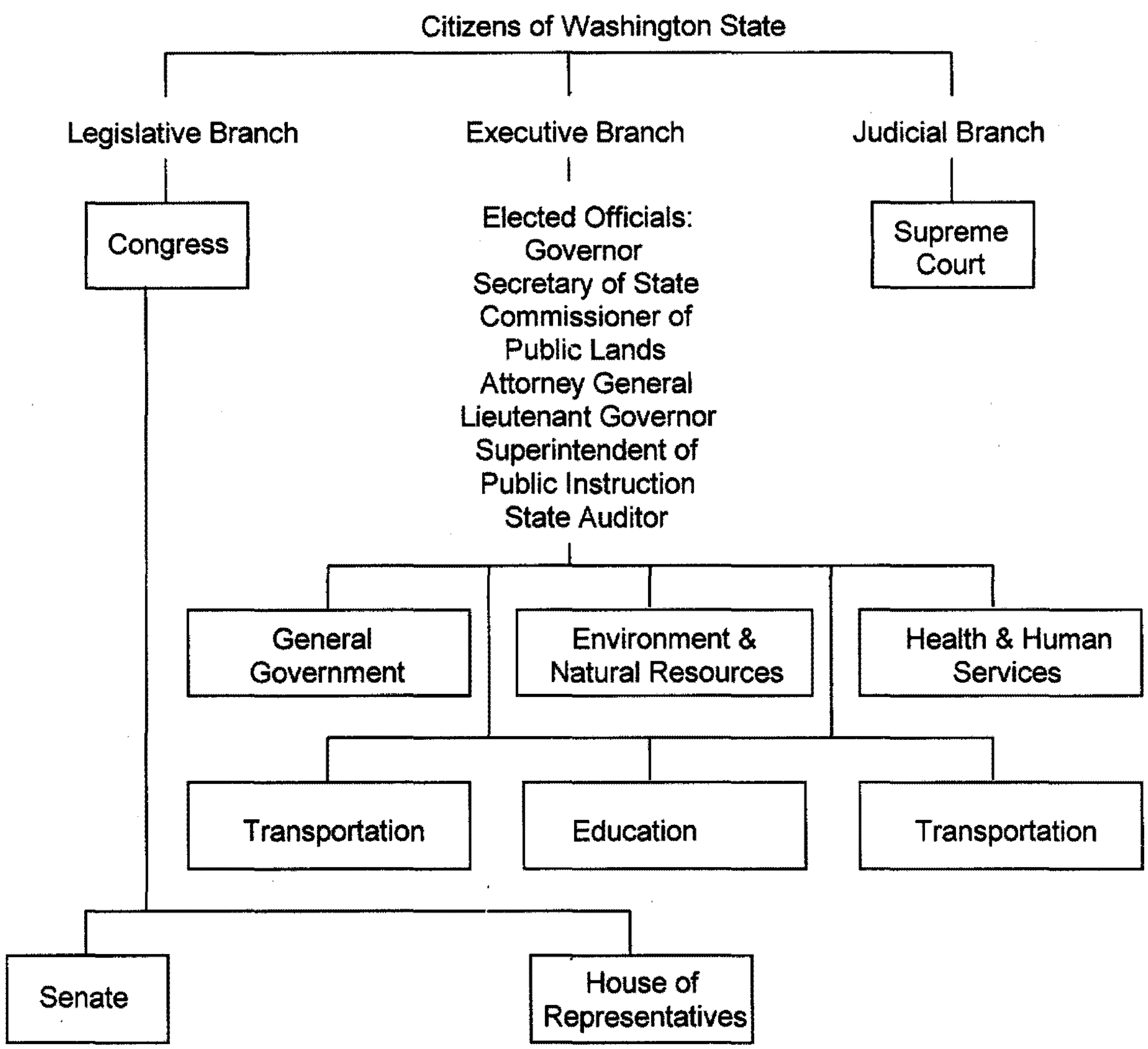
Committees: (House of Representatives)

Agriculture
Appropriations
Banking & Financial Services
Budget
Commerce
Economic & Educational Opportunities
Governmental Reform & Oversight
Judiciary
National Security
Natural Resources
Rules
Science
Select Intelligence
Small Business
Standards of Official Conduct
Transportation & Infrastructure
Veterans Affairs
Ways & Means

How a Bill Becomes Law
United States



State of Washington



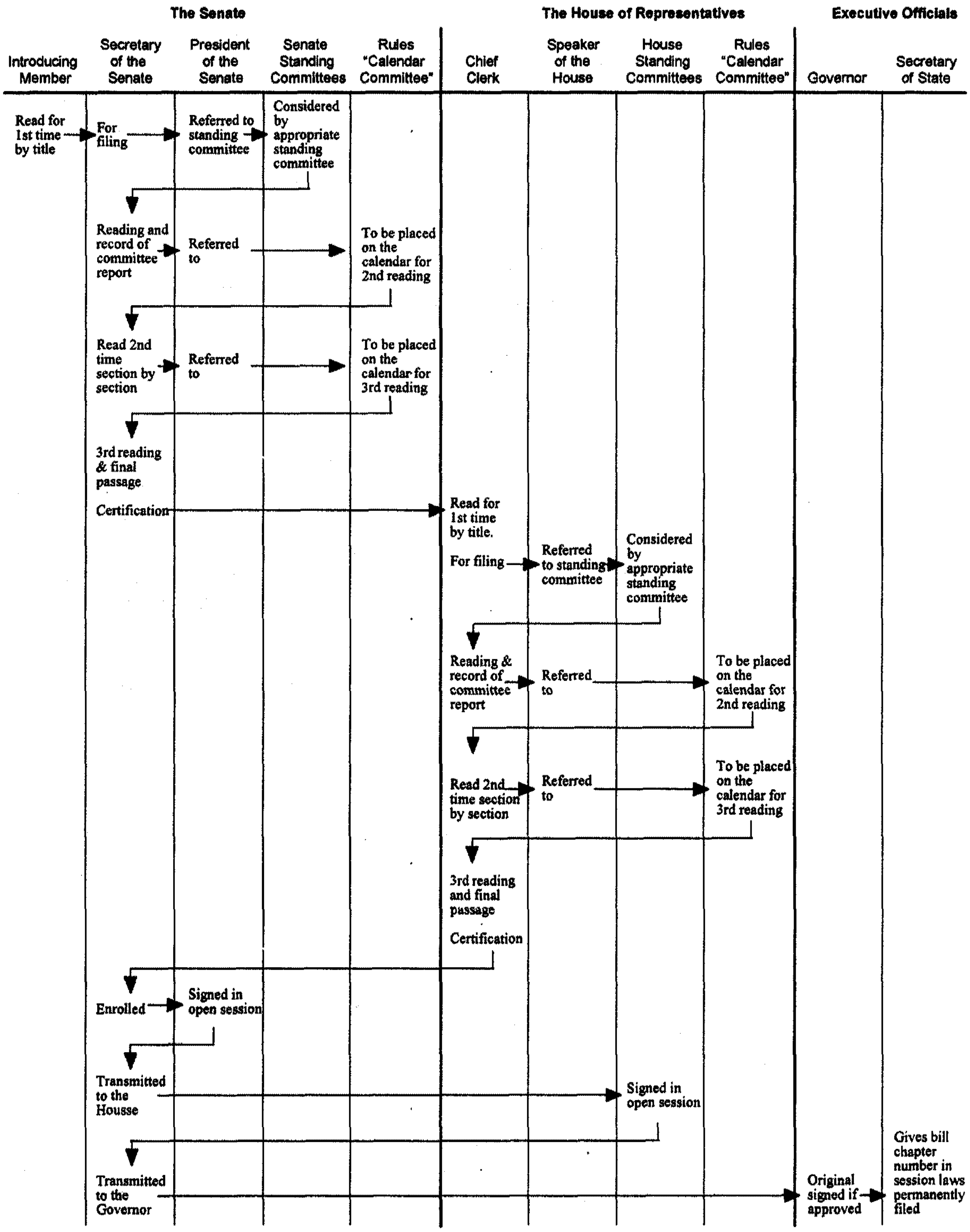
Committees: (Senate)

Agriculture, Trade & Development
Ecology & Parks
Education
Energy, Telecommunications & Utilities
Financial Institutions & Housing
Governmental Operations
Health & Long Term care
Higher education
Human Services & Corrections
Labor Commerce & Trade
Law & Justice
Natural Resources
Rules
Transportation
Ways & Means

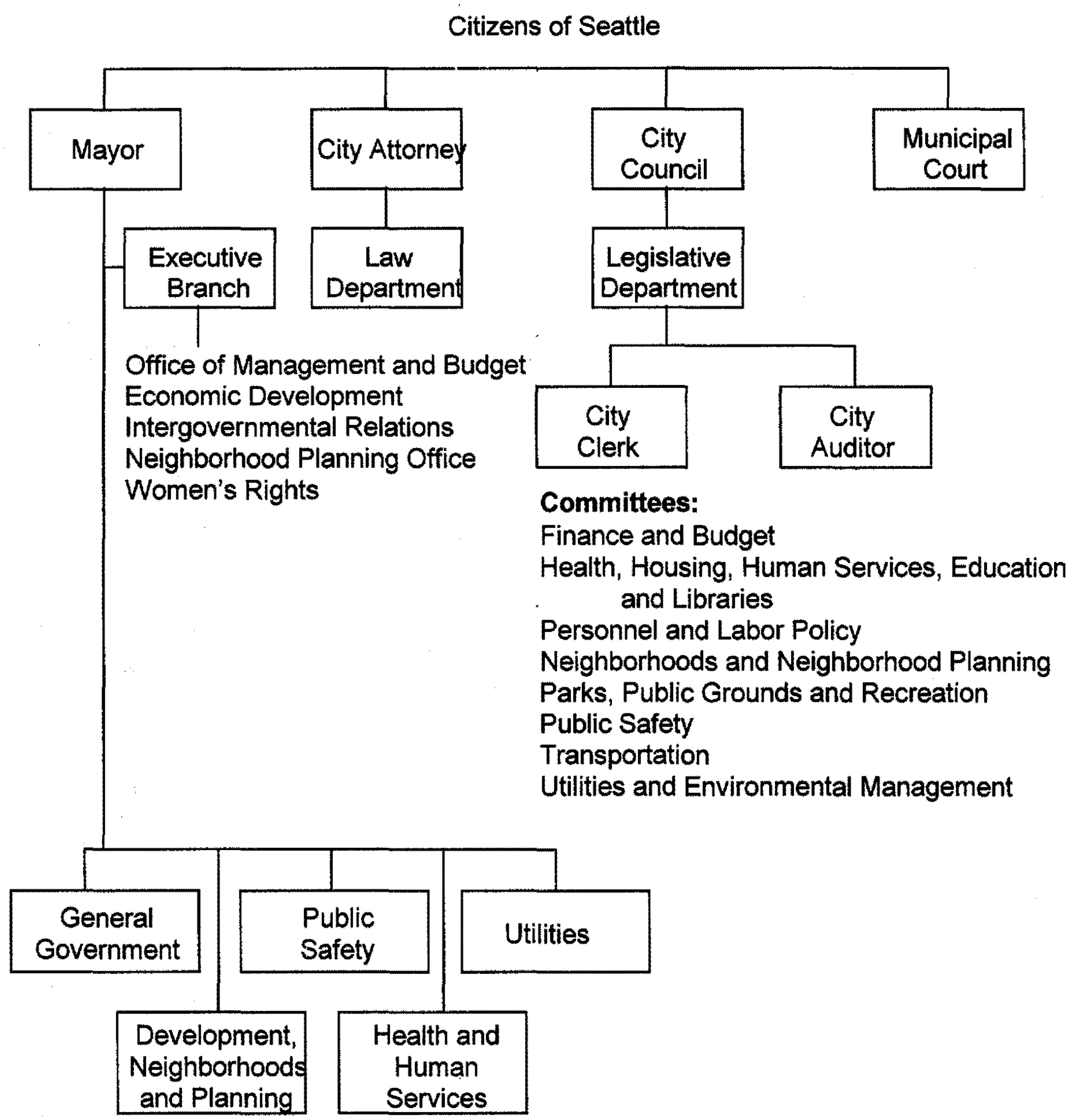
Committees: (House of Representatives)

Agriculture
Appropriations
Capital Budget
Children & Family
Corrections
Education
Energy & Utilities
Finance
Financial Institutions & Insurance
Government Operations
Health Care
Higher Education
Law & Justice
Natural Resources
Rules
Trade & Economic Development
Transportation

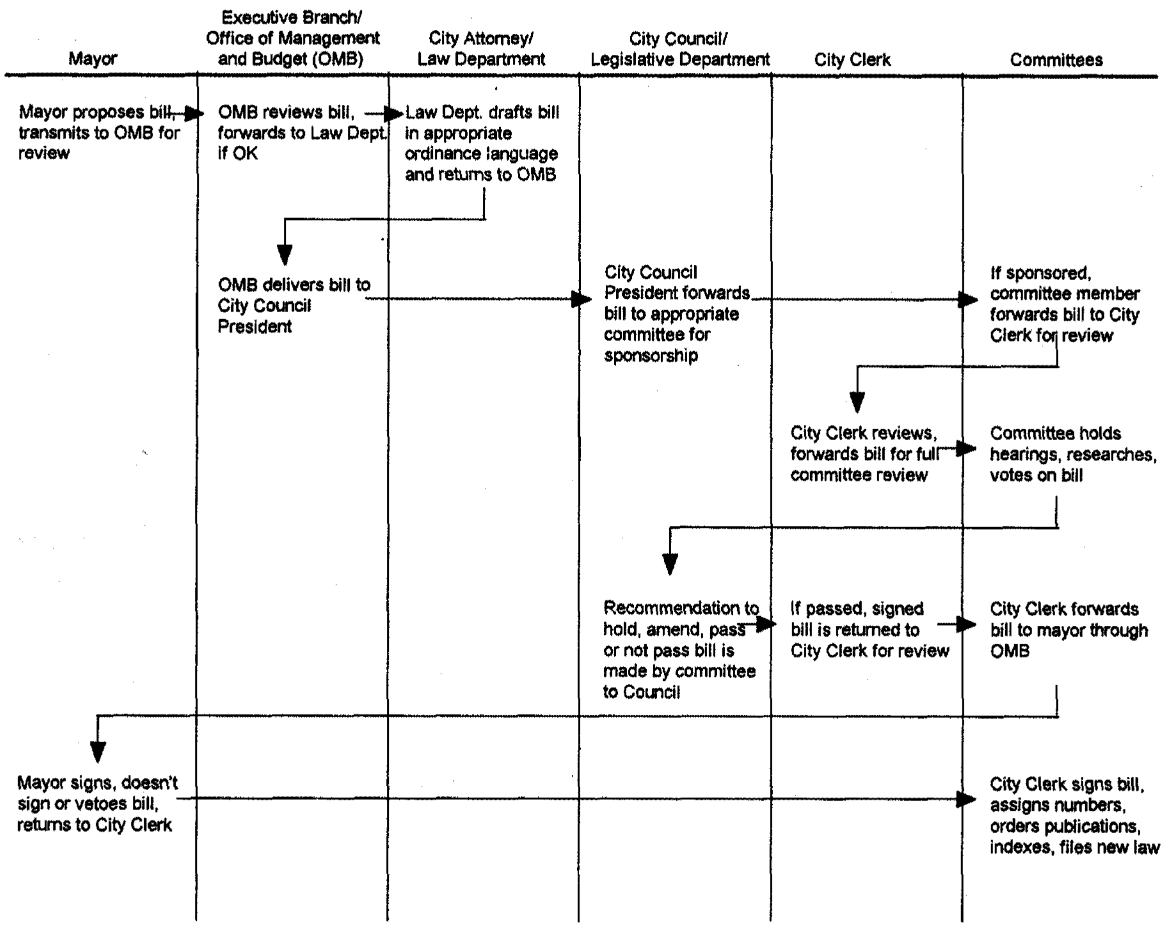
How a Bill Becomes Law
Washington State



City of Seattle, Washington Government Structure



How a Bill Becomes Law
Seattle, Washington



Operation And Training

Operation- and training-related challenges to effective incident management often stem from communications problems, liability concerns, insufficient training, and limited documentation.

Communications

Effective and efficient incident-related communication is difficult to achieve and can be most detrimental to incident management efforts if not improved. "The most significant obstacle to effective response is the need to communicate information about the incident to the appropriate organizations, rapidly make informed decisions about the incident to the appropriate organizations...and maintain smooth communication between organizations throughout the process" (National Incident Management Coalition 1996). It's important to resolve communications problems both because of the life-and-death consequences of mistakes on the part of emergency personnel and because of the standards to which these personnel are held. "Most disasters occur without warning, but people still expect a rapid and flawless response on the part of government. There is no room for error" (PSWAC 1996).

How Do We Define "Communications"?

Incident management communications includes the exchange of information both on- and off-scene, and within and between agencies and companies participating in incident management. Note that this limited definition does not include communication with the motoring public, which is handled in a separate module (Module 5 - Motorist Information).

Our limited definition of communications in the context of incident management thus includes the following links:

- Dispatch < -- > field
- Field < -- > field
- Dispatch < -- > dispatch

Breaking out interdisciplinary and interjurisdictional communications in this way will allow us to focus on field and dispatch communication problems, which are institutional, procedural, and equipment-related.

Why Is It Important To Improve Incident-Related Communications?

There are two basic objectives of communications in incident management:

- to ensure that the appropriate personnel and equipment are requested to assist in resolving the incident as quickly as possible with the least loss (in terms of life, limb, property, and environmental resources)

- to ensure that incident responders can experience a seamless line of communications, regardless of time of day.

Case-in-point: The Air Florida Crash

To illustrate the complexities of incident-related communications, consider the tragic example of the 1982 crash of an Air Florida flight into rush-hour traffic crossing Washington, D.C.'s, 14th Street bridge during a driving snowstorm. Parts of the aircraft, containing many casualties, landed on the bridge, while others fell into the Potomac River. Twenty different agencies, including local police from six jurisdictions, responded. Eventually, helicopters, life rafts, divers, tow trucks, and traffic control agencies were called to the scene. A list of the public agencies involved follows.

- Arlington County, Virginia, police
- Arlington County, Virginia, fire/EMS
- District of Columbia fire/EMS
- District of Columbia police
- Fairfax County, Virginia, fire/EMS
- Federal Protective Service
- Montgomery County, Maryland, fire/EMS
- National Airport fire
- National Airport police
- Prince George's County, Maryland, fire/EMS
- RACES (Radio Amateur Civil Emergency Service)
- Red Cross
- U.S. Army MASH unit
- United States Coast Guard
- United States Navy
- United States Park police

- Federal Aviation Administration
- Virginia Department of Transportation
- Virginia State Police
- WMATA police

Almost unbelievably, a Metro subway car derailed in an underground tunnel near the Smithsonian station just a half an hour later. This subsequent incident created the need for a large assortment of rescue workers similar to those just deployed on the bridge. Communication among the participating agencies was poor; leading to serious repercussions for the injured. For example, congestion on the radio systems, combined with telephone line overload, prevented field personnel from communicating with area hospitals. Consequently, hospitals were not informed as to the number of injured that would be transported, much less the nature of the victims' injuries or when they would arrive. Emergency medical services were likewise unable to monitor hospital capacities and therefore were unsure as to how to distribute the injured across the hospital network. As a result of the communications problems experienced during this disaster, many inquiries and reports followed.

Although it was unusual in its particulars, the magnitude of the Air Florida/Metro subway disaster is not unique. Since that incident, disasters with major roadway impacts have occurred on several occasions, including the collapse of San Francisco's Embarcadero during the Loma Prieta earthquake of 1989; the devastating Northridge earthquakes in southern California; and bombings in Oklahoma City and Atlanta. All of these have severely tested the communications planning and equipment of the incident management personnel. Although the vast majority of roadway incidents to which emergency and support personnel respond are not this challenging, the issues are the same: how can personnel from different agencies, companies, and jurisdictions work together with the resources available to communicate effectively?

The First Steps for Improving Incident-Related Communications

It is not necessary, or even desirable, for everyone on-scene to be able to communicate with everyone else. This is easily grasped by considering the Air Florida crash, which involved 20 separate agencies. Even if each agency were represented by only two field personnel and one dispatcher (surely a low estimate), over 350 separate links would be required for each individual to speak with every other individual. If nothing else, this number of links would be extremely difficult to keep straight; much time would be spent in circuitous communication; and radio and phone systems would quickly become congested, making transmission of critical information problematic. Simply put, trying to maintain so many communications links would detract from the real job of rescuing and treating victims and restoring the scene.

Therefore, it is up to incident responders to plan for incident management in order to identify the following:

- What are the essential links?
- What are the weak links?
- What are the missing links?
- Are problems institutional, procedural, or equipment-related in nature?

Communications that are critical in resolving an incident constitute essential links, which should be identified, in the course of incident management planning, thus reducing confusion and inefficiency in the field. Thus, it is important to check essential links to determine whether they are weak or even present. Post-incident critiques may be helpful in identifying weak or missing links that may have played a part in any communications failures.

On-scene communications can be facilitated through the Incident Command System structure, discussed in detail in Module 7 - Site Management. In many cases, sophisticated communications equipment may not be needed when key personnel can exchange information face-to-face at a central and designated location at the incident scene (i.e., a command post).

Practical Hints for Improving Incident-Related Communications

The following list of "practical" hints for improving incident-related communications was provided by Paul Purvis, a traffic engineer from Richardson, Texas (1990 population 74,840).

- Have available backdoor phone numbers in case all lines are busy, but don't abuse them.

- Develop good relationships with the parties you call. Visit their workplaces because nothing takes the place of face-to-face contact. Bring donuts and learn their names. Don't forget to say "thanks," as you'll need their help again.

- Don't be a nuisance to the on-scene commander. Respect that this person has his or her hands full.

- If you call for wreckers or heavy equipment, be sure that the police or fire department knows so that more equipment than is necessary doesn't show up, further crowding the scene and wasting time.

- Tell the tow company what the situation is instead of to telling them what to bring. Towers feel that they will be able to better clear the scene if they can use their own expertise in responding.

Institutional Challenges to Effective Communications

Many challenges to effective incident-related communications are institutional, stemming from differences among agencies, companies, and jurisdictions.

Multiple Jurisdictions

Serving the communications objectives of incident management is often difficult because doing so--particularly in metropolitan areas--depends on the cooperation and coordination of agencies and companies from many overlapping jurisdictions. Unfortunately, "turf" protectiveness often prevents effective on- and off-scene communication, a key to effective incident management. Incident management in urban, suburban, and rural areas will suffer unless adjacent jurisdictions communicate at all of the following points in time:

- before incidents occur, in planning sessions
- en route to the scene
- on-scene
- in post-incident critiques.

Although the prospect of coordinating the efforts of many fragmented jurisdictions may seem overwhelming, hope can be found in examples such as the TRANSCOM program in the New York City metropolitan area (1990 population 7,322,564), which ranges over the states of New York, New Jersey, and Connecticut and services over 100 public agencies and private companies.

Multiple Agencies and Companies

In addition to the challenges presented by multiple jurisdictions, challenges result from the differences among different types of incident response agencies and companies, such as police, fire, and transportation agencies, towing and recovery services, and the media. A lack of understanding of the roles, resources, and abilities of other personnel may contribute to communication problems among the different types of organizations. This point is supported by a study by the Federal Emergency Management Agency, which found that on-scene communications problems among incident responders were "the result of poor task allocation and coordination, confused authority relationships, and inadequate information collection and distribution...They were found to be the result of autonomous units acting independently and not talking with each other." Agency and company roles are covered in detail in an earlier section of this module.

Even where turf issues among different jurisdictions and agencies have been resolved, other mechanical problems may cause communications failures. Some of these are discussed below.

Multiple dispatch centers

The existence of multiple dispatch centers can complicate incident management, resulting, for example, in multiple calls to towing companies. Combining operations, as in joint police-fire dispatch, usually simplifies and improves communications. The emergence of cooperative, multi-agency Traffic Operations Centers, discussed in Module 9, is a positive development in this area.

<u>Procedural Challenges to Effective Communications</u>

Many challenges to effective incident-related communications are procedural in nature. Typically these challenges relate to a lack of awareness regarding who to call or how to call them.

Circuitous communications

When information is passed from point to point via long communications chains, the potential for miscommunication, lost detail, and wasted time is significant. Adherence to centralized communications philosophies (as practiced by the Incident Command System) eliminates or greatly reduces redundant, circuitous communications.

Who ya' gonna call?

A complete contact list, with name, phone, and FAX numbers, should be developed for each type of incident. A HazMat incident, for example, would require reference to a different call-out list than a minor traffic incident. In addition, the list should denote proper contacts for both daytime and nighttime operations, as these contacts are likely different. Also, shift changes should be specified; this is likely a time when under-staffing may occur if one person leaves early and another arrives late. Accurate assessment by the first responder is essential in getting the right people contacted quickly and in providing them the information they need to determine which equipment and personnel to bring to the scene. Contacts to consider for a list include the following:

- Police
- Fire and Rescue
- HazMat
- Department of Environment or Ecology
- Highway Maintenance/Traffic
- Department of Health
- Emergency Management
- Medical Examiner
- Private Sector
  - Ambulance Service
  - Towing and Recovery
  - Media
  - Private Traffic Reporters
  - HazMat Contractors
  - Airlift Ambulance Services

Everyone needs to be aware of each others' call-out procedures and contact points throughout the 24-hour day, seven days a week.

Different Lingo

Although 10-codes were developed in the 1930s to standardize timesaving verbal codes among public safety providers, variations on these codes have since emerged among different agencies, leading to yet other communications problems. Incident management experts feel that the most reliable way to deal with this issue is to avoid the use of specialized codes or acronyms between responders on-scene. As an example of potential confusion, CAD to a police officer stands for computer-aided dispatch; CAD to a traffic engineer stands for computer-aided drafting.

<u>Equipment-Related Challenges to Effective Communications</u>

Virtually all incident responders, whether from fire, emergency medical, transportation, and police agencies, or towing companies, have available mobile communications, which allow them to stay in touch with their own dispatch centers and other field personnel from their own agencies or companies. Most have a radio installed in the vehicle, as well as some form of portable, hand-held radio, which runs off a battery. Many incident responders now carry cellular telephones; some also carry pagers, and others are equipped with FAX/teletype devices. The equipment-related challenges for different types of communications include the following:

- Conventional radio systems. These are often incompatible among agencies and may be antiquated. Agencies need to coordinate purchases to ensure compatibility.

- Trunked 800 Megahertz (MHZ) radio systems. These are increasingly popular--many agencies are now changing to this method. They have more capacity, but introduce some compatibility problems, and agency coordination is still needed. Scanning by traffic reporters is difficult.

- Single-frequency emergency radio systems. These can be used to facilitate management of major incidents. The protocols for these conditions and use need to be defined.

- Cellular phones. These can be of special benefit to supervisory level persons for facilitating communications. However, cellular sites can become saturated during major incidents, limiting their usefulness.

- Pagers. They are good for brief messages. They typically require a subscription to a service.

- FAX/Teletype machines. These rely on written rather than verbal communication. It may be more time consuming to communicate a message with them.

Apples and Oranges: Equipment Incompatibility

Another set of communications challenges incident responders face are caused by communications equipment. One of the biggest problems is equipment incompatibility. For example, police personnel in adjacent cities may not be able to talk to one another on their radios nor may police personnel and fire personnel from the same city.

Although it might seem that the cellular telephone could neatly solve the problem of compatibility, they are not a reliable alternative or even an effective backup because cellular sites may quickly become saturated in major emergencies. In the aftermath of the Northridge earthquakes, for example, a CalTrans engineer reported that his crew was only successful in placing about one in 30 cellular calls attempted. Land-line telephones, often unavailable to field personnel in any case, are also susceptible to congestion and may also become useless in emergencies. Surprising as it is in this age of high technology, mobile field communications may be primitive. At the Oklahoma City bombing, for example, equipment problems and congested airwaves forced supervisory personnel to resort to runners to carry messages.

To get around equipment compatibility problems, some incident responders' vehicles are equipped with two or three separate radio systems, which allow them to communicate among certain responders in the field but also take up scarce vehicle space. Moreover, having to carry two or three hand-held radios outside the vehicle, each geared to a different frequency and containing a heavy battery, is cumbersome, making it difficult for responders to perform their actual duties.

Why is it so difficult, in this era of high technology, to give incident responders equipment that provides seamless communications? One constraint is that radio messages are carried along electromagnetic waves, which vary in frequency. Each frequency occupies some portion of the radio spectrum, a scarce resource that is much in demand and that is regulated by the Federal Communications Commission (FCC). In other words, there is only so much usable radio spectrum, and existing claims on that spectrum, from public safety providers to the private sector (which is thinking up all sorts of new uses for that spectrum), already exceed availability.

Each functional organization (e.g., police, fire, transportation) is assigned a particular sector of the radio spectrum, that is, a band of frequencies, for its operations. Equipment designed for one frequency does not work with another unless intermediary technology is used to "patch the communications through," which, in field situations, involves considerable cost and technical expertise on-scene.

Although it would already be technically feasible to produce inter-operable wireless communications systems, several obstacles stand in the way:

1. Such an effort would require additional space on the radio spectrum.

2. New technologies involving wireless data and video transmission are emerging. The transmission of data and video requires even more spectrum than the transmission of voice messages.

3. Incident management agencies have already invested many millions (if not billions) of dollars in existing radio systems, which may continue to be useful for decades. It may be extremely difficult to persuade agencies (much less taxpayers) to abandon these investments for new systems.

4. The desirability of a common incident-related communications system is complicated by a need for security, especially for police agencies. When criminals can scan police radio systems, it gives them useful information with which to evade authorities. Messages can be encrypted, garbling unauthorized interception, but this necessity further complicates the ability to provide a common radio system that is freely accessible to all incident management responders.

5. It would be difficult to coordinate the thousands of police, fire, and transportation responders across the country (to name a few) in purchasing and implementing fully compatible wireless equipment. Many private companies are building the technology; getting these companies to adopt common standards so that new equipment is truly compatible will be a major coordination challenge.

The Federal Effort to Resolve Communications Problems

Efforts are under way to resolve communications problems at the national level. The Public Safety Wireless Advisory Committee (PSWAC) was formed in 1983 upon acknowledgment by the U.S. Congress, the Federal Communications Commission, and the National Telecommunications and Information Administration that "the effectiveness of police officers, firefighters, emergency medical services (EMS) personnel, and other public safety officials is inextricably tied to communications capability" and that the public safety community's radio systems were operating under increasing burdens, posing critical challenges to the delivery of emergency services.

The good news for incident responders is that problems in communications technology/compatibility are being addressed at the federal level, with representation from all levels of government. However, solving these problems in this era of constrained resources will take time. According to Kevin Kearns, a former firefighter who is now working to develop a more effective communications infrastructure for incident management, the best way for incident responders to deal with both institutional and technical obstacles to effective incident management communications is to adhere in the meantime to some simple, common sense principles:

1. Meet with participating agencies regularly to plan for incident management, to critique incident responses after the fact, and to keep interjurisdictional and interagency communications open.

2. On-scene, one of the first orders of business should be to identify and exchange information on common communications abilities (e.g., "What channels do you have?" "What's your cell phone number?").

3. Maintain good ICS procedures on-scene; this is the most effective way to integrate disparate agencies and jurisdictions into a coherently

functioning unit.

The Future of Incident-Related Communications

Below is a summary of predicted changes or advancements in incident-related communications.

1. "The revolution in microelectronics and computers has brought and will continue to bring enormous improvements in the performance of wireless technology." (Wireless transmission refers to messages that can be transmitted via electromagnetic waves, without physical connection between the sender and receiver. Thus, radio messages and cellular calls are examples of wireless technologies, whereas standard telephone and fiber optic connections, which are relayed via a wire, cable, or physical connection, are not.) Further, it is expected that technologies that have not yet even emerged from laboratories will play a significant role in public safety communications within the next 15 years.

2. Voice messaging is expected to shift from the current FM analog technology to digital transmission, which offers advantages in audio quality and security, because digital messages can be encrypted (or coded) much more easily.

3. Transmission of still images (or pictures) is expected to become much more prevalent. Such development offers areas such as law enforcement some great advantages--allowing for example, transmission of fingerprints, mug shots, driver's license photos, and photos of incident scenes to and from dispatch centers among field personnel. In addition, image transmission is expected to benefit fire personnel, who may receive building plans complete with maps of HazMat locations. The provision of emergency medical services may be enhanced when emergency room physicians are able to view pictures of patients on the scene or en-route and thus provide emergency medical technicians or paramedics with specific instructions better tailored to the patient's condition.

4. Video systems, in addition to existing roadway surveillance systems, will benefit transportation agencies in monitoring traffic flow and taking

corrective action; and they are also expected to aid all participating agencies in incidents involving bombs, hostages, and HazMat exposure.

Two things should be emphasized:

1. there is much work to be done to resolve the many technical issues pertaining to incident-related communications; and

2. coordinating the efforts of the many thousands of agencies, companies, and jurisdictions so that the emerging technologies end up being truly compatible, which involves a lot of coordination. Efforts on both fronts are under way at the federal level.

Liability

Improvements in incident management can often be obstructed for reasons related to liability or legal authority. This resistance is often unfounded and stems from a lack of understanding regarding the motivation behind litigation and the legislative process. Below is a general discussion of both liability-related issues and the legislative process.

Who Is At Risk For Liability?

As personal responsibility wanes, risk of liability increases. "I know I did it, but it wasn't my fault." If people are looking to put blame for their own actions on someone else, an easy target is a large, monolithic government agency or private company that is less likely to evoke sympathy.

Liability concerns are present for all agencies, not just transportation agencies. However, Transportation agencies may be more at risk for liability than other public agencies; they typically have larger budgets and thus provide greater potential for return for prosecutors.

In the majority of cases, the suit will be brought against the agency or company for which an individual works, even though it may have been the individual's actions that initiated the suit. In rare instances, if an individual is not operating within the scope and duty of his or her job, the employer may choose not to support his or her actions.

Why Worry About Liability?

As more state-level money is spent on liability-related compensation, less state-level money is available to ensure that you have the resources (e.g., personnel and equipment) that you need to properly perform your duties. Most cases brought against public agencies are seeking substantial compensation as a result of serious injuries and fatalities, not fender-bender accidents or whiplash injuries. The California Department of Transportation (CalTrans) reports spending $20 million in liability compensation, plus $8-10 million in additional liability-related costs each year. The total potential liability compensation costs from 40 other states is nearly $40 billion in damages. The trend is toward more cases and more compensation per case. In some states, a single case can result in up to $15 million in damages. To avoid such exorbitant pay-outs, nearly half of the states have capped the amount of compensation that can be awarded. Nevada has set one of the lowest limits at $50,000 maximum compensation per claim. Most other states limit the compensation to $1-2 million. Property damage only incidents rarely result in liability claims because of the low potential for pay-out.

How Does Liability Relate To Incident Management?

With respect to incident management, liability concerns are most frequently raised when methods for speeding incident clearance are considered.

"What if a disabled vehicle is damaged while being pushed off the roadway or shoulder by a push bumper-equipped response vehicle?"

Although the danger resulting from a disabled vehicle in a travel lane is evident, there is disagreement as to whether a disabled or abandoned vehicle on the shoulder of a roadway is a hazard. Many state laws, in fact, facilitate the presence of disabled or abandoned vehicles on the shoulder for 48 hours or longer. As was discussed in Module 1 - Introduction to Incident Management, over 4 percent of all fatality crashes occur on the shoulder of the roadway (NHTSA 1993). The cost of a single fatality crash is estimated to be $830,000, resulting largely from lost workplace and household productivity (NHTSA 1994). This cost does not include agency-borne liability costs brought about by the survivors, which, at a minimum, are likely to be $50,000. In contrast, the approximate cost of a new, lightweight, plastic formed bumper is $2000.

From strictly an economic perspective, quick clearance becomes easily justifiable. In addition, most property damage claims are covered by the private individual's insurance.

"What if the trailer or the cargo of an overturned truck is further damaged in the clearance process (i.e., if a front end loader is used)?"

This question raises similar issues, namely, additional damage incurred through response agency actions. The difference in this case is that the potential damage costs are higher and the affected party is a business rather than an individual. As with the private individual, insurance will likely cover all or a large portion of the resulting damages to the vehicle or the cargo. Unlike the case involving an individual, if secondary injuries or fatalities result because of the first incident, the business can be named as a contributing party to negligence. Certainly, the business would not want to be responsible for additional liability-related costs.

A third question that frequently comes up is an individual incident responder's exposure to liability. Individual employee accountability is rare because the potential for compensation pay-out is small. In addition, an individual has the potential to evoke more sympathy from the juror than does a representative from a larger company or agency. Hence, the suit may not be successfully awarded to the prosecutor. In the majority of cases, the suit will be brought against the agency or company for which an individual works, even though the individual's actions initiated the suit. In rare instances, if an individual was not operating within the scope and duty of his or her job, the employer may choose not to support his or her actions. An example of this is if an employee drove the company car while intoxicated and seriously injured another individual. If there are doubts as to whether or not certain actions are supported by your agency, be sure to ask your employer or check with your agency's or company's lawyer(s).

When Is An Agency Or Company Considered Negligent?

Negligence can result in two ways: (1) doing something that a reasonable person would not do (e.g., driving drunk, excessive speed) or (2) neglecting to do something that a reasonable person would do (e.g., putting up a warning sign).

Four key elements are required to prove negligence:

- a duty or standard to perform or maintain
- a breach of that duty, either through some action or omission
- an actual loss or harm to involved parties
- a connection between the breach of duty and the resulting harm

States operate under what is called a "Duty of Care," which places the responsibility to maintain reasonably safe travel under ordinary travel conditions on state agencies. An example of a "Duty of Care" statement is provided below:

A [county] [city] [town] [state] has a duty to exercise ordinary care in the [construction] [maintenance] [repair] of its public [roads] [streets] [sidewalks] to [keep] [construct] them in a [manner] [condition] that is reasonably safe for ordinary travel by persons using them in a proper manner and exercising ordinary care for their own safety.

This duty is typically divided into two areas: (1) periodic repair and (2) response to unpredictable natural and unnatural events (e.g., ice, accidents). Fulfillment of this duty requires notification of the existence of a problem and a reasonable amount of time to correct the problem.

<u>If A Lawsuit Is Unavoidable, What Should Be Expected?</u>

If a lawsuit cannot be avoided, the process you can expect is described below.

Filing a claim

A claim can be filed against a public agency more than three years after an incident occurs. With such a time duration, comprehensive and well-organized documentation procedures are critical.

Filing a Lawsuit

After the claim is filed, the claimant must wait 60 days before a lawsuit can occur. This 60-day period gives public agencies a chance to prepare for the case. During this period, both the prosecutor (for the claimant) and the defendant (for the public agency) gather as much information as possible regarding the incident. Both agencies seek information regarding the public agency's notice of the problem and its actions to correct it. Notification can come in the form of actual notice (i.e., a problem is reported to the agency) or constructive notice (i.e., the problem should have been obvious because of past safety problems in the area).

During this investigative process, the prosecution may request access to various information sources, including post-it notes, e-mails, diaries, notes, and accident records. The Public Information Act and the Freedom of Information Act enable prosecutors to gain access to much of this information. However, a Congressional statute was recently enacted that may prevent access to some of this information and consequently reduce the amount of liability compensation for state agencies. Initiated by the railroad industry which had been hit hard with litigation, the statute in essence overrides the Public Information Act and allows public agencies the right to not disclose safety information for Federal Aid Section 409 funded roadways. Even if a project was "eligible" for 409 funding but was instead funded through local sources, it may still be protected by the Federal Aid Section 409 privacy statute. Check with your agency's lawyer(s) or your local Attorney General's Office.

Pre-trial Settlement Conference

Before actually going to trial, a pre-trial settlement conference is held. Settlement is not an admission of guilt, although it is often viewed that way. Settlement stems from a combination of factors, including courtroom congestion, a particular lawyer's strengths and weaknesses, and a lack of documentation (i.e., lack of a strong case).

Trial

At the trial, the plaintiff must prove that (1) the public agency knew about the dangerous situation, and (2) that the public agency had time to react. Taking care of acts of nature (i.e., ice, rocks in road) is often believed to be the duty of transportation maintenance personnel. Immediate response to acts of nature is unreasonable; maintenance personnel may not be notified of the problem immediately and time is needed to ready and dispatch resources to remedy the problem. In such instances, the plaintiff will try and prove that there were interim measures, such as the placement of warning signs or the diversion of traffic, that could have improved safety. It is ineffective to argue that limited resources prevented the adequate handling of the safety hazard; there are always interim measures that can be taken.

The best defense that a public agency has against arguments such as these is to prove the reasonableness of personnel actions. Reasonableness should be supported by common sense, statutes and regulations, relevant published policies, and procedures by roadway maintenance organizations (it is important to note that Manual on Uniform Traffic Control Devices (MUTCD) is not legal standard in all states). This information should be supplemented with evidence proving that personnel acted reasonably. Diaries; radio logs; workload prioritization lists; hazard notification; dispatch and response times; photographs of the scene, including signing, geometrics, and traffic control; and witnesses can be used as information sources.

Liability is a fact-driven process, regardless of differences in state compensation laws. It is better if an agency documents and corrects a problem rather than covers it up. The truth always comes out.

Outcome

There are three options to every case:

- dismissal
- settlement
- win/loss

If the case results in either settlement or a loss, public agencies are responsible for compensation. As discussed earlier, compensation costs can be quite high, typically covering medical expenses to date, ongoing medical care, and pain and suffering.

A single agency may be responsible for providing compensation; multiple agencies may be responsible for providing compensation to varying or equal degrees; a third party may be wholly or partially responsible for providing compensation; or the amount of compensation may be reduced because the plaintiff is partly at fault.

The plaintiff may be awarded no compensation if he or she was trespassing on a closed facility, performing illegal maneuvers, or was extremely careless (i.e., driving while intoxicated).

Training

As athletes and musicians improve their performance with training and practice, so do incident responders. Training and practice are essential to improve the overall incident management process and to hone skills. Many agencies and companies have continuous personnel turnover, and all new people need to be trained in incident management practices. It is also important that people from one agency/company receive some basic training on the practices and procedures of other agencies/companies to facilitate understanding at the scene of an incident. Understanding of the roles, duties, and responsibilities of other agencies and companies engenders trust and patience on the scene.

Incident management training efforts may focus on three general areas:

1. training specific to incident management within one's own agency or company

2. training aimed at increasing awareness of other responders' roles or existence

3. training aimed at improving specific procedural operations.

Specific Incident Management Training

Too often, incident management is learned on the job; the importance of or motivation for incident management is seldom explained. Transportation agencies, in a formal capacity, are relatively new to incident management and, therefore, lack substantive training materials. Unlike police and fire agencies, whose personnel devote much of their time to training for emergency or life-threatening situations, transportation personnel are typically not trained in such areas. One reason may be that the role of transportation agencies at an incident scene may be clear in the most general terms (i.e., to provide traffic control) but quickly becomes vague in regard to specific duties such as response to hazardous material incidents. In addition, the roles and involvement of transportation agencies in incident management vary nationally (i.e., some transportation agencies are very proactive and would like to assume additional incident management responsibilities, whereas others are content to perform construction and maintenance functions).

In Washington state, incident management training tailored for transportation agencies, namely the Washington State Department of Transportation, is available. Methods of transferring this training to other transportation agencies in the country are being explored.

Training for Increased Responder Awareness

Non-transportation responders should understand the traffic and safety implications of lane closure or total freeway closure. Non-police personnel should be aware of the importance of accident investigation and the maintenance of evidence. Non-fire personnel should be cognizant of the fire department's role and needs at an incident scene. The needs of private company personnel should be recognized as well. Such education can take place through interdisciplinary training courses similar to this. However, logistically, it is difficult for multiple disciplines to commit to this type of training very frequently. A more realistic educational method is to involve guests from outside of your discipline to speak about their role in incident management at your regular agency or company training sessions.

A representative from the Washington State Department of Transportation's major incident response team speaks regularly to cadets at the Washington State Patrol's training academy.

Training for Improved Procedures

Training to improve incident management procedures should directly involve personnel from all affected disciplines. This training is best if it is "hands on." Ideally, "staged" incidents provide the best forum for learning if the time and place of the staged incident are covert. Again, logistics prevent this form of training from occurring frequently. A training alternative, Critical Incident Management Training, is being used successfully in New York. Originally intended for large-scale emergencies, this training exercise includes 8 hours of lecture followed by a series of role-playing exercises. Materials include a detailed scale model of a city (the model varies by area in the state). Using toy cars, the representatives from police, fire, private industry, and others act out what they would do in a sample emergency. So far, this life-like exercise has been well received. Transportation agency personnel have not yet been involved; however, work is being done to incorporate transportation personnel and reflect their importance in the emergency or incident scenario. The benefit of such formal training over on-the-job training is that participants can stop at any time and question other responders about their actions. At an actual incident scene, urgency in performing actions does not allow this type of insightful discussion.

Incident Management Debriefings

It is important to have follow-up reviews or assessments of incidents (i.e., debriefings) to discuss what went well and what didn't work. Ideally, debriefing meetings should occur immediately after the incident has been cleared to ensure that details and procedures of the response effort are not forgotten but following the necessary data collection. The main goals of these meetings are to critique the procedures used and any decisions made and to determine whether future management could be improved in any way (e.g., by restructuring the procedures, adding extra resources, or modifying the paperwork). Personnel in attendance should include the responders at the incident.

Below are some guidelines for conducting the incident response debriefing.

After the incident has been cleared, notify all the responders of the location of the debriefing session. Conducting the debriefing immediately after the incident ensures that all of the affected responders are present at the debriefing, and efforts to schedule future meetings will not be necessary. If a debriefing meeting cannot be scheduled immediately following the incident, then the meeting should be scheduled as soon as possible after the incident.

During each debriefing, the following steps may be appropriate, depending on the type of incident.

- Recreate the incident chronology.

- Each agency should offer input on the positive and negative aspects of the operation.

- Each agency should suggest possible improvements.

- Discuss the suggestions and determine what changes are needed.

- End discussions on a positive note.

Graphic aids or videotapes can be useful in reviewing incident management procedures. If these are not available, an area map should be provided. This is most helpful when major incidents are reviewed at a later date.

At least one person attending the debriefing should be in charge of documenting the results. The main reasons for documentation are to list the lessons learned and to note any changes in procedure for future incidents (WSDOT 1994).

Training Materials

To ensure that training efforts are effective, operations are efficient, and the program success has longevity, it is important to develop textual material to support your actions. Variations in training content and intent exist. Single-disciplinary or multi-disciplinary incident management manuals can be developed. Special procedures required at incidents involving hazardous materials may be included in these manuals or provided separately. The policies and responsibilities for each participating agency or company should be discussed and included. These policies can be fairly general to allow them to be adapted to different incidents but specific enough so that each responder's responsibility within the context of incident management is clear.

For a full description of an incident management manuals as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included in the back of this notebook (see Incident Response Manual).

Documentation

Documentation is often a forgotten detail at the scene of an incident. This is especially problematic with increasing threats of litigation. Nonexistent or poor documentation of incident management actions can severely reduce a responding agency's or company's defense against litigation. The documentation of incident management is essential for several other reasons:

- to justify the need for a program or program expansion
- to demonstrate benefits attributable to a program
- to evaluate a program's effectiveness
- to identify critical locations or areas where incidents are likely to occur
- to identify critical time periods for incidents or specific incident types
- to identify equipment or personnel needs

General types of information to document at every incident include:

- date
- time
- location (by milepost) or other cross-references used by responding agencies
- incident type and characteristics (e.g., HazMat, fatality accident, disabled vehicle, etc.)
- number and description of lanes impacted
- actions taken

- duration of incident - that is, amount of time to
  - detect
  - verify
  - respond
  - clear

Photographs and Videotapes

Photographs and videotapes are becoming increasingly popular ways of documenting circumstances and actions taken at an incident scene. It is important to capture the information that can be used to defend your actions. Such information may include the following:

- traffic control
- signing
- response vehicle parking
- personnel performing duties
- materials in use
- equipment in use
- roadway surface
- roadside vegetation.

Inappropriate information to capture may include

- persons involved in the incident
- license plates
- blood, etc. (WSDOT 1994).

Incident Management Database

Another increasingly popular method of documentation is the use of an incident management database. An incident management database allows incident-related information to be entered and stored electronically at the scene of an incident, thus eliminating problems with illegible field notes and lengthy data entry at the office. The time savings resulting from direct data entry in the field means that more timely information related to motorists and vehicles involved in incidents, as well as incident management operating statistics, is available.

To ensure that the Washington State Department of Transportation's major incident response team (IRT) program improves its incident management efforts, historical information about response times, clearance times, and a variety of other details must be maintained. A database was recently developed to provide the IRTs with a consistent method of storing the incident data collected. In addition to justifying the operation of the IRT program, these data allow (1) the IRT to review its performance and make improvements on the basis of documented examples of the techniques that have proved to be most time and cost effective, (2) WSDOT to recover more of the costs of the incident response effort from the insurance companies of the parties at fault, and (3) WSDOT to improve its budget and planning forecasts (Cutting, et al . 1994).

The information maintained in the database is summarized below.

Location (City and County)

- nearest city, by code
- county in which the incident occurred, by code

General Information

- KA job number (a four-digit code used to recover the clean-up costs)
- name of the person preparing the report
- date of the report
- date of the incident
- time of the incident
- time the IRT received the call to respond to the incident
- time the first IRT member arrived at the scene
- date incident ended
- repair notes

WSDOT Personnel

- number of WSDOT employees involved

- number of WSDOT employees involved by type (i.e., Maintenance Technicians 1, 2, and 3; Maintenance Lead Technician; Incident Response Lead Technician, Maintenance Area Supervisor; and Incident

Response Supervisor)

- number of hours each was at the incident site

Location (WSDOT Region and Maintenance Area)

- WSDOT Region and Maintenance Area in which the incident occurred
- Regional Maintenance Area number
- Highway/Route Information
- state route number and nearest milepost number
- description of the nearest intersection if the state route and milepost number are not available
- travel direction of the affected lanes
- lanes closed (i.e., ramp, single lane, multiple lanes, all lanes in one direction, or all lanes in both directions)
- roadway surface
- reason for road closure (i.e., single-vehicle accident, multiple-vehicle accident, fatal accident, hazardous and non-hazardous material spill)

Travel Conditions

- weather conditions (i.e., rain, snow, fog, wind, calm, and clear)
- road conditions (i.e., dry, wet, ice covered, and snow covered)
- light conditions (i.e., day, dawn, dusk, or night—night with street lights on, night with street lights off, or night with no street lights at all)

Agency Participation

- agencies present at the incident site (WSDOT, WSP, DOE, county emergency services, fire department, county police, city police, or other)

Equipment

- WSDOT equipment used
- IRT vehicle equipment used
- non-WSDOT equipment used

Materials and Maintenance

- IRT vehicle materials used
- follow-up maintenance

Cleanup

- delayed cleanup until off-peak time

- conditions at the incident scene (i.e., presence of hazardous materials, non-hazardous materials, fuel spillage, fire, flammable liquid, corrosive material, explosive material, radioactive material, or toxic materials)

- agency responsible for cleanup

Traffic Control

- lane where the incident originated
- detour route, if applicable
- occurrence of incident in construction zone

Investigation

- method of WSP investigation (i.e., tape, total station equipment)
- WSP accident and case number (if applicable)
- lead investigating agency (WSP, county, city)
- number of vehicles involved in the incident
- number of pedestrians and/or cyclists involved
- number of injuries
- number of fatalities

Number of Vehicles

- number of vehicles, by type (e.g., one bus, two passenger cars, and a taxi)

Causing Party's Vehicle Type

- type of vehicle that the causing party was driving

Driver and Vehicle Identification

- driver's last name, first name and middle initial
- driver's license number
- state or province in which the driver's license was issued
- driver's address
- driver's phone number
- number of occupants in the vehicle of the party at fault
- number of injuries in the vehicle of the party at fault
- number of fatalities in the vehicle of the party at fault
- vehicle license number of the party at fault
- vehicle year, make, model, and vehicle identification number (VIN)
- state or province that issued the vehicle license of the party at fault
- insurance of the party at fault
- insurance company
- city in which the company is based
- insurance policy number
- insurer's phone number

Comments

- description of cargo that was cleared from incident, how it was disposed of, or whether it was stored, etc.,

- or other information/comments.

These data provide useful statistics about the drivers and vehicles involved in incidents and the performance of the IRT and cooperating responders in clearing incidents quickly while minimizing the impacts to the traffic.

This information is available in several forms. Incidents can be summarized daily, for a range of dates, and for a particular location. In addition, specific incidents can be recalled by IRT database number, by job or case number, or by the preparer's name.

Further Reading

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EMS MANAGEMENT FOR HAZARDOUS MATERIALS INCIDENTS

One of the newest and most challenging responsibilities of an EMS supervisor or administrator is the management of his/her department's involvement in the response to a Hazardous Materials Incident. During recent years, all Emergency Medical Service (EMS) systems have been required to participate in these incidents (both morally and legally) and to provide triage, treatment, and eventual transport services to toxically exposed patients. In light of this need and responsibility, it would appear important to consider some of the numerous facets of the often complex matter of managing the EMS portion of a Hazardous Materials emergency.

JURISDICTIONAL ISSUES & INCIDENT COMMAND

First, of many considerations, is that of deciding who's responsible for what. As is frequently the case, jurisdictional and interdepartmental issues must be resolved early in the planning process. The exact involvement and responsibility of Emergency Medical Service personnel in a hazardous materials emergency must be determined long before the need to respond to an incident arises. The need for them to respond, however, should not be at issue. That has been codified in 29 CFR 1910.120 (contiguous federal OSHA & EPA Regulations), which requires EMS personnel to participate in any bona-fide hazardous materials emergency.

When multiple agencies or jurisdictions are involved in the pre-planning process, it is likely to be even more complicated and will need to address issues relating to the exact roles of each of the participating agencies. In consideration of the history of inter-service rivalries in many communities, this may entail a lengthy and "spirited" discourse. The need, however, can not be diminished nor denied, to eventually decide the definitive character and purpose of all of the agencies involved.

In all cases, a lead agency must be designated as the one that will provide overall supervision and management of the incident. The on-scene leader of that agency, upon his/her arrival would then be referred to as the "Incident Commander". Which agency provides that leadership is very probably a matter to be decided by the duly elected political structure that exists in any given jurisdiction or political subdivision. At the very least, it must collectively be decided and understood by those agencies that can be expected to participate in any incident.

Many cities, counties, and states have a predetermined arrangement as to which agency shall assume command responsibility for a particular type of incident. One method of determining command responsibility is that of real functionality. For example, at a Hostage/Barricade incident, the senior police officer at the scene will assume overall command. In the event of school bus accident, the senior EMS/Rescue officer takes charge. And...in many jurisdictions, at a hazardous materials scene, the most senior fire officer will become the "Incident Commander.

This arrangement is not a finite definition of who should be an "Incident Commander", but rather to offer some examples of typical arrangements that might take place. Another instance of determining the leadership role involves the custom of understanding that the "Fire Chief" of the given town, in which the incident occurs, automatically assumes the role of "Incident Commander" in any incident. This is the case in many suburban and rural "mutual aid" networks.

In other subdivisions of government, a ordinance or law may dictate who is in charge of an incident. In at least one state, regardless of the type or location of the incident, if a State Trooper arrives at the scene...he is the "Incident Commander". Several other cities and states designate a political official or governmental appointee as the "Leader". In at least one major Midwestern city, the Fire Commissioner is designated by ordinance as being in charge of any incident. For the purpose of this discussion, it is only important to know that the role and definition may be set forth in a local or state law.

Regardless of how the decision was arrived at, once the determination of the overall leadership role has been made and can be readily understood by everyone, the remainder of the planning effort can go forward. The role and responsibility of the various other sectors and agencies can then be delineated and further defined. In the case of Emergency Medical Service (EMS) responders, there could appear to be some obvious and other not so apparent areas of responsibility.

DUTIES TO BE PERFORMED AT A HAZARDOUS MATERIALS INCIDENT

The primary functions that must be performed at any toxic release remain fairly consistent, without consideration of who performs them. The top twenty actions that must be taken will generally involve:

1. Incident "Size-up" and assessment
2. Scene Control/establishment of perimeter(s)
3. Product Identification/information gathering
4. Pre-entry examination and determination/donning of appropriate protective clothing & equipment
5. Establishment of a decontamination area
6. Entry planning/preparation of equipment
7. Entry into a contaminated area & rescue (as needed)
8. Containment of spill/release
9. Neutralization of spill/release
10. Decontamination of victims/patients/Rescuers
11. Triage of ill/injured
12. BLS Care
13. Hospital/physician consultation
14. ALS care/specific Antidotes
15. Stabilization/clean-up of spill
16. Post-Entry evaluation examination of rescuers
17. Transport of patients to appropriate hospital
18. Delegation of clean up to responsible party
19. Record keeping/reporting
20. Complete mitigation/analysis of actions

Note: Several of these actions may be occurring simultaneously. They are listed in an approximate order of occurrence for the purposes of planning of the organization of activities.

EMS AREAS OF RESPONSIBILITY A HAZARDOUS MATERIALS INCIDENT

The most evident expertise of EMS personnel is the prompt and proper provision of emergency care to the sick and injured. They may, however, have various other abilities and responsibilities in any given jurisdiction. The most basic duties of EMS personnel must include:

1. Identification of the substance that is involved
2. Protection of themselves & the patient
3. Prepare to prevent/minimize secondary contamination
4. Pre/Post entry evaluation of rescuers
5. Triage
6. Treatment
7. Transportation to an appropriate hospital

Other duties that may be performed by EMS personnel (at the discretion of the jurisdiction having authority over the incident):

1. Physical extrication & rescue
2. Decontamination
3. Use of computerized information resources
4. Administration of specific antidotes
5. Act as a safety officer(s)
6. Incident Command Authority

EMS TOXICOLOGY NEEDS

In order to effectively perform their duties at a hazardous materials incident, EMS personnel must understand some basic toxicology principals. They include (but are not limited too):

A. Acute and Delayed toxicity

B. Routes of Exposure

1. Inhalation
2. Absorption
3. Ingestion
4. Through open wound/Injection

C. Local and systemic effects of exposure

D. Dose Response as it relates to Risk assessment

E. Synergistic effects of combined substances

F. Assessment of toxicology information services/information

G. Relationship of proper decontamination to higher mortality and morbidity

H. Alteration of triage principals as they relate to toxically exposed patients.

I. Levels of personal protective clothing and equipment needed

EMS TREATMENT PROTOCOLS

As is normally the case, EMS managers must work with their locally designated Medical Control Authority (Project Medical Physician), when determining the appropriate levels and types of care to be given to the toxically exposed patient. Due to the dynamic and often hostile nature of a hazardous materials environment, it is suggested that Standing Medical Orders (S.M.O.s) be pre-established that will allow EMS responders to follow a comprehensive set of medical treatment guidelines, without radio contact or direct physician intervention.

This recommendation does not mean to preclude or discourage physician/EMT interaction or consultation, but rather it offers a option in the event of communications failures or catastrophic events occurring at the scene. Normal radio (telemetry) communications procedures should be utilized as they are available.

Some EMS Basic Life Support (BLS) systems even have physicians or registered nurses that respond to the scene of hazardous materials incidents that involve casualties. EMS administrators are cautioned, however, that untrained and ill-equipped medical personnel can be a greater liability than an asset at the scene of an ever-changing and potentially dangerous incident.

A far better choice involves the preplanning of pre- designated, trained, and equipped Advanced Life Support (ALS) personnel available to respond to the incident. While this may still involve physicians or nursing personnel (depending on the level of EMT training in the jurisdiction having authority), they will have been previously trained and have practice drills with Hazardous Materials mitigation and rescue personnel.

They should also be totally familiar with the four levels of protective clothing and equipment, to include proper protection by respirators or self-contained-breathing- apparatus (SCBA). In order to maximize physician involvement, it is also recommended that they have a working knowledge of toxicology and specific antidotes.

(Author's Note: These recommendations are not intended to diminish the role or responsibility of EMS physicians, but to point out the inherent dangers of participating at the scene of a toxic release. Literally, a "shift in the wind", could expose previously safe rescuers to injury or even death. It is likely that liability, training, disability, and safety issues could become a factor in direct physician or nurse clinical intervention at a hazardous materials site.)

NATIONALLY RECOGNIZED LEVELS OF PRE-HOSPITAL CARE PROVIDERS

Emergency Care First Responder - completion of U.S. DOT (ECFR) recognized first responder course(40 HRS.)

Emergency Medical Technician - completion of U.S. Ambulance (EMT-A) DOT recognized (In some jurisdictions- course and holds a EMT-A EMT-B - Basic) certification from an agency having jurisdiction(110 HRS.)

Emergency Medical Technician - completion of a U.S. (Intermediate EMT-I) DOT recognized course and holds an EMT-I certification from an agency having jurisdiction(150 HRS.)

Emergency Medical Technician - Completion of a U.S. DOT Paramedic (EMT-P) recognized course and holds an EMT-P certification or license from an agency having jurisdiction(min. 390 HRS.)

(Note: Training Hours are approximate and generally reflect the minimum number required to obtain the certification or license indicated...these numbers vary by state)

INFORMATION RESOURCES AVAILABLE TO EMS DECISION MAKERS

BOOKS:

Emergency Response Guidebook, U.S. Dept. of Transportation

Emergency Care For Hazardous Materials Exposure, Bronstein & Currance, C.V. Mosby Co.

Hazardous Materials Injuries, Stutz, et al, Bradford Communications Corp.

NIOSH/OSHA Pocket Guide to Chemical Hazards, U.S. Dept. of H.H.S., National Institute of Occupational Safety & Health

Fire Protection Guide to Hazardous Materials, National Fire Protection Assn.

Toxicologic Emergencies, Rumack, et al, Robert J. Brady Co.

First Aid Manual for Chemical Accidents, Lefevre, et al, Dowden, Hitchinson, and Ross, Inc.

COMPUTER SOFTWARE:

TOMES Plus CD-ROM Database-Haz/Mat-Medical Information

System, Micromedex Inc.

Chemtox Database Software System, Resource Consultants, Inc.

"CHRIS" System, U.S. Coast Guard

Emergency Response Guide Software, Labelmaster, Inc.

CAMEO Incident Planning & Command, US EPA, US NOA, National Safety Council

"ON-LINE" COMPUTER SERVICES:

Agency for Toxic Substances and Disease Registry

National Institute of Health - "Med-Line"

"Hazard-Line"

"Tox-line"

SOURCE: 911 Dispatch Services, Inc. 1990-1994

911 Centers Offered Liability Insurance

The nation's public safety dispatchers achieved a new status when one of the nation's largest insurers announced liability coverage for 911 communications centers.

As one dispatcher put it, "You know your job has become a profession when they start writing you liability insurance."

Markel Service, Inc. kicked off the ground-breaking insurance, that pays for defending lawsuits and up to $1,000,000 for judgments. And, DISPATCH has learned that Markel will require dispatchers to be certified by the International Municipal Signalman's Association (IMSA) to qualify for the insurance.

The new insurance covers 911 boards, dispatchers and other communications center employees against lawsuit judgments for such allegations as mishandling a call, failing to perform, or misdirecting an emergency unit. For an additional fee, the policy also covers the agency against lawsuits arising from personnel matters.

Markel's insurance pays for three areas of loss: up to $1 million for any court judgment, unlimited costs of defense, and the opposing party's legal fees if directed by the court. Defense costs can often exceed $500,000 for complex lawsuits.

Markel Service, Inc. is based in Richmond, Virginia and has been writing insurance for 61 years. They began selling government liability insurance in 1981 and serve over 9,000 law enforcement, government, and school agencies in 48 states.

In an exclusive interview with DISPATCH, senior vice-president James Chapman emphasized the insurance is for communications agencies unrelated to a police or fire department--mainly communications centers created by 911 legislation. Centers affiliated with a law enforcement agency are covered by their own line of liability insurance.

The market for this coverage is not trivial. Chapman said Markel sold $66 million of insurance to law enforcement, public officials and school boards in 1990. They expect to sell $80 million dollars this year and to expand to the EMS field by October.

"I think it's important for a dispatcher to know that he personally can be held liable for his own actions," Chapman said. In addition, 911 board members can also be held legally accountable for a dispatcher's performance.

Among the specific allegations Chapman mentioned were negligent training, supervision and retention of unfit personnel. He said the insurance also covers allegations, "that they have equipment that was unresponsive, that they didn't have the proper backup equipment in place."

But adverse judgments are actually a smaller percentage of Markel's payouts, at least for their current law enforcement insurance. "A lot of claims are without merit, but every claim has to be defended," Chapman said. He disclosed that 53 percent of Markel's payouts are just for defense costs.

Price

Chapman said they are basing the price of the liability insurance upon population, number of employees, type of 911 system (basic or enhanced), level of training of each employee, prior loss experience, amount of deductible, and the number of agencies and jurisdictions.

"Right now, it's somewhat scientific," Chapman said, "but there's not a big database [of experience]." If claim experience is high, then rates may be adjusted upward, and if they are low, they may be reduced.

More specifically, Chapman said the insurance will be, "less than law enforcement coverage," which is about $250 per dispatcher for those covered under law enforcement policies. Officer coverage ranges up to $1,000 a year per officer.

Required Training

The potentially touchy aspect of the new insurance is the training Markel requires to be insured. Markel has designated IMSA certification as their minimum insuring requirement. But since Powerphone, of Madison, CT, is currently the only training institute approved by IMSA, Markel's decision in fact certifies Powerphone.

In contrast to the dispatcher insurance, Markel's law enforcement coverage doesn't require specific training courses. "Because there are enough standards already set, they can get the help. The standards are not yet set in the industry for communications," Chapman said.

Chapman said Markel's research, "Helped us differentiate between trained departments and untrained departments, what type of training we had to have." Markel then began looking at training sources to evaluate their programs.

Two Markel employees attended classes given by Powerphone. David Cole, vice-president of marketing for Powerphone, said the Markel employees didn't identify themselves as non-dispatchers and were initially treated as experienced call-takers, even taking some live calls.

After studying the training agencies, Markel chose IMSA certification as the required level of training to be insured. During the interview, Chapman said he didn't recall the minimum level of training required. However, Cole told DISPATCH that Markel will require at least one dispatcher at every insured facility to be IMSA-certified. If all dispatchers are certified, Markel will offer a reduced premium, Cole said.

Chapman emphasized that Markel did not want to specify the actual training that should take place. "We're not in the business of setting standards," he said. "If we chose somebody who's in a profit mode of business, who's setting standards--are we qualified to pick one over the rest?"

On the other hand, Chapman called Powerphone, "The recognized entity or agency that sets the standard for training."

Isn't Markel really choosing Powerphone to perform the training? Chapman sighed at the question and said, "We had to have a place to start. We had to put a scratch in the dirt someplace," he said.

Chapman expects other training companies will want to become Markel-certified. "We're going to have to look into each and every training company to see what type of training they're doing and if they meet our minimum training standards," said Chapman. "If they do, I'm sure we're going to have to acknowledge them."

Powerphone's Cole said anyone is free to become IMSA-certified and take their cut of the Markel-required business. He explained that Powerphone's and IMSA's have a contract that allows Powerphone to administer IMSA's certification tests, and insures that Powerphone's training classes will include an agreed curriculum.

Ultimately, "I think the courts are going to set the (training) standards," said Chapman. He said the courts have already mandated training for many areas of law enforcement, but not for dispatchers. "The federal courts system is going to safeguard a citizen's right to an equal response, regardless of where they live," he said.

To help reduce losses, Markel will conduct free seminars for their insurance at regional locations around the country. "We'll be structuring these seminars based upon the type of experience we have," Chapman said. For example, if Markel receives many personnel action claims, they'll schedule classes on proper personnel procedures.

For more information on Markel's insurance, contact them at (800) 368-3583, or write 4551 Cox Road, Glen Allen, VA 23060.

SOURCE: 911 Dispatch Services, Inc. 1990-1994
Gary Allen

Paper Isn't Dead
Meaningful Reports Are Key to Effectiveness

Even though you communications center is full of electronics, it's important that your computers be capable of printing information on paper--meaningful information.

Looking at individual incidents on a video screen barely gives you a sense of how many you're handling, what kinds are being reported, how long they take to handle or where they're occurring. For a better analysis, you need printed reports.

Before you begin delving into printed reports, you should know some simple, mathematical definitions. The average is "being intermediate between extremes," according to the dictionary. It's derived from the sum of all entries, divided by the number of entries.

The median is the middle value in a distribution, above and below which lie an equal number of values. The median can sometimes look like an average, but they actually represent two different concepts.

The average weighs the value of the items, while the mean weighs the number of items. What's more meaningful in communications center reports? There's no real answer but, like using miles instead of kilometers, averages are more meaningful because they're most commonly used.

Finally, a percentage is the proportion or share in relation to a whole, expressed as a number from one to 100. Percentages are very useful in showing the size or number of one group in relation to all groups.

Percentages can be applied in several different ways. You can relate one group to the whole, such as robberies comprise 23% of all reported incidents. You can also use a percentage to express ranges, such as all non-emergency telephone calls were answered within 10 seconds, 30% within 30 seconds, and so on.

Where do you find all this information? Your computer-aided dispatch (CAD) software should collect most of it, but you may also find this data in your agency's records management system (RMS).

If you're lucky, CAD or RMS will print reports with just the right fields and the totals you need. If not, you'll need to dig into the raw data and extract the numbers yourself using a database management program or report writer.

However, handling raw data takes some knowledge of how it's structured and what it means. If you compile totals from mis-used data fields, the conclusions you draw could be way off base. You may need to consult your program's developer to obtain specific information on the data fields.

How Many?

A very fundamental question about public safety operations is "how many?" The common questions are:

- how many incidents have we handled? The answer helps formulate staff requirements, resource locations and, for police and fire departments, are necessary for state and federal reporting.

- how many incidents do we handle by time of day, and day of week? You can more accurately staff if you can anticipate when incidents will occur.

- how many incidents do we handle by police beat or fire district? This is another staffing question that will help your agency put its resources--officers or deputies, and fire stations--in the right location.

- how many incidents are handled by police/fire units from adjacent beats or districts? If units are consistently crossing boundaries, perhaps you need more districts and more units.

- how many incidents are handled by the dispatcher without a unit being dispatched? If the dispatchers are able to handle some calls from the communications center, you may find a telephone report team will cut the number of dispatched calls.

Which Ones?

Now that you have the totals, you can target specific information for further analysis--"which ones?"

- what types of incidents do we handle? If you know that you're responding to tons of audible alarms, perhaps you can begin a false alarm PR campaign, or even a fee program.

- what incidents are most frequently handled in each beat? By knowing how incident types differ among beats, you can better staff and make tactical decisions--should one area have plainclothes officers deployed?

How Long?

For certain activities, you'll want to know "how long?" it took to perform certain operations.

- how long does the call-taking and radio dispatching process take for all calls, and by priority? This is a common measure of performance for communications centers and public safety agencies. In the communications center, it can detect staffing and training problems, or indicate how the your system of prioritizing calls can be adjusted for a quicker response.

- how long does it take field units to handle cases in general, and by specific type? If your police, fire or EMS are being socked with many long-term incidents, perhaps you should form a "flying squad" to handle in-progress incidents the others can't respond to.

Where?

Next, you should be printing out reports on "where?" If you're lucky enough to have mapping software, you can view the geographical relationship of incidents. But with only a simple database program, you can print a listing of locations by frequency that will give you almost as much information.

- to what incident locations do we respond the most frequently? Some agencies report that a small number of locations generate a high percentage of incidents. Are there chronic problems that could be solved at these locations, thereby cutting out a large number of incidents?

- what addresses generate the most alarm calls? Again, you could save yourself a lot of repeat business by targeting troublesome alarms and getting them fixed or cut off.

- to what addresses do we respond the most from 911 calls? Citizens are encouraged to dial 911 for emergencies, but if you have a few addresses that are leading the pack, you might investigate why. Is it a phone booth, an apartment building?

- to what addresses do we respond to 911 hang-up calls the most? This looks at the other side of 911--are there locations that might be abusing 911 by making nuisance calls.

Compare Numbers

Lastly, you'll want to compare figures for the current week, month or year to previous periods to obtain an idea of trends.

Trends are difficult to spot when you're analyzing by weekly periods, unless you're a very busy agency with lots of incidents. The shortest period that yields meaningful results is usually four to six weeks. For more accurate figures, you should consider three to four months as a minimum.

On the other hand, a very long period--such as a year or longer--may not give you a quick enough peek at activity and trends. The yearly totals you see printed are usually only because administrators need something for their annual reports, not because they're tactically useful.

After you study all these meaningful reports, you'll have a better idea of how to change your operation to make it more effective and efficient.

SOURCE: **ITE Journal, 1994**

James D. Carvell, Edward J. Seymour, Richard L. Peterson and George Human

Interagency Communication: A Vital Element in the Dallas Multi Jurisdictional Environment

Providing efficient and economical traffic and transportation services in a highly developed urban area is a challenge to transportation professionals. Particularly challenging is delivering ser-vices to contiguous cities in a manner that is transparent (or seamless) to travelers as they pass across city limit lines from one jurisdiction to another. Although this problem is not unique to the Dallas Urbanized Area, area municipalities are dealing with it in some unique ways. This article describes the Dallas Urban Area and some of the ways area traffic and transportation engineers and planners are interacting to meet the urban transportation problem.

Although the Standard Metropolitan Statistical Area (SMSA) contains both Dallas (Dallas County) and Fort Worth (Tarrant County), this article concentrates on the eastern (Dallas) portion of the SMSA. The city of Dallas itself has a population of about 1 million. There are 33 incorporated cities in Dallas County. The city of Dallas has contiguous boundaries with 15 of these cities, five of which have populations greater than 100,000 and three more with populations between 50,000 and 100,000. Total population for Dallas County in 1994 is about 1.9 million.

There are more than 2,000 traffic signals in the Dallas urban area, about 60 percent are in the city of Dallas. Of the signals in the urban area, 78 percent are timed for coordination. Of the total number of signals in the urban area, 22 percent are in some type of computer-based system, either closed-loop or central mainframe.

There are more than 300 miles of freeway in the Dallas urban area, with about 125 miles in Dallas and the remaining mileage distributed among 24 other cities. With only two exceptions (in smaller cities), law enforcement and accident investigation on freeways are handled by the local police authorities within whose city the freeway lies.

The previous discussion was presented to give an overall feel for the Dallas urban area related to traffic operations and as a prelude to the following discussion of interjurisdiction communications mechanisms. Several such mechanisms have developed to meet specific needs and have evolved to meet other needs as they arise. The first mechanism is a case study of an interjurisdictional traffic signal improvement project in North Dallas County that involved six contiguous cities.

Case Study: North Dallas County Signal Project 1

Northern Dallas County experienced intense growth and development in the 1970s and '80s. A driver traveling east or west across northern Dallas County could pass through as many as six cities (Addison, Carrollton, Dallas, Farmers Branch, Garland and Richardson) over a distance of only 20 miles. Traveling north or south a driver could encounter as many as four cities in about 1 mile.

Recognizing the need for interjurisdictional coordination of traffic signals in this multijurisdictional area, the city of Dallas Transportation Department approached Dallas County with the proposal that funds be included in the county's 1985 bond program for signal improvements in the North Dallas County area. A provisional steering committee was formed with representatives of each of the cities and the county. This committee defined the program, developed consensus and secured the support of their respective city governments.

Although the objectives of the North Dallas County Signal Program were many, one overall objective was prime: improvement of traffic service to drivers through coordinated signals with-out regard to jurisdictional boundaries. To accomplish this objective, the elements of the program included:

- Traffic data collection for signal timing
- Development of optimized signal timing
- Upgrading of field control hardware to support improved timing

- Training of city personnel in the use of signal timing programs

- Procurement of microcomputers and peripherals to support signal timing programs

- Procurement of traffic counting equipment to support signal timing

- Development of a continuing operations plan to guide the cities in re-timing signals

- Development of a plan for extending the multijurisdictional signal program to other areas of Dallas County.

The County Commissioners Court recognized the potential benefits of the program, and the 1985 bond program included $4 million to fund signal improvements at 224 existing signalized intersections in the six cities. The voters approved the initiative overwhelmingly. The project area is shown in Figure 1.

Signal Improvement Program

The committee that guided development of the county bond signal improvements program was constituted as a steering committee for the project. Each of the six participating cities was represented by the professional most responsible for signal timing and operation in the respective city. An interlocal agreement between the county and the cities was developed and executed. The steering committee met monthly throughout program development and during the course of the project.

The first task for the committee was to develop guidelines for administering the program. The bond program defined 224 specific intersections and the types of improvements that could be funded but did not specify exact funding distribution among individual intersections or among the six participating cities. Therefore, the committee (which included a county representative) developed a working set of guidelines in keeping with both the spirit and letter of the bond program and the available funding:

- Individual projects would mutually benefit two or more cities

- Construction funds would be directed toward upgrading, not wholesale reconstruction

- The prime focus would be improved signal timing with hardware and soft-ware to support the improvements

- Central hardware and field interconnect would not be funded by the county program

- Cities were free to use their own con-troller specification but it had to contain minimum criteria (time-based coordinator equipped; minimum of six cycle lengths; detector data collection capability; and capability for lead/lag)

- An engineering consultant would be retained to provide signal design and timing development

- Cities would use their normal procurement procedures for purchase and installation of equipment but would provide documentation of bids and awards to the committee for approval

The committee would review all requests for reimbursements and make appropriate recommendations to the county.

The great majority of the 224 signalized intersections specified in the bond program were fully actuated with protected movements. Most were not coordinated. Three major freeways (I-635, U.S. 75 and Dallas North Tollway) cut through the project area posing special challenges at the frontage road intersections because of the long cycles required. The signal network would be characterized as "coarse" as compared to a central business district network; although some signals were spaced at normal block lengths, the majority were at quarter- or half-mile spacings.

An intensive traffic data collection and assimilation effort began, to the extent possible, existing city traffic count data were used. Existing "as-built" plans, secured from the individual cities, were used both to determine lane configurations for signal timing and to serve as base plans for signal hardware improvements. Finally, more than 2,000 travel data runs were made on the project thoroughfares for evaluation purposes.

It was important for development of signal timing to begin forthwith for two reasons. First, one city already procured new controllers and city forces were installing them; and second, results of the signal timing could influence the signal field hardware design. Since the majority of the sub-networks were linear with crossing arterials as opposed to closed networks, arterial optimization algorithms were used whenever possible.

Individual plans and specifications for signal improvements were developed for each city in its standard bid package format. With one exception each city advertised, received bids, awarded and administered the turnkey construction contract. (The city of Dallas installed equipment and materials with its own forces and was reimbursed by the county program for labor, equipment and materials.) Signal upgrades and improvements included:

- New National Electrical Manufacturers Association (NEMA) actuated controllers and cabinets and new local intersection detectors

- Replacement of all 8-foot (ft) signal heads with 12-ft heads and additional left-turn signal heads where necessary

- Additional wire conductors and signing to support revised phasing

- Limited interconnect wire to replace existing degraded wire

- Limited number of signal poles to assure that Manual of Uniform Traffic Control Devices requirements were followed for left-turn signals

Every effort was made to reuse existing controllers, cabinets and detectors that met program operational criteria.

In addition to signal hardware upgrades and new signal timing, the pro-gram also provided related enhancements to assist and enable the participating cities to continue the coordinated, cooperative signal program. Each city purchased an IBM-compatible microcomputer capable of supporting PC based traffic signal timing programs such as PASSER and TRANSYT. Related software also was procured. Each city procured the computer and peripherals through its normal purchasing procedures and was reimbursed by the county upon recommendation by the commit-tee. Each city also procured four traffic counting machines to support the updating of signal timing plans. As with computing equipment, normal city purchasing procedures were followed. Hands-on training in the use of the signal timing programs was provided for participants.

Program Effectiveness

To evaluate the program's effectiveness, funds were set aside for extensive data collection. In order that an independent evaluation be carried out, the steering committee directed that before-and-after data collection be performed by an entity other than the signal timing consultant. A subcontractor collected the before data and the Dallas County Public Works Department personnel collected the after data. Travel time and delay data were collected with vehicles instrumented with automatic recording equipment and field data were downloaded into an office microcomputer for analysis and summary: More than 2,000 before-and-after data collection runs were performed. Data were collected in both directions in four time periods: morning peak, afternoon peak, noon peak and off-peak.

Before-and-after data were analyzed and evaluated within each of the four time periods. Data were also categorized by city. Favorable results were experienced in all time periods and in all cities. The analysis indicated that travel time was reduced by 6 percent; delay was reduced by 43 percent; stops were reduced by 34 percent; and fuel consumption was reduced by 5 percent. These improvements resulted in an estimated annual saving of $26 million in vehicle operating costs, fuel costs and motorist time. Environmentally, the following savings were estimated: 2 million gallons of fuel, 1,640 tons of carbon monoxide, 216 tons of hydrocarbons and 123 tons of nitrous oxide.

During the four years that elapsed between before-and-after data collection, traffic volumes in the project area increased about 20 percent. The evaluation data were not factored to account for the increased demand so the evaluation results are considered conservative, that is, the increased traffic volume was accommodated with reduced stops and delay. The results also are considered conservative because only 11 hours (7 a.m. to 6 p.m.) of data for each weekday were evaluated. Improvements in service for evening periods and weekends were not included in the evaluation. Given that the county bond allocation was $4 million, this represents a benefit/cost ratio of 6.5 for one year. Since the benefits of improved signal timing and control hard-ware will accrue over several years, the benefit/cost ratio is even greater.

Other Program Features

Because a long-term objective of the signal improvement program is to foster continuous cooperation among the cities, the consultant developed a Continuing Operations Manual, which provides guidelines for when and how to update timing plans and recommendations for communication among the cities.

Based on the success, effectiveness and visibility of this multijurisdictional program, the county is now extending the program to other areas. In 1991, the Dallas County voters approved a bond program that included $8.2 million for multijurisdictional signal improvements. In addition, $4 million in bonds were approved for implementation of an Incident Detection Response (IDR) system and $12.1 million for intersection bottleneck improvements. The total transportation system management projects included in that package included more than $24 million, not including leveraged amounts from state or federal sources.

Summary

The North Dallas County Signal Program has been a success in measured, quantifiable benefits to Dallas County motorists. Of equal importance, the program demonstrated that multi-jurisdictional cooperation in a complex urban environment is not only viable, but can be a reality. The hallmark of the program was the cooperation and camaraderie that developed during the monthly steering committee meetings. To a great extent this intergovernmental cooperation has been catalytic in strengthening and developing other interagency transportation programs, some of which are described below.

Traffic Management Team

As with other major urban areas in Texas (Austin, Fort Worth, Houston and San Antonio), an interagency traffic management team (TMT) meets monthly to bring forward and discuss traffic problems of an operational or safety nature. The committee is convened by the TxDOT Dallas District Freeway Operations Engineer Representatives (primarily from traffic departments) from TxDOT, area cities, Dallas County and Dallas Area Rapid Transit (DART) meet on the first Thursday of each month. Representatives from the Dallas Police Department also participate and law enforcement agencies of other cities attend as the need arises. Attendance averages about 40 and outside speakers sometimes make presentations.

Technical Advisory Staff Committee

The Technical Advisory Staff Committee (TASC) was constituted to help guide DART in developing a revised transit system plan. With a one percent sales tax slated in part for a regional light rail system, DART developed a policy to return a portion of that tax to local agencies (who would not receive rail transit within seven years) for on-street traffic improvements. TASC developed policies for determining eligible improvements and approval process. In addition, the TASC served in an advisory capacity to the Dallas Regional Mobility Coalition (DRMC), an organization of local elected officials (mayors, council members and county judges), which was formed to promote mobility in the area and to interface with state and federal transportation authorities to secure funding for area transportation improvements. TASC provided technical assistance to DRMC for programs such as HOV, TDM and incident management. The TASC met monthly (on the first Thursday of each month following the TMT meeting) to review and recommend funding requests from member cities. These monthly meetings of transportation professionals from several local agencies resulted in exchange of ideas and the scope of the committee began to broaden to other traffic and transportation issues.

Mobility Technical Committee

To reflect its broadened scope, the TASC became the Mobility Technical Committee (MTC). The committee also opened its membership to include members of the private sector including engineering consultants. In fact membership was open to anyone interested in improving transportation mobility in the Dallas area. The MTC played a key role in developing a consensus and submitting successful proposal for FHWA/TxDOT funding for a regional IVHS plan, which is now underway.

MTC/TMT IVHS Subcommittee

This subcommittee was initially formed to become informed and stay in touch with the developments in IVHS. It spearheaded the development of the proposal for the regional IVHS plan, cited above, and serves as the steering committee for that project. The subcommittee meets the first Thursday of each month, between the MTC and TMT meetings. This scheduling is convenient for those who can attend one but not both of the other meetings but who have an interest in the IVHS plan. The subcommittee (steering committee) reviews the progress of the plan development, hears reports from other area IVHS-related projects and hears presentations from private-sector companies involved in the IVHS arena.

Local ITE Chapter

In 1992, the Texas Section of ITE voted to allow the formation of local area chapters. The first such chapter in Texas was formed as the Greater Dallas TexITE Chapter in December 1992 and has continued to meet monthly, except when there is a regular semiannual section meeting (as required by the bylaws). The format is a luncheon meeting with a technical presentation. Membership currently is more than 120 and attendance is generally 50 or more. This meeting also enhances communication among local traffic and transportation agencies. More than 40 agencies and local consultants are represented with members working in all areas of transportation, including signal technicians, transportation planners, city transportation department heads and traffic equipment suppliers. It is hoped that membership in ITE will be increased as participants in this forum are encouraged to upgrade their memberships.

Closure

Intergovernmental and interagency communication and cooperation are vital in urban areas but particularly in one such as the Dallas urban area where so many jurisdictions are interdependent. Although the series of "acronymed" meetings previously described seems to present an over-whelming scheduling problem, concentrating the meetings on one afternoon a month allows considerable business to be transacted. Participants can plan contacts with others that might otherwise have required another meeting. Besides, if all problems are not solved in those formal meetings, they can be addressed in an informal setting following those meetings at a favorite gathering place in Dallas' popular West End area. Those of you attending 64th ITE Annual Meeting in Dallas Oct. 16-19 will have the opportunity to experience the West

End, and the authors would highly recommend it.

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SOURCE: http://www.ari.net/kendrick/winning.html

Winning a Grant or Contract

Figure it out for yourself: A Request for Proposals (RFP) attracts 50 competitive responses. Of these, 20 proposals are credible and 5 are outstanding. A government-appointed review panel has the thankless task of reviewing all 50 offers and making recommendations regarding one award. While this is an oversimplification of a complex competitive procurement process, hopefully you get the point that actually winning a grant or contract is a very competitive sport.

There are only three reasons to prepare and submit a proposal: (1) to win, (2) to place among the finalists and maintain a reputation for being a major player, and (3) to gain attention and respect as a serious new competitor. If you do not accomplish one of these three goals, you are better off investing your money in a fishing trip.

Winning a grant or contract-or accomplishing one of the other two objectives-requires more than simply submitting a proposal. Here are the bottom-line issues:

For Negotiated Contracts, you need:

- Visibility and credibility with the prospective customer before the RFP is released
- A knowledge of the agency's needs, preferences, and priorities
- Information about the leading competitors - their strengths and weaknesses
- A realistic strategy for winning
- Competitively credible key personnel

- A viable and believable technical approach
- Full responsiveness to the evaluation criteria
- A professionally prepared proposal that projects your reliability and competence
- A pricing strategy that is attractive to the agency
- Fully documented cost information
- An explanation of your business systems that demonstrates your superior ability to perform the project.

For Competitive Grants, you need the same thing!

In today's environment of scarce federal resources, the key issues for grants are those cited above for contracts, even though the procurement procedures are somewhat different.

Recently when I spoke with a health agency official, he said that the colleges and universities winning the most money were those who had gotten to know the agency's program officers. No, this was not a case of impropriety: The successful educational institutions took the time to understand the agency's funding goals, to ask questions and explore agency preferences, and to learn about the achievements of other institutions who would be competitors.

Key Personnel

Here are two scenarios to ponder:

Competition #1: XYZ Corporation is proposing the world renowned research scientist who achieved fame through successful projects relevant to the current agency competition, and ZZZ Corporation is proposing an individual with an unrelated Ph.D. who has worked as a middle manager.

Competition #2: Wolf University is proposing a principal investigator who is widely published in relevant areas and well regarded by the agency, while Sheep University is proposing a professor who is unpublished and unknown.

So who do you think will favorably impress the agency reviewers in the above competitions?

If you do not have the right individuals to propose, you may need to change your hiring practices. You can consider contingency hires (employment after award), but you must convince the agency that the individual will really come on board ... and replicate success in your environment. You can also consider a panel of several renowned experts on a consulting basis, but their participation must be real and a believable contribution to the project.

Other Issues

Your institutional credibility is important, too. Have you performed similar projects previously? Do you have the necessary facilities, equipment, and management resources? Do you have a reputation for full and complete performance of projects? Are you trustworthy? Do you complete work within budget? Can you manage projects professionally, or are you a pain in the neck? Be sure to communicate your institutional strengths.

Only a very few institutions are successful in winning solely on the basis of politics, especially in these days of investigative journalism. Do use legitimate political connections, but that alone will almost never win the award unless you address all of the other issues outlined in this paper.

SOURCE: http://fdncenter.org/2fundpro/2prop.html
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A Proposal Writing Short Course

Introduction

The subject of this short course is proposal writing. But the proposal does not stand alone. It must be part of a process of planning and of research on, outreach to, and cultivation of potential foundation and corporate donors.

This process is grounded in the conviction that a partnership should develop between the nonprofit and the donor. When you spend a great deal of your time seeking money, it is hard to remember that it can also be difficult to give money away. In fact, the dollars contributed by a foundation or corporation have no value until they are attached to solid programs in the nonprofit sector.

This truly is an ideal partnership. The nonprofits have the ideas and the capacity to solve problems, but no dollars with which to implement them. The foundations and corporations have the financial resources but not the other resources needed to create programs. Bring the two together effectively, and the result is a dynamic collaboration.

You need to follow a step-by-step process in the search for private dollars. It takes time and persistence to succeed. After you have written a proposal, it could take as long as a year to obtain the funds needed to carry it out. And even a perfectly written proposal submitted to the fight prospect may be rejected.

Raising funds is an investment in the future. Your aim should be to build a network of foundation and corporate funders, many of which give small gifts on a fairly steady basis and a few of which give large, periodic grants. By doggedly pursuing the various steps of the process, each year you can retain most of your regular supporters and strike a balance with the comings and goings of larger donors.

The recommended process is not a formula to be rigidly adhered to. It is a suggested approach that can be adapted to fit the needs of any nonprofit and the peculiarities of each situation. Fund-raising is an art as well as a science. You must bring your own creativity to it and remain flexible.

Gathering Background Information

The first thing you will need to do in writing the master proposal is to gather the documentation for it. You will require background documentation in three areas: concept, program, and finance.

If all of this information is not readily available to you, determine who will help you gather each type of information. If you are part of a small nonprofit with no staff, a knowledgeable board member will be the logical choice. If you are in a larger agency, there should be program and financial support staff who can help you. Once you know with whom to talk, identify the questions to ask.

This data-gathering process makes the actual writing much easier. And by focusing once again on mission and available resources, it also helps key people within your agency seriously consider the project's value to the organization.

Concept

It is important that you have a good sense of how the project fits into the philosophy and mission of your agency. The need that the proposal is addressing must also be documented. These concepts must be well articulated in the proposal. Funders want to know that a project reinforces the overall direction of an organization, and they may need to be convinced that the case for the project is compelling. You should collect background data on your organization and on the need to be addressed so that your arguments are well documented.

Program

Here is a check list of the program information you require:

- the nature of the project and how it will be conducted;
- the timetable for the project;
- the anticipated outcomes and how best to evaluate the results; and
- staffing needs, including deployment of existing staff and new hires.

Financials

You will not be able to pin down all the expenses associated with the project until the program details and timing have been worked out. Thus, the main financial data gathering takes place after the narrative part of the master proposal has been written. However, at this stage you do need to sketch out the broad outlines of the budget to be sure that the costs are in reasonable proportion to the outcomes you anticipate. If it appears that the costs will be' prohibitive, even with a foundation grant, you should then scale back your plans or adjust them to remove the least cost-effective expenditures

Components of a Proposal

1. Executive Summary: umbrella statement of your case and summary of the entire proposal, 1 page
2. Statement of Need: why this project is necessary, 2 pages
3. Project Description: nuts and bolts of how the project will be implemented, 3 pages
4. Budget: financial description of the project plus explanatory notes, 1 page
5. Organization Information: history and governing structure of the nonprofit; its primary activities, audiences, and services, 1 page
6. Conclusion: summary of the proposal's main points, 2 paragraphs

The Executive Summary

This first page of the proposal is the most important section of the entire document. Here you will provide the reader with a snapshot of what is to follow. Specifically, it summarizes all of the key information and is a sales document designed to convince the reader that this project should be considered for support. Be certain to include:

Problem -- a brief statement of the problem or need your agency has recognized and is prepared to address (one or two paragraphs);

Solution -- a short description of the project, including what will take place and how many people will benefit from the program, how and where it will operate, for how long, and who will staff it (one or two paragraphs);

Funding requirements -- an explanation of the amount of grant money required for the project and what your plans are for funding it in the future (one paragraph); and

Organization and its expertise -- a brief statement of the name, history, purpose, and activities of your agency, emphasizing its capacity to carry out this proposal (one paragraph).

The Statement of Need

If the funder reads beyond the executive summary, you have successfully piqued his or her interest. Your next task is to build on this initial interest in your project by enabling the funder to understand the problem that the project will remedy.

The statement of need will enable the reader to learn more about the issues. It presents the facts and evidence that support the need for the project and establishes that your nonprofit understands the problems and therefore can reasonably address them. The information used to support the case can come from authorities in the field, as well as from your agency's own experience.

You want the need section to be succinct, yet persuasive. Like a good debater, you must assemble all the arguments. Then present them in a logical sequence that will readily convince the reader of their importance. As you marshall your arguments, consider the following six points.

First, decide which facts or statistics best support the project. Be sure the data you present are accurate. There are few things more embarrassing than to have the funder tell you that your information is out of date or incorrect. Information that is too generic or broad will not help you develop a winning argument for your project. Information that does not relate to your organization or the project you are presenting will cause the funder to question the entire proposal. There also should be a balance between the information presented and the scale of the program.

Second, give the reader hope. The picture you paint should not be so grim that the solution appears hopeless. The funder will wonder if this investment in a grant would be worth it. Here's an example of a solid statement of need: "Breast cancer kills. But statistics prove that regular check-ups catch most breast cancer in the early stages, reducing the likelihood of death. Hence, a program to encourage preventive check-ups will reduce the risk of death due to breast cancer." Avoid overstatement and overly emotional appeals.

Third, decide if you want to put your project forward as a model. This could expand the base of potential funders, but serving as a model works only for certain types of projects. Don't try to make this argument if it doesn't really fit. Funders may well expect your agency to follow through with a replication plan if you present your project as a model.

If the decision about a model is affirmative, you should document how the problem you are addressing occurs in other communities. Be sure to explain how your solution could be a solution for others as well.

Fourth, determine whether it is reasonable to portray the need as acute. You are asking the funder to pay more attention to your proposal because either the problem you address is worse than others or the solution you propose makes more sense than others. Here is an example of a balanced but weighty statement: "Drug abuse is a national problem. Each day, children all over the country die from drug overdose. In the South Bronx the problem is worse. More, children die here than any place else. It is an epidemic. Hence, our drug prevention program is needed more in the South Bronx than in any other part of the city."

Fifth, decide whether you can demonstrate that your program addresses the need differently or better than other projects that preceded it. It is often difficult to describe the need for your project without being critical of the competition. But you must be careful not to do so. Being critical of other nonprofits will not be well received by the funder. It may cause the funder to look more carefully at your own project to see why you felt you had to build your case by demeaning others. The funder may have invested in these other projects or may begin to consider them, now that you have brought them to their attention.

If possible, you should make it clear that you are cognizant of, and on good terms with, others doing work in your field. Keep in mind that today's funders are very interested in collaboration. They may even ask why you are not collaborating with those you view as key competitors. So at the least you need to describe how your work complements, but does not duplicate, the work of others.

Sixth, avoid circular reasoning. In circular reasoning, you present the absence of your solution as the actual problem. Then your solution is offered as the way to solve the problem. For example, the circular reasoning for building a community swimming pool might go like this: "The problem is that we have no pool in our community. Building a pool will solve the problem." A more persuasive case would cite what a pool has meant to a neighboring community, permitting it to offer recreation, exercise, and physical therapy programs. The statement might refer to a survey that underscores the target audience's planned usage of the facility and conclude with the connection between the proposed usage and potential benefits to enhance life in the community.

The statement of need does not have to be long and involved. Short, concise information captures the reader's attention.

The Project Description

This section of your proposal should have four subsections: objectives, methods, staffing/administration, and evaluation. Together, objectives and methods dictate staffing and administrative requirements. They then become the focus of the evaluation to assess the results of the project. Taken together, the four subsectors present an interlocking picture of the total project.

Objectives

Objectives are the measurable outcomes of the program. They define your methods. Your objectives must be tangible, specific, concrete, measurable, and achievable in a specified time period. Grantseekers often confuse objectives with goals, which are conceptual and more abstract. For the purpose of illustration, here is the goal of a project with a subsidiary objective:

Goal: Our after-school program will help children read better.

Objective: Our after-school remedial education program will assist fifty children in improving their reading scores by one grade level as demonstrated on standardized reading tests administered after participating in the program for six months.

The goal in this case is abstract: improving reading, while the objective is much more specific. It is achievable in the short term (six months) and measurable (improving fifty children's reading scores by one grade level).

With competition for dollars so great, well-articulated objectives are increasingly critical to a proposal's success.

Using a different example, them are at least four types of objectives:

1. Behavioral -- A human action is anticipated.

Example: Fifty of the seventy children participating will learn to swim.

2. Performance -- A specific time frame within which a behavior will occur, at an expected proficiency level, is expected.

Example: Fifty of the seventy children will learn to swim within six months and will pass a basic swimming proficiency test administered by a Red Cross-certified lifeguard.

3. Process -- The manner in which something occurs is an end in itself.

Example: We will document the teaching methods utilized, identifying those with the greatest success.

4. Product -- A tangible item results.

Example: A manual will be created to be used in teaching swimming to this age and proficiency group in the future.

In any given proposal, you will find yourself setting forth one or more of these types of objectives, depending on the nature of your project. Be certain to present the objectives very clearly. Make sure that they do not become lost in verbiage and that they stand out on the page. You might, for example, use numbers, bullets, or indentations to denote the objectives in the text. Above all, be realistic in setting objectives. Don't promise what you can't deliver. Remember, the funder will want to be told in the final report that the project actually accomplished these objectives.

Methods

By means of the objectives, you have explained to the funder what will be achieved by the project. The methods section describes the specific activities that will take place to achieve the objectives. It might be helpful to divide our discussion of methods into the following: how, when, and why.

How: This is the detailed description of what will occur from the time the project begins until it is completed. Your methods should match the previously stated objectives.

When: The methods section should present the order and timing for the tasks. It might make sense to provide a timetable so that the reader does not have to map out the sequencing on his own .... The timetable tells the reader "when" and provides another summary of the project that supports the rest of the methods section.

Why: You may need to defend your chosen methods, especially if they are new or unorthodox. Why will the planned work lead to the outcomes you anticipate? You can answer this question in a number of ways, including using expert testimony and examples of other projects that work.

The methods section enables the reader to visualize the implementation of the project. It should convince the reader that your agency knows what it is doing, thereby establishing its credibility.

Staffing/Administration

In describing the methods, you will have mentioned staffing for the project. You now need to devote a few sentences to discussing the number of staff, their qualifications, and specific assignments. Details about individual staff members involved in the project can be included either as part of this section or in the appendix, depending on the length and importance of this information.

"Staffing" may refer to volunteers or to consultants, as well as to paid staff. Most proposal writers do not develop staffing sections for projects that are primarily volunteer ran. Describing tasks that volunteers will undertake, however, can be most helpful to the proposal reader. Such information underscores the value added by the volunteers as well as the cost-effectiveness of the project.

For a project with paid staff, be certain to describe which staff will work full time and which will work part time on the project. Identify staff already employed by your nonprofit and those to be recruited specifically for the project. How will you free up the time of an already fully deployed individual?

Salary and project costs are affected by the qualifications of the staff. Delineate the practical experience you require for key staff, as well as level of expertise and educational background. If an individual has already been selected to direct the program, summarize his or her credentials and include a brief biographical sketch in the appendix. A strong project director can help influence a grant decision.

Describe for the reader your plans for administering the project. This is especially important in a large operation, if more than one agency is collaborating on the project, or if you are using a fiscal agent. It needs to be crystal clear who is responsible for financial management, project outcomes, and reporting.

Evaluation

An evaluation plan should not be left for consideration as your project is winding down; instead, it should be built into the project. Including an evaluation plan in your proposal indicates that you take your objectives seriously and want to know how well you have achieved them. Evaluation is also a sound management tool. Like strategic planning, it helps a nonprofit refine and improve its program. An evaluation can often be the best means for others to learn from your experience in conducting the project.

There are two types of formal evaluation. One measures the product; the other analyzes the process. Either or both might be appropriate to your project. The approach you choose will depend on the nature of the project and its objectives. For either type, you will need to describe the manner in which evaluation information will be collected and how the data will be analyzed. You should present your plan for how the evaluation and its results will be reported and the audience to which it will be directed. For example, it might be used internally or be shared with the funder, or it might deserve a wider audience. Your funder might even have an opinion about the scope of this dissemination.

The Budget

The budget for your proposal may be as simple as a one-page statement of projected expenses. Or your proposal may require a more complex presentation, perhaps including a page on projected support and revenue and notes explaining various items of expense or of revenue.

Expense Budget

As you prepare to assemble the budget, go back through the proposal narrative and make a list of all personnel and nonpersonnel items related to the operation of the project. Be sure that you list not only new costs that will be incurred if the project is funded but also any ongoing expenses for items that will be allocated to the project. Then get the relevant costs from the person in your agency who is responsible for keeping the books. You may need to estimate the proportions of your agency's ongoing expenses that should be charged to the project and any new costs, such as salaries for project personnel not yet hired.

Put the costs you have identified next to each item on your list.

Your list of budget items and the calculations you have done to arrive at a dollar figure for each item should be summarized on worksheets. You should keep these to remind yourself how the numbers were developed. These worksheets can be useful as you continue to develop the proposal and discuss it with funders; they are also a valuable tool for monitoring the project once it is under way and for reporting after completion of the grant.

To see what a portion of a worksheet for a year-long project might look like, click here.

With your worksheets in hand, you are ready to prepare the expense budget. For most projects, costs should be grouped into subcategories, selected to reflect the critical areas of expense. All significant costs should be broken out within the subcategories, but small ones can be combined on one line. You might divide your expense budget into personnel and nonpersonnel costs; your personnel subcategories might include salaries, benefits, and consultants. Subcategories under nonpersonnel costs might include travel, equipment, and printing, for example, with a dollar figure attached to each line.

Budget Narrative

A narrative portion of the budget is used to explain any unusual line items in the budget and is not always needed. If costs are straightforward and the numbers tell the story clearly, explanations are redundant.

If you decide a budget narrative is needed, you can structure it in one of two ways. You can create "Notes to the Budget," with footnote-style numbers on the line items in the budget keyed to numbered explanations. If really extensive or more general explanation is required, you can structure the budget narrative as just that - straight text. Remember though, the basic narrative about the project and your organization belong elsewhere in the proposal, not in the budget narrative.

Organizational Information

Normally a resume of your nonprofit organization should come at the end of your proposal. Your natural inclination may be to put this information up front in the document. But it is usually better to sell the need for your project and then your agency's ability to carry it out.

It is not necessary to overwhelm the reader with facts about your organization. This information can be conveyed easily by attaching a brochure or other prepared statement. In two pages or less, tell the reader when your nonprofit came into existence; state its mission, being certain to demonstrate how the subject of the proposal fits within or extends that mission; and describe the organization's structure, programs, and special expertise.

Discuss the size of the board, how board members are recruited, and their level of participation. Give the reader a feel for the makeup of the board. (You should include the full board list in an appendix.) If your agency is composed of volunteers or has an active volunteer group, describe the function that the volunteers fill. Provide details on the staff, including the numbers of full and part-time staff, and their levels of expertise.

Describe the kinds of activities in which your staff engage. Explain briefly the assistance you provide. Describe the audience you serve, any special or unusual needs they face, and why they rely on your agency. Cite the number of people who are reached through your programs.

Tying all of the information about your nonprofit together, cite your agency's expertise, especially as it relates to the subject of your proposal.

Conclusion

Every proposal should have a concluding paragraph or two. This is a good place to call attention to the future, after the grant is completed. If appropriate, you should outline some of the follow-up activities that might be undertaken to begin to prepare your funders for your next request. Alternatively, you should state how the project might carry on without further grant support.

This section is also the place to make a final appeal for your project. Briefly iterate what your nonprofit wants to do and why it is important. Underscore why your agency needs funding to accomplish it. Don't be afraid at this stage to use a bit of emotion to solidify your case.

What Happens Next?

Submitting your proposal is no where near the end of your involvement in the grant making process. Grant review procedures vary widely, and the decision-making process can take anywhere from a few weeks to six months. During the review process, the funder may ask for additional information either directly from you or from outside consultants or professional references. Invariably, this is a difficult time for the grantseeker. You need to be patient but persistent. Some grantmakers outline their review procedures in annual reports or application guidelines. If you are unclear about the process, don't hesitate to ask.

If your hard work results in a grant, take a few moments to acknowledge the funder's support with a letter of thanks. You also need to find out whether the funder has specific forms, procedures, and deadlines for reporting the progress of your project. Clarifying your responsibilities as a grantee at the outset, particularly with respect to financial reporting, will prevent misunderstandings and more serious problems later.

Nor is rejection necessarily the end of the process. If you're unsure why your proposal was rejected, ask. Did the funder need additional information? Would they be interested in considering the proposal at a future date? Now might also be the time to begin cultivation of a prospective funder. Put them on your mailing list so that they can become further acquainted with your organization. Remember, there's always next year.

This short course in proposal writing was excerpted from The Foundation Center's Center's Guide to Proposal Writing (New York: The Foundation Center, 1993), by Jane C. Geever and Patricia McNeill, Fund-raising consultants with extensive experience in the field.

The Foundation Center's Guide to Proposal Writing and other resources on the subject are available for free use in Foundation Center libraries and Cooperating Collections.

Additional Readings

Burns, Michael E. Proposal Writer's Guide. New Haven, CT: Development & Technical Assistance Center.

Coley, Soraya M, and Cynthia Scheinberg. Proposal Writing. Newburg Park, CA: Sage

Publications

Gooch, Judith Mirick. Writing Winning Proposals. Washington, D.C.: Council for Advancement and Support of Education.

Hall, Mary. Getting Funded: A Complete Guide to Proposal Writing. 3rd ed. Portland, OR: Continuing Education Publications.

Kiritz, Norton J. Program Planning and Proposal Writing. Expanded version. Los Angeles, CA: The Grantsmanship Center

SOURCE: http://www.ari.net/kendrick/proposal.html
Jim Kendrick & the P2C2 Group

Suggestions for Proposals

The kiss of a princess may transform a frog into Prince Charming, but few ugly and poorly prepared proposals are ever transformed into awards.

If you think the government is just waiting to give you a truckload of money, please send your proposal to the North Pole. I cannot help you. However, t£you are committed to approaching proposals like a competitive sport, with the discipline to succeed, you could become a winner.

Large proposals to the government can be major undertakings, and it is important that your organization plan ahead. After all, you want to protect your investment by maximizing your possibilities for winning the contract or grant. Here are some suggestions. Of course, you should adapt these ideas to your own situation.

Do not spend money on a proposal unless you know your organization has a reasonable chance of winning. This involves gathering intelligence and background information, which will also be useful when writing the proposal.

Develop a preliminary cost proposal or model before writing the technical proposal. This will give you a chance to evaluate pricing strategies--which you should know before selecting resumes or developing the technical approach.

Review the evaluation criteria and your intelligence about the award preferences of the funding agency. Then develop a sales theme for winning--which will be reflected in the technical approach, resumes, and project summaries. You must clearly present yourself as a viable option that is distinct from the competition. You must also provide the explicit information needed to gain the maximum points delineated in the evaluation criteria.

Read the entire RFP--especially the instructions for preparing the proposal.

The quality of your key personnel will often be a major factor in determining whether the proposal is successful. Recruit and assign personnel who are best matches ... better than those offered by the competition ... for the project.

Develop an outline for the proposal. Make sure you do not omit any important information.

Develop, customize, and produce the "boiler plate" material: resumes, project summaries, and business information--several weeks in advance of the due date of the RFP. This will enable you to concentrate on writing and refining the technical approach, management section (scheduling, project organization, etc.) and cost proposal.

Write an original technical and management solution, even if you add extensive "boiler plate." Most statements of work have unique features that will not be addressed by "canned" material. Assign a talented editor to refine drafts. This person should be separate from the writer(s).Schedule a "red team" to read the draft proposal and criticize it (brutally). Better that your team pick the proposal to pieces ... rather than the agency with the contract or grant to award.

Reserve time for revising the proposal.

Always plan to have the final manuscripts and documents available two days in advance. Reserve the last day before delivery for double-checking, photocopying, and binding.

SOURCE: http://www.ari.net/kendrick/xwriting.html
Jim Kendrick

The Weird Science of Bad Proposal Writing

If you read many technical proposals, you will find evidence that some of the writers are clones of HAL, the insane computer in 2001. Here is the evidence:

1. Sentences resembling English but conveying little information and even less indication of sentient life

2. Shotgun paragraphs from the proposal archives, pasted together in random order without a logic meaningful to humans

3. An emphasis on tribal incantations, known to some as "jargon" and to others as gibberish

4. Technical diagrams from alternative realities with little meaning for earthlings.

If such proposals are not the work of mad ET computers, then poor writing habits are the only other explanation. This would actually be good news, because earthlings can learn to write clearly.

Even the most complex technical or scientific information can be presented clearly. The use of technical terminology may be appropriate, provided the audience (including generalist managers) understand your message.

The "bottom line," however, is that writing reflects thinking. Too often, jargon and technical babble mask fuzzy thinking or confusion. The writer may not understand the RFP or may fail to go through the thought process required to arrive at a valid technical solution.

Some of the worst writing is by those who give no thought at all, filling pages with cut-and-paste material that fails to address the needs of the customer.

SOURCE: **ITE Journal, 1990**
George L. Crawford

Politics and Public Relations

Eight years ago I presented a paper on politics and public relations at the ITE "Forum On the Future Role Of Urban Transportation Engineers," held in Boston, Massachusetts. Today, that subject is even more relevant than it was then. With ever-increasing competition for a limited amount of public funds, the traffic engineer needs to be even more conscious of relations with the public and with political bodies.

There are five important areas to consider in dealing with politics and public relations:

- Relations with elected officials.
- Input into pending transportation legislation.
- To accommodate or stand firm: The proper balance.
- Responding to citizens' complaints and requests.
- Selling your programs and yourself.

Relations with Elected Officials

Relations with elected officials are extremely important to the engineer. Elected officials are ultimately account-able to the public for the successful execution of a public agency program, be it a capital improvements program or an operational program. Also, in many cases, the elected officials act as a body to appoint the traffic engineer or his or her immediate superior. There is thus a direct relationship between elected officials and transportation engineers when it comes to transportation matters. Elected officials are sensitive to the voting public's wants, needs, and demands. After all, they are in office because they were voted there by a majority of their constituents, and if they intend to remain in office they must continue to get the approval of most of the voters. They will listen very carefully to what their constituents want.

Because citizen input is so important to elected officials, it is necessary for you, the transportation engineer, to let them know that you are willing to help them to respond to citizen concerns in a responsible and professional manner. The engineer must establish a frank, open, and friendly dialogue with members of the governing body. In order to do that, you need to determine each elected official's greatest concern, as well as any other particular problems or concerns voiced by his or her constituency. A friendly dialogue is very important-an adversarial relationship makes it difficult to gain anyone's vote of confidence. You may gain a certain amount of respect in an adversarial relationship, but you will probably not gain the backing you need from your local officials.

It is important that you support your legislators when you find yourself in agreement on matters other than those that relate to transportation. It is also important that you become involved in other issues in your community. If the public officials feel that you are concerned with the general welfare of the community, and not just transportation matters, they will be more likely to be receptive to your concerns about and solutions for transportation matters.

The need to avoid an advocacy role in your relationship with your governing body cannot be stressed enough. You should clearly state your position and define the problems, but it should be done in a manner that allows for open discussion while downplaying advocacy in terms of what is right and what is wrong. For you to be successful in your role as a traffic engineer for a public agency, you need to gain the confidence and cooperation of the governing body for whom you are working. Without that cooperation, life is going to very difficult, and you are going to be constantly fighting an uphill battle. Remember, a good relationship with elected officials will make your life easier.

Input into Pending Legislation

The second area of public relations to consider is your input into legislation pending at any level (local, state, or federal). You've got to track the pending transportation legislation that may affect your agency and your programs. One way this can be done is through reading the legislative material that is sent to you by the professional Organizations to which you belong, such as ITE. If you aren't aware of pending legislation, then you can't do your community a service by reacting to it and suggesting alternatives or changes to that legislation.

If you see that changes or modifications to legislation need to be made, you should prepare a paper outlining your (and your agency's) position. In preparing this document, be sure to keep it simple and straightforward so that it can be readily understood by the legislators to whom you are sending it. You should follow-up with a phone call asking the legislator whether he or she has any questions about, or would like to dis-cuss, your report. Volunteer to appear before the committee that is considering the legislation to testify on behalf of your agency and the position you are taking. It is imperative that you inform your supervisor of your activities and that you have his or her approval.

On legislation pending within your agency, it is even more important to talk individually to each involved elected official. Explain to them on a one-to-one basis what effects this legislation might have on your department (such as manpower and capital improvement funds). If necessary, ask other traffic professionals to appear before your governing body to support your position. Private- as well as public-sector professionals, should be included in this support group. Be certain that the people you ask to appear will be able to come across in a friendly and straightforward manner. Nothing will turn elected officials off more than someone from outside the community talking down to them about pending legislation.

Be prepared, if it is professionally proper, to compromise your position in order to gain three-fourths of a loaf rather than lose all of it. If you're asking for an ordinance to be introduced that would affect your department, be sure that the person you're asking to introduce it is completely briefed as to the whys and wherefores of the legislation. Nothing is more embarrassing to a politician than to be questioned about something he or she is uninformed about. No one wants to be surprised. Make sure that when you're asking someone to introduce and support your legislation that he or she is not caught off guard by being uninformed.

Be prepared to appear on the behalf of other urban traffic engineers on matters that may be coming before their governing bodies. Be careful, however, to avoid controversy with your own governing body. Let the members of your governing body know what you are going to do. Ask them if they see any problems with it, and tell them what you're going to say and why you're going to say it. Your support of other traffic engineers is needed, but not to the detriment of you or your governing body. When you ap-pear and talk to a public body of another agency, be sure that it is in a friendly, forthright manner that doesn't turn them off.

In order to effectively voice your opinions on legislation, you need to be concise and clear, and have a common-sense approach to the problem. Be prepared to compromise when it will not kill a program to do so. You'll rarely be so lucky to get 100 percent of what you want--and it is much better to have 50 or 75 percent of a problem solved than to have accomplished nothing.

Accommodate or Stand Firm?

The third area to be discussed is whether to accommodate or stand firm, and what is the proper balance between the two. This is probably the most difficult thing for most traffic engineers to cope with. Most traffic engineers are trained in the civil engineering field and know that two and two always equal four. In general, civil engineering is an exact science. But in reality, traffic engineering in many in-stances is an art and not a science.

In order to work in the sector of art, not science, in your dealings with people or legislation, you need to fully review your position and see if you can compromise in some way and still have a good professional outcome. Let me emphasize a good professional outcome. Not the best or only professional product. The best or only solution that you have in mind may not be acceptable to the citizens or the politicians. In our profession, there's more than one way to skin a cat.

When dealing with controversial is-sues, be prepared to present your position and to listen to the other side very carefully to see where it may be possible to accommodate that side without professionally hurting your position. Many times if you can concede small points you may be able to win overall. Always remember, "don't win the battle and lose the war? because that is not going to get the job done.

When the other side is clearly asking you to do something unprofessional, however, you have to take a firm stand and stick by it even if that means resigning or being fired from your job. That's pretty hard to do, but when you get to that point, you have to take a firm stand that you can live with. Of course, the secret of all this is knowing what is professional and what is not. To deter-mine what is professional, you have to use your yardstick, as well as that of other professionals.

Suppose you design a traffic signal for an intersection and your superior doesn't agree with your design. He asks you to redesign it in a way that doesn't meet all the criteria you feel are necessary. At that time you should clearly state the case for your design. If your boss rejects your argument, you should design the traffic signal the way he wants it. You're not compromising your professional standing by doing this unless it's clear that this signal is definitely not standard and will be a detriment to the public. If this is the case, then you have to take a very firm stand and refuse to redesign it. Remember, however, that in our profession there are very few areas of black and white--many decisions are made in a gray area.

You must be prepared to put into action those programs that you do not recommend or favor. The governing body has the prime responsibility of answering to the public. The elected officials set policy and are responsible to voters if that policy is not carried out in the proper manner. You also have a responsibility to the public--that responsibility is to see that programs are carried out in a professional manner. There is more than one way to professionally carry out programs.

If you find that you are continually losing the war, then it is time to move on to another position. If you can't seem to do anything right by your superior's standard, then it is time to say goodbye. You will feel much better about yourself if you can work in an atmosphere of acceptance rather than continual rejection. Again, don't help create that atmosphere of continual rejection by failing to compromise on small issues.

Responding to Citizens

The next area of public relations to be discussed is responding to citizens' requests and complaints. The problems in the minds of the citizens are very real and very urgent to them even if they seem inconsequential to you. To parents, the safety of a few children crossing a street is just as important as if there were 75 or 100 children crossing. You may respond to the problems of a small group differently from the problems of a large one, but, in either case, you need to assure the citizens that you are working to solve their problem because it is important. This doesn't mean, however, that you should blow the problem or solution out of proportion.

Most citizens are not traffic professionals, but they do conceive a real problem and feel that they have a real solution. Don't shut them out. Listen to what they have to say. You may be surprised by a good idea, which, in conjunction with your professional approach, could actually solve a problem. Remember, there's more than one way to skin a cat.

Don't present to the public a superior or condescending attitude. Don't give the impression that you're trying to point out their inadequacies. Rather, explain your position in a clear, simple manner. That's sometimes hard to do in traffic engineering, but we have to get it down to the proper level to present our case to the public. Don't spout a bunch of formulas or numbers to the citizenry. They probably won't understand them, and they certainly will think that all you're trying to do is cloud the issue. If need be, the data can be presented to those people who might have an interest and some technical know-how to understand what the numbers mean. Then those citizens, if you win them over, may be able to win over the other people who don't understand the numbers. Again, it should be emphasized that we must pre-sent our case to the public in a very simple, straightforward manner. Remember, most of the people we deal with and talk to every day are not professional engineers. And those who are professionals in other fields may have very little understanding of traffic engineering principles.

The importance of being prepared to concede on small points where it is professionally acceptable to do so cannot be emphasized enough. This very tactic may allow you to win over the citizens and win the entire war, even though you may lose a particular battle.

When citizens win over your objections and the governing body enacts legislation or instructs you to do something that you didn't recommend or favor, do so unless it is unprofessional. When you do carry out those programs do so in a friendly manner. Remember, on another day and another controversy, you may need friends. If citizens understand that you are willing to accept defeat and carry out those things that are professionally correct, they will probably have a greater respect for you and will be more apt to take your position in future controversies.

One of the best ways to deal with the citizenry is to take action before the public mounts a concerted effort. This will help your image by conveying to the public that they don't have to create a controversy to get things done. It will make them feel that you are aware and sensitive to their problems and willing to do something to solve them without being pressured by any particular group or political body. Taking the winds out of the sails is always a good policy.

Selling Your Programs and Yourself

The last area to be discussed is selling yourself and your programs. In selling yourself and your programs, all of the things previously discussed are going to be helpful. You should work at selling yourself and your programs every day. Doing so will make life a lot easier when a problem comes along because people will already have a better understanding of who you are and where you're coming from. This allows the public to under-stand and accept your viewpoints. By exposure to the public through any means (press, television interviews, etc.), you will give the public a better understanding of you and your professionalism.

As often as possible, you should volunteer to appear before groups and civic clubs to explain what you and your department are doing. Explain your programs, your needs, your resources, and why certain programs can't be instituted because of a lack of funds available to you. At those meetings ask for questions, gripes, and comments. Being able to listen to someone's problems or comments may give you the opportunity to solve a problem before it ever really be-comes one. Most problems don't start off as such--they become problems when they get blown out of proportion. When that happens, stands are hardened and sides are taken and statements are made that do not allow for compromise. It's therefore essential that, whenever possible, you head off any problem early on.

Also, when problems are blown out of proportion they inevitably reach the media. Then you find that reporters pick out controversial situations that they feel will interest their readers. A frequent result is that the problem gets blown further out of proportion. If you can avoid getting it in the media you will be much better off.

A better way to use the media is to prepare a good public relations program to present your programs. Get acquainted with the media so that you can speak to them as someone they know and not as some bureaucrat they have never heard of. By talking to the media on a regular basis you will be able to establish a good relationship. Then when controversies do occur, the media will already know about you and your objectives. In all of this, remember not to overshadow your superior or your governing body: They might get the impression that you are a prima donna. That won't help you sell yourself; rather, it will be a negative in your relationship with them.

In selling yourself and your programs you have to be accessible. Set aside some time each day to be available by phone or in person. Nothing is worse to a citizen than not getting a response to their request or telephone call. Sometimes, even a negative response is better than none at all. People like to be stroked. If you give them attention, many times you can win them over to your side.

Also, we know some people will repeatedly call about some imagined problems. These people need to be shut off in a friendly and gentle way. You can't let those people dominate your time to the detriment of others with real problems.

Always present your ideas and pro-grams in a manner that can be readily understood by the layperson. After all, the lay council person will be calling the shots and making the decisions concerning ordinances or programs that you may want to get through your governing body.

Probably the most important element to being a successful traffic engineer is presenting yourself to the public and the politicians in a friendly, professional manner. You might be very professional, but paint a bad picture to others. Most of our work as urban traffic engineers has a lot to do with people. Formulas don't count, numbers don't count, only people count in getting our programs successfully carried out.

Win people over to your side and much of your everyday work as a traffic engineer will be made easier.

Conclusion

One of the most important functions that an urban traffic engineer has to perform is to deal with the politicians and public. If you fail to establish a good public relations program you are not going to accomplish a great deal in your community. If you do establish a good program, you will be looked upon as an astute professional and be readily accepted by the community.

We sometimes try to impress our fellow professionals more than we try to impress the politicians and the public. You're not gaining much in your community by impressing only your fellow traffic engineers. Certainly you gain professional respect, and that is a key element to professional acceptance. But regardless of whether traffic engineers accept you, if you are not accepted by the people in your community, then you haven't done very well professionally. As a matter of fact, you have failed professionally. If you do a good job in your community and are widely accepted and respected by both politicians and citizens then you'll find that professional traffic engineers will also accept and respect you. The respect of the citizenry, the politicians, and your fellow traffic engineers can be gained through your public relations activities and through your professional demeanor.

While all of the above has been directed at public-sector traffic engineers, the same general principles apply to the traffic engineer in the private sector. For the private-sector engineer one addition has to be made--that is, he or she must apply all these principles to public- and private-sector clients, as well as to politicians and the public.

In conclusion I would like to reiterate that with an ever-increasing competition for a limited amount of public- and private-sector funds, the traffic engineer needs to successfully practice the art of public relations to get a share of those funds.

SOURCE: Washington State Department of Transportation

Appendix 4 Summary Table

Type of Publication	Characteristics	Flexibility	Authorize & Review
Executive Order	Broad, high level policy supporting agency vision, mission, and goals. (They drive manuals and IL's.)		No review required.
Policy Statement	Broad, high level policy supporting agency vision, mission, and goals. (They drive manuals and IL's.)		Authorized by Office of Secretary or designee (direct report). PSA directs review to affected executives affected organizations, DOT Audit Office, and, when appropriate, AG.
Manual	Rules, standards, procedures, and guidance. (Driven by Department Policy and Executive Orders	Owner provides a process, method, and standard form for customers to suggest process changes for making improvements to the manual's procedures. Decisions to change or not will be guided by Quality tools and documented.	Authorized by manager of the organization manual owner or manager of organization directs review to impacted organizations. Authorizing organization determines need for review by DOT Audit Office, ERG, and others at appropriate.
Instructional Letter	Short term (one year or less) policy and/or cross organizational rules, guidance and procedures		Authorized by originating executive or designee. No review required, except by DT Audit Office.
Handbook	Extracts from approved directional documents.		Reviewed by owner(s) of manual(s) from which extracts are taken.

SOURCE: **1994 ITE Compendium of Technical Papers**

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THE FEASIBILITY OF PLANNING, ESTABLISHING AND IMPLEMENTING A FREEWAY INCIDENT MANAGEMENT PROGRAM

The economic feasibility of developing a freeway incident management (FIM) program in the Des Moines, Iowa metropolitan area was estimated using a life-cycle cost approach. The costs of planning, establishing and implementing the various components of an FIM program were estimated for a 40 year period. Those costs were then compared to travel efficiency gains over the same period. The travel efficiency gains are based on the program's ability to reduce non-recurring congestion, typically associated with automobile incidents. The FHWA Freeway Delay Calculation .program (FREWAY) was used to calculate non-recurring traffic delay. The program estimates delay based on facility capacity, average daily traffic and a probability of incident occurrences, broken down into seven separate incident types. Incident probability was determined based on empirical Incident rates on similar facilities across the country. The study found FIM to be economically feasible with an estimated benefit/cost ratio of approximately 6.0. This paper examines the benefit and cost assumptions used to examine the feasibility of an FIM program and applies these assumptions to the Des Moines Area Alternatives Analysis.

In 1989, Wilbur Smith Associates was hired to examine a series of transportation alternatives to a proposed capacity expansion on Interstate 235, an urban freeway utilized mainly to transport commuters to and from suburban residences and the central business district. Twenty-three alternatives were initially proposed and were gradually reduced to six, including the Freeway Incident Management (FIM) program discussed in this paper.

The feasibility of the FIM program was determined by using a life cycle cost approach. The costs of planning, establishing and administering the various components of an FIM program were estimated for a 40 year period (1994-2034). The life cycle costs were then compared to travel efficiency gains over the same 40 year period. The results indicate that the program is economically "feasible" from a travel efficiency standpoint.

TRAVEL EFFICIENCY BENEFITS

By investing in an FIM program, the Iowa Department of Transportation will save the public time and vehicle operating costs. The magnitude of these savings is dependent on the ability of FIM to reduce the delay associated with non-recurring congestion. Non-recurring congestion is defined as congestion associated with a random event, such as an accident or automobile breakdown. Recurring congestion, on the other hand, refers to predictable, recurring congestion, such as peak hour traffic jams.

The FHWA Freeway Delay Calculation Program (FREWAY) was used to calculate non-recurring delay. The program estimates delay based on facility capacity, average daily traffic and a probability of incident occurrences, broken down into seven separate incident types. Incident .probability was determined based on empirical incident rates of similar facilities across the country.

The delay is then converted into dollar figures for both time lost and gasoline consumed, using a monetary value assigned to time and fuel. The monetary value assigned to travel time saved is subject to some debate. The FHWA suggests that a 1989 value of $8 per hour for automobiles and $15 per hour for trucks be used. The values were checked for, applicability to the Des Moines area and adjusted. A weighted average of $10.42 per hour was used for this analysis, based on results of both driver and household surveys, Fuel costs were assumed to be $1.00 per gallon.:,

An FIM program has a possible indirect effect of reducing the number of secondary traffic accidents. Post-incident congestion creates an environment where stop-and-go movement, rubbernecking, and sudden deceleration creates the potential for more rear-end collisions. Early detection and quick removal reduces the probability of these occurrences. However, following the conservative approach of this study, no benefits were assumed for this reduction in accidents.

Determining Non-Recurring Congestion Costs

Delay was calculated on I-235 for the years 1990 and 2020, assuming both the existing freeway with minor rehabilitation and the limited build alternative. The limited build alternative assumes additional capacity expansion without right-of-way takings.
Exhibit 1 summarizes the expected 1990 and 2020 delays, with the corresponding costs associated with non-recurring congestion. Without any major improvements to 1-235, the delay and associated costs of non-recurring congestion are expected to double over the next 40 years. Assuming a limited rebuild of 1-235, the expected costs would actually fall by approximately 57 percent. This indicates that the worse the traffic problems become on 1-235 the greater the benefits of an FIM program.

FREEWAY INCIDENT MANAGEMENT COSTS

While detailed design of a comprehensive freeway incident management system is beyond the scope of this study, the envisioned system would probably contain:

- A Central Traffic Control Center
- Communications Cable
- Detector Systems
- Video Cameras
- Variable Message Signs
- Highway Advisory Radio (HAR) Stations
- Freeway Service Patrol

To obtain a rough estimate of the construction, maintenance and operations cost of such a system, reviews were made of comparable systems around the country. In addition, several assumptions were necessary to accurately estimate costs. First, it was assumed that the control center could be situated in conjunction with some future transportation facility in downtown Des Moines, and the system would operate from 6 a.m. to 7 p.m. weekdays. Based on normal service life, the system components would have to be replaced approximately every 18 years, with the exception of the patrol vehicle which would be replaced every other year. Maintenance costs would be approximately 10 .percent of construction cost. Personnel requirements would be as follows:

- Service Patrol:
  1 Full-Time Trooper
- Control Center:
  2 Full-Time Operators
  2 Full-Time Engineers

Based on these assumptions, the FIM program costs were estimated:

<u>Construction Costs</u>	
Control Center	$1,200,000
Control Center Equipment	1,450,00
Engineering, Software, Testing	3,400,000
Other *	3.900.00
	$9,950,000
<u>Maintenance Costs (Annual)</u>	
Patrol Vehicle	$ 15,000
Personnel	182,000
Equipment	650,000
	$847,000

* Includes conduit, junction boxes, poles, fiber optic cable, detectors, closed circuit TV, changeable message signs, and HAR stations.

The next step was to project these costs over the next 40 years. Exhibit 4 shows the projected costs between 1994 and 2034. The large spikes around the years 2000 and 2018 represent the cost of equipment replacement, with the remainder representing annual operating expenses. The present value of these estimates is presented in Exhibit 5. The results indicate that the project would coat approximately $18.0 million over the 40-year period.

FIM FEASIBILITY

To calculate the feasibility in travel efficiency terms, all costs and benefits in constant dollars were determined for years 1994 through year 2034, and then discounted back to 1994. The benefits were then compared to the costs using conventional feasibility indicators.

The travel efficiency feasibility of freeway incident management is summarized in Exhibit 6. T interpret the results the following rules are appropriate:

- A feasible project is one which has a positive Net Present Value and a Discounted Benefit/Cost Ratio of 1.0 or higher; and
- The higher the NPV and B/C, the more feasible the project.

Exhibit 6 suggests that freeway incident management is feasible under both the existing freeway with rehabilitation and the limited build alternatives.

CONCLUSIONS

The FIM analysis revealed that the alternative would have a positive impact on the Des Moines metropolitan area. Certain FIM costs, such as added start-up and labor costs, will create an initial burden on the local government. However, the benefits to the motoring public will more than compensate those added costs.

The FIM program with the existing system plus some rehabilitation will create the greatest benefits in terms of relieving nonrecurring congestion. This, however, is merely a function of the level of congestion and added risk associated with the existing system. It would seem obvious that an FIM system would have the greatest benefits on streets or highways where there are the most accidents.

When the same program is carried out in conjunction with limited reconstruction and design of the highway, the benefits show a marked reduction. The benefits do, however, still outweigh the costs by more than 250 percent. The results indicate that the initial costs of an FIM program are slight compared to the potential benefits, even on a relatively safe and efficient freeway.

References

Wilbur Smith Associates. 1-235 Alternatives Analysis: Final Report, *prepared for the Iowa Department of Transportation, January 1994.*

SOURCE: **1994 ITE Compendium of Technical Papers**
Gerard J. Kerwin and Jerry Lutes

DEVELOPMENT OF A MULTI-AGENCY COMMUNICATION MASTER PLAN FOR NEW JERSEY'S TRANSPORTATION AGENCIES

New Jersey's transportation agencies are beginning to collaborate on sharing communication infrastructure. Although some of the agencies have been sharing microwave towers for years, the shared towers were planned and built by a single agency for its needs only. The current effort involves designing new fiber optic links and other facilities specifically to serve multiple agencies.

EXPECTED BENEFITS

One reason for sharing is to save money. Communication infrastructure is often the most costly part of a traffic control or freeway management project, especially in an urbanized area like northern New Jersey. After a traffic management project is built, we often find that communication infrastructure is the major determinant of performance and the largest component of maintenance costs. By sharing communication facilities, the agencies can provide the public with better transportation at lower cost than if each agency built and maintained all the communication links it needs.

A second reason for sharing communication infrastructure is to facilitate the exchange of information among the transportation agencies. Here's an example. The George Washington Bridge linking New York and New Jersey belongs to the Port Authority of New York and New Jersey (PANYNJ). The New Jersey Turnpike, which connects the bridge with points south, belongs to the New Jersey Turnpike Authority (NJTA).

Routes 46 and I-80, which connect the bridge with points west, belong to the New Jersey Department of Transportation (NJDOT). All of these facilities carry huge traffic volumes and all are equipped (or soon will be) with variable message signs, highway advisory radio, or both. All three agencies are able and willing to warn commuters of unusual delays on the other agencies' facilities, provided they know about the delays. To facilitate this information exchange, NJDOT is installing a fiber optic link between its I-80/Route 46 traffic control center and the bridge, with provision for connection to NJTA's future fiber optic system.

ACTION TO DATE

To achieve the objectives of saving money and improving interagency data exchange, NJDOT took action on several fronts:

- It organized an interagency task force on IVHS implementation and made communication a recurring topic of the group's meetings.
- It formed a subcommittee of that task force to deal with compatibility issues.
- It hired consultants to make recommendations concerning a possible statewide fiber optic network.
- It identified key policy and administration issues relating to shared communication infrastructure and presented them to the appropriate state executives.

Although NJDOT first began informally exploring opportunities for sharing fiber optic links three years ago, the actions mentioned above were all undertaken in the last 18 months. They are all continuing. The task force mentioned above is the technical committee of the Committee for a Smart New Jersey (CSNJ), the first state chapter IVHS America. The technical committee, formally the IVHS Incident Management Master Plan Subcommittee is permanent.

The technical committee coordinates all IVHS activities of the state's transportation organizations, not just the communication aspects. It does this by exchanging information about current activities and by recommending standards and policies.

The technical committee is chaired jointly by a representative of the Commissioner of the NJDOT and by a representative of the Executive Director of the New Jersey Highway Authority (NJHA), owner of the Garden State Parkway.

Membership includes not only senior technical personnel from the New Jersey transportation agencies, but also representatives of consulting firms, communication companies, and other private companies involved in IVHS implementation. Approximately 50 people representing 21 organizations are invited to the monthly meetings. Attendance at the monthly meetings is typically 30, with at least one representative from nearly every invited organization.

The high attendance reflects the widespread feeling among the members that the committee is performing a valuable function. Members look forward to the meetings as an opportunity to find out what the other organizations are doing, and discuss practical solutions to common problems.

The committee has agreed on guidelines for highway advisory radio installations and message content. The committee now finalizing similar standards for variable message signs.

With regard to sharing communication infrastructure, the task force has agreed that New Jersey should have a statewide communication network shared by all the state's transportation agencies. It further agreed that the network should be composed primarily of fiber optic cable. The group has also endorsed the recommendations of its Communication Subcommittee.

COMMUNICATION SUBCOMMITTEE

The task force's Communication Subcommittee is trying to eliminate challenges to information exchange and sharing of facilities that could be caused by incompatible systems. The subcommittee's recommendations to date have been as follows:

- Fiber optic cable on links that may be shared should be single mode.

- Long haul voice and data communication should use equipment meeting the Synchronous Optical Network (SONET) standards.

- Video compression/decompression (codec) equipment designed for use with low speed communication channels should adhere to the Px64 standard.

Currently, the Communication Subcommittee is dormant because the task force members believe that the above guidelines are enough. As additional compatibility issues arise, they will be referred to this committee.

NETWORK DESIGN

The New Jersey transportation agencies have already installed tens of miles of fiber optic cable, with more going in every day. The designers of these links know only the communication requirements of the particular project the fiber serves, and must estimate how much additional capacity to install for other agencies, and for other uses by the building agency. Designers must also estimate where their cables will connect with other agencies' cables.

In an attempt to provide the designers with more guidance, NJDOT asked consultants to identify an appropriate shared communication network. The consultants visited each of the New Jersey's transportation agencies, preparing lists of communication needs and inventorying existing and planned communication links.

With regard to needs, NJDOT asked the consultants to investigate not only communication needs related to IVHS, but all types of communication needs. Such non-IVHS activities include toll collection, voice communication, and the exchange of computer files among offices. Among IVHS applications, the consultants concluded that video surveillance of the state's major freeways and arterials will create a tremendous demand for additional, high capacity communication links.

With regard to existing and planned communication infrastructure, the consultants reported that the New Jersey transportation agencies had already installed, or committed themselves to installing, about 150 miles of fiber optic cable that could form the core of a future multi-agency network. Another 250 miles is likely to be added over the next several years.

The consultants also documented about 250 miles of empty conduit available for future fiber. Some of this was installed by NJDOT in conjunction with highway lighting and resurfacing projects. Much of the remainder was provided by telephone companies in return for permission to install their own ducts along NJHA and NJ TRANSIT right of way.

Using this information about needs and available communication infrastructure, the consultants developed four alternative multi-agency fiber optic networks. The smallest used only existing and committed fiber links. The other three networks were formed by adding to this core in an incremental fashion. The four networks ranged from 69 to 860 miles of cable. The construction costs, excluding amounts already committed, ranged from $3 to $125 million. Figure 1 shows an alternative involving 375 miles of cable and costing $40 million.

For each alternative, the consultants provided a list of the transportation agency offices, yards, and traffic management systems that would be on the network, and the uses that each agency could make of the network. For example, the consultants pointed out that the network shown in Figure 1 could provide voice, dam, and video communication among 21 State Police facilities, provide redundant links to six State Police radio towers, and provide a means for the State Police to observe the pictures from future highway surveillance cameras all over the state.

To maximize reliability, the consultants proposed that the links in the network be interconnected to form rings that would provide paths around any malfunctioning link or node. For the same reason, the NJDOT suggested that the rings be linked by redundant cross connects in different locations.

POLICY AND ADMINISTRATIVE ISSUES

The consultant's report raised many policy and administrative issues that must be resolved before the transportation agencies can agree on which fiber links will compose the network and begin sharing those links.

The most fundamental issue is whether use of the network will be limited to transportation agencies. Some people believe that it would be in the public interest to allow other state agencies use the network. The state lottery, for example, might be able to reduce its communication costs substantially by using the fiber network instead of leased telephone lines. An important potential educational application is long distance learning.

The transportation agencies are concerned that if the network served all state agencies, capacity needed by a transportation agency might be allocated to others. They also wonder whether the presence of a network cable on their right of way would restrict their construction and maintenance operations.

A second fundamental issue is who will manage and maintain the network. One option is for each agency to maintain the fiber and equipment in its right of way. Another option is that one party, such as a private company contracted by New Jersey's Office of Telecommunications and Information Systems (OTIS), maintain the entire network. A third possibility is for a telecommunications firm to supply service in exchange for access to state right of way. Under any of these options, an agency finds itself depending on others to fix communication problems. Some agencies are understandably uneasy about losing control of the time to repair communication failures.

Of course, the financial aspects of the network are also issues. The concerns are not with the overall cost of building and maintaining the network, although that is substantial. As stated at the beginning of this paper, the agencies expect that shared infrastructure will cost less than independent communication systems, so the cost of building and maintaining the network should be covered by funds available for traffic management projects that will be built with or without a shared network.

The key financial issue is how to allocate costs among agencies that use the network. One option is to have each agency pay the cost of building and maintaining the portions of the network on its right of way. This would allow agencies with little or no right of way, such as the State Police, to use the network for free. Another option is to operate the network like a telephone company, billing each agency in accordance with usage. That approach has worked for high capacity telephone company circuits that OTIS has leased for use by multiple state agencies. However, if the using agencies simply pay as they use the service, the question arises as to where the initial funds to build the system will come from.

A final issue is the role of the private sector. If the State were to build an extensive fiber optic network to be used by many state agencies and charge those agencies based on usage, it would look remarkably like a telephone company. Opinions differ as to whether this is a proper role for the State.

Even if the State were to develop its own communication infrastructure to minimize its use of private telephone companies, there are still possibilities for private sector participation in building and maintaining the network. One such possibility is illustrated by a recent agreement between Bell Atlantic (BA) and NJHA, in which BA is building, and will maintain, a fiber optic communication system along 50 miles of the Garden State Parkway. NJHA expects to pay far less than it would have paid to build and maintain the system itself because BA will use much of the infrastructure to serve other customers as well as NJI-IA.

The CSNJ technical committee quickly recognized that these issues need to be resolved at a higher level and have referred them to the Governor's office. New Jersey changed governors in January, so the policy issues have not yet been resolved. However, we understand that they will receive close attention in the next few months. Perhaps at next year's ITE meeting, we will be able to tell you how the issues were resolved.

SOURCE: **Cambridge Systematics, Inc.**

Summary of Incident Management Programs
Funding Sources (1 of 2)

States	Fed.	State	Local	Privat e	Motorist Reim-bursement	Other	Notes
AZ	●	●					STP and CMAQ programs
CA	●	●	●		●		Federal IM, CMAQ, and ITS demonstration
CO	●	●	●	●			
CT	●	●		●			STP/SMAQ and routine operations funds
FL		●	●				FDOT District offices; State assists with planning
MD	●	●		●			SPT/CMAQ and routine operations funds
MI	●	●	●				
MO	●	●	●	●	●		CMAQ and routine operations funds
NJ		●				Tolls	
NY		●					
PA		●					
RI	●	●					CMAQ funding
VA	●	●	●		●		

SOURCE: **Cambridge Systematics, Inc.**

Summary of Incident Management Programs

Funding Sources (2 of 2)

Metropolitan Area	Federal	State	Local	Private	Motorist Reim-bursement	Notes
Atlanta	●	●	●			CMAQ funds, SIP, Section 402
Boston	●	●	●	●		ITS, CMAQ, state/local operations, private patrols
Buffalo	●	●	●	●		Feds for planning, state TOC, local operations
Charlotte	●	●			●	State motor fuel tax revenues
Chicago		●			●	State motor fuel tax revenues
Columbia	●	●				Early deployment underway
Dallas	●	●	●		●	CMAQ funds for planning, state/local for operating
Denver	●	●			●	Mostly CDOT fund; some Interstate maintenance funds
Des Moines		●	●			
Detroit	●	●	●	●		MDOT, Federal ITS and CMAQ funds
Fort Worth	●	●	●		●	CMAQ funds for planning, state/local for operating
Houston	●	●	●	●		CMAQ, state, local, and private funds

Metropolitan Area	Federal	State	Local	Private	Motorist Reimbursement	Notes
Kansas City	●	●	●	●		CMAQ minimum allocation funds
Las Vegas	●	●	●			In planning stages
Los Angeles	●	●			●	Federal 4R funds and ITS demonstration funds
Lower Hudson Valley, NY	●	●	●	●		Pilot programs under development
Milwaukee	●	●				Pilot program with state/federal funds
Minneapolis /St. Paul	●	●	●	●	●	Interstate Maintenance, ITS funds
New Orleans	●					NHS funding for callbox installation
NY City	●	●	●	●		
Portland	●	●	●			Still in planning stages
Sacramento	●	●	●		●	
San Francisco/Oakland	●	●	●			
Salt Lake City	●	●		●	●	CMAQ grant for start up
Seattle	●	●			●	Federal support for TOC
St. Louis	●	●	●	●	●	CMAQ & routine operation funds
Washington, DC	●	●	●	●	●	FHWA channeled through volunteer organization

Module 4
Detection and Verification

The goal of Module 4 is to describe the detection and verification phase of the incident management process, describe specific challenges to effective detection and verification, describe potential tools or strategies for improving detection and verification efforts and provide the opportunity to examine local detection and verification needs and potential tools/strategies for improvement.

MODULE 4
DETECTION AND VERIFICATION

DEFINITIONS

DETECTION
Determination that an incident has occurred.

VERIFICATION
Determination of the location and nature of the incident.

OBJECTIVES

- Dispatch appropriate resources
- Improve operational efficiency
- Improve detection on low traffic roadways
- Improve access to the scene
- Reduce secondary incidents
- Improve responder safety

BENEFITS

- Reducing detection time from 5.2 to 3 minutes would reduce fatalities by 10% annually, or 212 lives.
- Reducing detection time from 5.2 to 2 minutes would reduce fatalities by 308 lives.

- NHTSA

ISSUES AND BARRIERS

Detection in non-urban, remote areas

- Mayday systems
  - Automated vehicle location
  - Automated collision notification

ISSUES AND BARRIERS

Too many calls for a single incident

- Enhanced 9-1-1 systems
- May improve verification efforts

ISSUES AND BARRIERS

Accurate information from motorists

- Enhanced 9-1-1
- Compare multiple calls
- Install more frequent, detailed roadway identifiers

ISSUES AND BARRIERS

Automated detection vs. Cellular call-in in urban areas

- Automated detection
  - more accurately locates
  - monitors routine congestion
- Cellular call-in is low cost

ISSUES AND BARRIERS

Motorist aid call boxes - a safety concern?

- Pedestrians typically advised to "remain in vehicle"
- Interstate pedestrians illegal

NON-TECHNICAL TOOLS/STRATEGIES

- Dedicated Roving Patrols
- Cooperative Partnerships with Fleet Operations
- Fixed Observers
- Aerial Surveillance
- Supplemental Signing for Location Identification

TECHNOLOGY-BASED TOOLS / STRATEGIES

- Cellular Phone Reporting
- Dedicated Incident Phone Lines
- CB Radio Reporting
- Motorist Aid Call Boxes
- Electronic Loop Detectors
- Closed-Circuit Television
- Video Imaging Processing

EMERGING TECHNOLOGIES

- Automated Collision Notification and Automated Vehicle Location Systems (Mayday)
- Smart Call Boxes
- Portable Detection and Surveillance Systems
- Automatic Cargo Identification

EMERGING TECHNOLOGIES

- Automatic Vehicle Identification
- Cellular Geolocation
- Microwave Radar Detectors
- Pulsed-Doppler Ultrasonic Detectors
- Acoustic Detectors
- Infrared Detectors

NATIONAL EXAMPLES

*"For a good (commute) time call...*77"*

- Dedicated Incident Phone Lines in Portland, OR

NATIONAL EXAMPLES

- Cooperative Partnerships with Fleet Operations in Pennsylvania

Truckers notify the Turnpike Commission, or State Police directly via CB.

NATIONAL EXAMPLES

Aerial Surveillance in Delaware and Virginia

- Observation balloon system
- DelDOT/VDOT joint project
- Intended for special events

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Module 4
Detection and Verification

Definitions

Detection and verification are the first steps in the incident management process.

Detection is the determination that an incident of some type has occurred. Incident detection occurs in person (i.e., by motorists, aerial surveillance) or automatically (i.e., through roadway loop detectors, video imaging systems). The occurrence of an incident is reported to the location where response is initiated (although the reporting process sometimes takes a circuitous rather than direct route).

Verification is the determination of the precise location and nature of the incident. Accurate and detailed information about the incident can help to ensure that the most appropriate personnel and resources are dispatched to the scene. As with incident detection, verification can be accomplished in person (i.e., by response personnel at the scene) or automatically (i.e., via closed-circuit television, or global positioning systems).

Objectives/Benefits

The effectiveness of incident detection and verification can "set the tone" for the remaining steps in the incident management process. Improvements in incident detection and verification can ultimately result in improved access to the scene by incident responders; responders are dispatched and reach the scene before the traffic backup becomes lengthy

- the appropriate personnel and equipment being dispatched to the scene, reducing the overall incident duration

- reduced secondary incidents

- improved agency efficiency by reducing the number of and time that personnel and equipment are at the scene of an incident

- saved lives by ensuring that vehicle crashes do not remain undetected on low traffic roadways; "the golden hour" is not squandered

- improved responder safety; receiving information about the incident before arriving at the scene helps responders be watchful and alert to possible danger, especially if fire or hazardous materials are involved.

It is difficult to quantify the benefits of improved incident detection and verification in isolation. Improved detection and verification also serve to improve response and clearance times by initiating incident management efforts before traffic has congested the scene. Improved detection and verification also serve to improve both the timeliness and accuracy of information provided to motorists. The National Highway Traffic Safety Administration (NHTSA) has reported improved detection benefits in isolation. NHTSA has estimated that a reduction in incident detection times from 5.2 minutes to 3 minutes (a time savings of 2.2 minutes) would result in a fatality reduction of 10 percent annually, or 212 lives. A reduction in incident detection times from 5.2 minutes to 2 minutes (a time savings of 3.2 minutes) would reduce fatalities by 308 (1994).

Issues or Specific Barriers

Below, the more common issues related to improving detection and verification are described. When possible, suggestions for mitigating these issues are provided.

Detection in Non-Urban or Remote Areas

In non-urban or remote areas, incident detection times can be lengthy. In fact, if a vehicle leaves the roadway during the incident, it may not be detected for days. One needs to consider the effect on fatality rates. Would the motorist involved in the incident have survived if the incident had been detected quickly and emergency medical personnel had reached the scene within "the golden hour?" In urban areas, higher traffic volumes and a greater number of motorists who carry cellular phones result in much quicker and more reliable detection times. To date, little improvement in incident detection has been possible in non-urban or remote areas. However, emerging technologies, particularly Automated Collision Notification and Position Location Systems or Mayday systems, show great promise for improving the detection of incidents in remote areas.

Too Many Calls for a Single Incident

Often, especially after the occurrence of a major incident, dispatchers receive multiple calls from motorists reporting the incident. These multiple calls can overload dispatchers and limit their attention to other emergencies. However, these multiple calls can improve incident verification efforts if an efficient process for collecting information from calls is developed. Motorists do not often understand what information is useful to the responding agencies. In addition motorists may provide inaccurate location information and may exaggerate incident severity. By comparing responses from multiple calls, dispatchers can get a much clearer picture of the incident circumstances.

Accurate Information from Motorists

As described above, motorists who report an incident may not provide accurate location information and may exaggerate incident severity. Motorists may use landmarks to describe the incident location rather than roadway identifiers. Often, directional information is confused as well; motorists will report that an incident is in the eastbound lanes of a roadway that runs north and south. Dispatchers can compare responses from multiple calls to improve the accuracy of the information. Also, installing more frequent roadway identifiers, such as closely spaced mile markers, can help to ensure that motorists more accurately report incident location. Some areas have installed mile markers every one-tenth of a mile. In addition to providing more frequent markers, some areas have included directional and route information on the markers (e.g., northbound I-5 at milepost 45.3).

Automated Detection vs. Cellular Call-In in Urban Areas

One might think that the increased use of cellular telephones has all but eliminated the need for automated detection technologies (i.e., electronic loops, acoustic detectors) in urban areas. However, a public survey of cellular phone owners in Seattle, Washington indicated that nearly 40 percent never report an accident or incident that they are not involved in. Only 18 percent report that they always report incidents (Nee, et al. 1996). This information implies a need for alternative incident detection tools or strategies although areas such as Chicago, Illinois report higher call-in rates. Automated detection technologies also provide more information than just the occurrence of an incident (i.e., reporting traffic conditions during periods of routine congestion). Motorists seldom call in to report expected or routine congestion. In addition, the information motorists provide may not be accurate. Automated detection methods may show better promise of accurately identifying incident location, although improvements in incident detection algorithms are necessary (currently, incident detection algorithms have difficulty distinguishing an incident from routine congestion without additional technologies such as CCTV).

Motorist Aid Call Boxes as a Safety Concern?

Motorist aid call boxes are communications devices that are permanently installed along the roadway. Typically, call boxes are installed at bridge or tunnel locations where incident impacts are large or at other high incident areas. Call boxes have also been located near more remote interstate interchanges where other communications services (e.g., pay phones) are limited. While call boxes can be a big source of information, call boxes require motorists involved in or observing an incident to exit their vehicle and walk some distance to use the box. This action may cause conflict in that pedestrian travel is illegal on many limited access roadways. In addition, pedestrian travel has been proven to be unsafe on limited access roadways. As reported by the AAA Foundation for Traffic Safety, many of the pedestrian-involved fatalities on interstate highways resulted from actions that would be required for a motorist to use a call box (i.e., crossing the road, walking along the shoulder, standing near a vehicle or getting in or out of a vehicle) (1997). These potential safety concerns should be addressed in any motorist aid call box system design.

Tools/Strategies for Improving Detection/Verification

A number of tools or strategies can be used, and are currently being used around the country, to improve detection and verification. Many of these are listed below.

Non-technical Tools/Strategies

- Dedicated Roving Patrols
- Cooperative Partnerships with Fleet Operations
- Fixed Observers
- Aerial Surveillance
- Supplemental Signing for Location Identification

Technology-Based Tools/Strategies

- Cellular Phone Reporting
- Dedicated Incident Phone Lines
- CB Radio Reporting
- Motorist Aid Call Boxes
- Electronic Loop Detectors
- Closed-Circuit Television (CCTV)
- Video Image Processing (VIP)

Emerging Technologies

- Automated Collision Notification and Automated Vehicle Location Systems (Mayday)
- Smart Call Boxes
- Portable Detection and Surveillance Systems
- Automatic Cargo Identification (ACI)

- Automatic Vehicle Identification (AVI)
- Cellular Geolocation
- Microwave Radar Detectors
- Pulsed-Doppler Ultrasonic Detectors
- Acoustic Detectors
- Infrared Detectors

Each of these tools or strategies is described more fully below.

Non-technical Tools/Strategies

Dedicated Roving Patrols

Dedicated roving patrols are useful in not only detecting and verifying incidents but also in immediately responding to and clearing minor incidents (e.g., disabled or abandoned vehicles). Roving patrols can be publicly operated by transportation or police departments or can be privately operated. Vehicles used for dedicated roving patrols are most often vans or small pickups, but they range from motorcycles to heavy-duty large trucks. Roving patrols can operate 24 hours a day or only in the peak period. Dedicated roving patrols have been very popular in areas across the country largely because of the flexibility in services offered, hours of operation, cost, and other considerations. For a full description of dedicated roving patrols as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included at the back of this notebook (see Dedicated Freeway/Service Patrols and Peak Period Motorcycle Patrols). Supplemental information related to specific dedicated roving patrol programs from around the country in included in the Further Reading section at the end of this module.

Cooperative Partnerships with Fleet Operations

To further increase the number of "eyes" on the road watching for incidents, fleet operators can be used as an incident detection tool. Fleet vehicles include publicly owned vehicle fleets (e.g., maintenance, utility, postal, transit) or privately owned vehicle fleets (e.g., truck, taxi, transit). Ties with fleet operators may improve incident detection efforts, as well as provide other traffic information, because these vehicles are already equipped with radios and already on the road. Incidents can be reported quickly, given the substantial number of fleet vehicles and wide geographic spread. For a further description of ties with fleet operations, specifically transit and taxi vehicles, as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included at the back of this notebook (see Ties with Transit/Taxi Companies).

Fixed Observers

The use of fixed observers is not recommended as a long-term incident detection and verification tool. Fixed observer programs are labor intensive, can be costly if not volunteer, and have a limited range of coverage. Fixed observer programs are often used during special events or construction when an incident could have large impacts. For example, Baltimore, Maryland (1990 population 736,014), uses an observer located high in an office building overlooking Baltimore's Inner Harbor to provide detection, verification, communications, and coordination functions for incidents in downtown Baltimore when the Orioles are playing at Camden Yards. Fixed observers were also used to detect and report incidents and disabled vehicles during the reconstruction of Highway 401 in Toronto. For a full description of fixed observers as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included at the back of this notebook (see Volunteer Watch).

Aerial Surveillance

Aerial surveillance, if performed by the media and other private traffic reporting services, is beneficial for detecting and verifying incidents, as well as reporting traffic conditions to the motoring public. In most major urban areas, the media and other private traffic reporting services often have planes or helicopters in the air, especially during peak traffic periods. Aerial surveillance may also be provided by public agencies; however, the cost of owning and operating the equipment is often prohibitive. Aerial surveillance is limited by poor weather conditions. For a full description of aerial surveillance as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included at the back of this notebook (see Aircraft Patrol).

Supplemental Signing for Location Identification

Supplemental signing can help reporting motorists to accurately identify an incident's location. Street signs on overpasses provide location information to motorists. Closely spaced mile markers are another strategy to ensure that motorists more accurately report incident location. Rather than spacing the mile-markers at mile intervals, some areas have installed tenth-mile markers. Motorists who report an incident will likely be able to see a marker from the reporting location if they are this closely spaced. In addition to providing more frequent markers, some areas have included directional and route information on the markers (e.g., northbound I-5 at milepost 45.3). For a full description of closely spaced mile markers as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included at the back of this notebook.

Technology-Based Tools/Strategies

Cellular Phone Reporting

By far, the most common device motorists use to report incidents is the cellular telephone.

Cellular phone reporting receives favorable reaction from the public. Other benefits have been realized, including the reporting of malfunctioning traffic signals, debris in the roadway, and other incident causing conditions. Cellular detection is most effective during peak periods when coverage is highest. Detection is usually quick, within a minute or two after the occurrence of an incident.

Some problems have been noted with cellular reporting systems. Because they are mobile, cellular 911 calls may actually be routed to a jurisdiction other than the one where the incident is, potentially complicating the response process. In addition, when a major incident occurs, cellular systems may become saturated with too many calls.

For a full description of cellular telephone reporting as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included at the back of this notebook.

<u>Dedicated Incident Phone Lines</u>

Dedicated incident phone lines consist of a special telephone line that allows the public to call one number to elicit incident or emergency response. With a good initial publicity effort and continued cooperation with media agencies, motorists are less confused about who to report incidents to. Incident phone lines can be established for standard or cellular telephone use. Incident phone lines alleviate some of the burden on 911 dispatchers. Calls are usually free. In some areas, local media have established toll-free cellular numbers to report incidents.

Motorists in the Chicago, Illinois (1990 population 2,783,726), area call *999 to report incidents. The Pennsylvania Turnpike Commission's *11 incident phone line is another example of free emergency cellular telephone service. Anyone with a cellular telephone can call *11 to report incidents directly to the Commission's Communications Center. The cost is free to motorists; the cellular telephone companies and the Commission cover the expense of the service. The average number of monthly cellular *11 calls is around 1,100.

For a full description of incident phone lines as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included at the back of this notebook.

<u>CB Radio Reporting</u>

CB radio reporting has decreased in popularity with the increased use of cellular telephones. Many truckers still use CB radios, and some police agencies still monitor CB radio calls. To ensure that this resource is used to its full potential, CB radio operators must be educated about the correct procedures for incident reporting, including the types of situations to report and how to report incident type, location, and direction. Roadside signs are also required to remind motorists of the dedicated CB radio frequency.

For a full description of CB radio reporting as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included at the back of this notebook.

Motorist Aid Call Boxes

Motorist aid call boxes are permanently mounted roadside communications devices that allow motorists to request assistance or report an incident. Early call boxes provided only one-way communication; the motorist would push a button to summon help. With this type of device, the motorist had no verification that the call had been received. In addition, maintenance was high on the early call boxes, and they quickly became regarded as an unreliable mean of detection. Many improvements have been incorporated into the new call box systems. New call box systems typically have two-way voice communication that allows the person reporting to relay additional information about the incident or circumstances. Many are solar powered. Disadvantages to call box systems include the following:

- motorists must exit their vehicles and walk to use the call box, exposing them to passing traffic

- because incident location is unpredictable, call boxes are not always available where the incident occurs

- highly visible signing is required to ensure motorist awareness of the system

- some motorists don't understand that they are for public use

Before a call box system is implemented, issues of spacing, location, and safety of access should be considered. Further information regarding call box system design and operation can be found in the "CHP/CalTrans Call Box and Motorist Aid Guidelines" available through the California Highway Patrol or California Department of Transportation (1992). For a full description of motorist aid call boxes as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included at the back of this notebook.

Electronic Loop Detectors

Electronic or inductive loop detectors are by far the most common method of detecting vehicles and sensing incidents automatically. These loops rely on detecting changes in vehicle speed as the vehicles pass over successive loops embedded in the roadway. The loop information (i.e., speed, occupancy) is interpreted by detection algorithms (software) to pick up patterns which are indicative of incidents. Electronic loop detectors do not provide a means for verification. The accuracy of incident detection using electronic loops is limited at both low and high traffic volumes. The cost of electronic loop detectors continues to decrease. Average costs of the major system components are given below.

- Loop with amplifier (purchase and installation) - $700 per loop
- Controllers - $2500 per unit
- Controller Cabinet - $5,000 per unit
- Fiber optic cable (purchase and installation) - $300,000 per mile (California PATH Program 1996)

Loop failure rates vary significantly across the country, ranging anywhere from 3 to 15 percent per year (California PATH Program 1996).

For a full description of electronic loop detectors as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included at the back of this notebook.

Closed-Circuit Television (CCTV)

Closed-circuit television cameras provide the "eyes" for "blind" electronic surveillance systems. Whereas electronic loop detectors (described above) provide detection capabilities but no verification, CCTV provides verification capabilities but is not terribly useful for incident detection. Experience has shown that manual monitoring of CCTV images leads to a "blank stare" at the monitor; even if an incident is visible on the screen, the viewer may not register it. The two are best used in combination. Improvements in picture quality, pan and zoom capabilities, and video data transmission rates make CCTV a very useful incident verification tool. For a full description of closed-circuit television as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included at the back of this notebook.

Video Image Processing (VIP)

Video image processing (VIP) employs machine vision technology to analyze traffic data collected with CCTV. VIP greatly enhances the detection capabilities of CCTV. Several video detection technologies are offered internationally (i.e., AID System, AUTOSCOPE, IMPACTS, INVAID) that automatically detect incidents from video pictures. VIP can monitor several lanes with one camera. Environmental conditions can affect the success of VIP for incident detection.

VIP's initial costs are high; including an existing transmission link, a camera, mast, and processing equipment, the cost is approximately $30,000 (California PATH Program 1996). However, its cost is predicted to decrease dramatically as the technology is refined and more systems are deployed. Additionally, it is estimated that for highly congested sites, VIP systems will save $98,000 per km per year in terms of safer driving conditions and reduced vehicle delay (California PATH Program 1996).

For a full description of video image processing as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included at the back of this notebook.

Emerging Technologies

Automated Collision Notification and Automated Vehicle Location Systems (Mayday)

Automated collision notification and automated vehicle location systems, often referred to as Mayday systems, serve (1) to improve detection of incidents in remote areas through either the automatic or motorist-initiated activation of an alarm and (2) to improve the verification of a vehicle's location through the automatic transmission of location data. The more popular position location technologies include global positioning systems (GPS) and cellular geolocation techniques that rely on the time difference of cellular signal arrival and the angle of arrival.

Several operational tests are currently under way to evaluate Mayday systems. The Colorado Mayday System in North -Central Colorado will evaluate the use of GPS for vehicle location and the use of cellular phone for two-way communications to provide emergency and non-emergency assistance to travelers operating in an area of over 12,000 square miles. The Puget Sound Help Me (PuSHME) Mayday System in Seattle, Washington, will evaluate two devices equipped with special features: a two-way pager and a cellular telephone. There are different levels of assistance requests such as emergency, mechanical failure, accident, and request for directions. Once activated, the emergency notification devices will automatically transmit vehicle location using a Differential Global Positioning System signal to a 9-1-1 dispatch center, where an electronic map will be able to identify the vehicle's location within 30 feet. Projects tasks include (1) human factors and institutional assessment, (2) controlled field testing, (3) user group deployment, and (4) evaluation. The project will determine whether the Mayday system is more effective than the use of cellular phones and the 911 system.

The emergency Mayday system for rural and urban areas (NCHRP ITS-IDEA Project 32) is developing a Mayday system to provide complete nationwide emergency coverage. The study phase is being performed in Illinois. The Mayday system will be integrated with GPS, cellular radio, and high frequency radio for capability in urban and rural conditions. The regional station is expected to receive the GPS information, then route the information via phone lines to a local service center such as a county police/fire unit. The message will have a warning priority; the highest priority would be a crash, an intermediate priority could be vehicle failure according to an engine sensor, and low priority could be a test signal. A unique vehicle identifier (i.e., license plate number and state) will also be sent in the message.

Smart Call Boxes

An operational test, Smart Call Box, in San Diego, California, is investigating the feasibility of using call boxes as surrogate roadside controllers. Specifically, the project will test the feasibility of using the Smart Call Boxes to collect traffic counts, flows, and speeds for incident detection; report information from roadside weather information systems; control changeable message signs; and control roadside closed-circuit television cameras. Future applications may include traveler information systems, automatic vehicle location technologies, weigh-in-motion technologies, vehicle speed measurements, and vehicle emissions testing.

Portable Detection and Surveillance Systems

An operational test, Mobile Communications Systems, in Orange County, California, will test and evaluate the use of a portable detection and surveillance system for highway construction, special events, and incident locations. Specially equipped trailers will be placed at temporary traffic congestion locations. In essence, this technology will replace the need for manual fixed observers for incident detection.

Automatic Cargo Identification (ACI)

In the event of a truck-related incident involving hazardous materials, Automatic cargo identification (ACI) provides a safeguard if the vehicle's placard is not visible, the driver's manifest is not obtainable, or the first responder to the scene is not trained to identify the cargo. ACI systems rely on uniquely "tagging" (usually electronically with a transponder) a cargo load with an identification number. Roadside readers and a computer processing system recognize and record the tagged cargo load as the vehicle passes. Should an incident occur, these records can be reviewed to determine the potential danger. This vehicle- or trailer-mounted tag, and related identification number can be used to access more detailed information about the cargo from a computer database.

For a full description of automatic cargo identification as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included at the back of this notebook.

Automatic Vehicle Identification (AVI)

Automatic vehicle identification (AVI) systems rely on uniquely identified vehicles (usually equipped with an electronic tag or transponder) in the traffic stream, roadside readers, and a computer processing system. "Tagged" vehicles pass subsequent roadside readers. By knowing the spacing of the readers, the "tagged" vehicles' speeds can be determined (i.e., how long does it take a vehicle to reach the second reader after having passed the first?). If vehicle speeds fall below a certain threshold value during regularly uncongested traffic times, an incident may have occurred. An operational test, TRANSMIT, in Rockland and Bergen Counties, New Jersey, is evaluating the use of automatic vehicle identification (AVI) technology as an incident detection tool. The system consists of AVI "tag" readers that allow vehicles equipped with transponders to serve as traffic probes. Incidents are detected by comparing actual to predicted travel times between the AVI readers.

For a full description of automatic vehicle identification as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included at the back of this notebook.

Cellular Geolocation

Cellular geolocation technologies in essence track the transmission of cellular signals. Cellular geolocation relies on cellular signals sent from cellular devices to a series of cellular towers. By considering the times for signal arrival and the angle of signal arrival to at least two towers, triangulation methods can be used to determine vehicle location. Although these location data are useful for verifying the location of an incident, they can also be useful for detecting incidents if the vehicle location process is repeated and the predicted vehicle speed between two areas does not match the actual speed. In the Washington, D.C., metropolitan area, an operational test, CAPITAL, is under way. This test makes extensive use of the existing cellular infrastructure for both area-wide surveillance and communications to determine the accuracy of geolocation data; the accuracy and completeness of traffic information; the usefulness of passive statistical processing for measuring volume and incidents; the criteria for selecting roadways that can be monitored by these techniques; the systems' capabilities; costs for deployment; public acceptance; and the usefulness of information dissemination to fleet vehicles.

For a full description of cellular geolocation as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included at the back of this notebook (see Cellular Telephone Monitoring).

Microwave Radar Detectors

Microwave radar detectors transmit electromagnetic energy at the speed of light. Measurement of when the transmitted light wave is interrupted by a passing vehicle at two different locations indicates the speed of the vehicle. Microwave radar detectors have proven excellent at accurately determining vehicle speeds. Additionally, this technology is insensitive to changing weather conditions and lighting conditions. As part of the Connecticut Freeway Advanced Traffic Management System, in Hartford, Connecticut (1990 population 139,739), the use of roadside mounted radar detectors, in combination with closed-circuit television (CCTV), for incident detection and verification was evaluated.

For a full description of microwave radar detectors as an incident management strategy, refer to the "Vehicle Detection Technologies" document included in the Further Reading section of this module (California PATH Program 1996).

Pulsed-Doppler Ultrasonic Detectors

Ultrasonic detectors, particularly pulsed-Doppler ultrasonic detectors, work similarly to microwave radar, only inaudible sound waves are emitted rather than light waves. Measurement of when the transmitted sound wave is interrupted by a passing vehicle at two different locations indicates the speed of the vehicle. The success of measuring vehicle speeds is only fair. Additionally, this technology is sensitive to changing weather conditions and has a smaller range than microwave radar. For a full description of ultrasonic detectors as an incident management strategy, refer to the "Vehicle Detection Technologies" document included in the Further Reading section of this module (California PATH Program 1996).

Acoustic Detectors

Acoustic detectors do not rely on emitting sound waves but instead use a series of mounted microphones to measure the sound waves produced by vehicles in the traffic stream. The times by which the sound reaches the various microphones indicate vehicle speeds. Acoustic detectors have difficulty in distinguishing the sound of multiple vehicles; vehicle speed estimation is fair. AutoAlert, an automated acoustic detection of traffic incidents, is one of the NCHRP ITS-IDEA projects being developed and tested for traffic and travel management. The AutoAlert system provides direct incident detection by capturing the dynamic characteristics of the time-varying acoustic pattern.

For a full description of acoustic detectors as an incident management strategy, refer to the "Vehicle Detection Technologies" document included in the Further Reading section of this module (California PATH Program 1996).

Infrared Detectors

Both active and passive infrared detectors are capable of measuring vehicle speeds and consequently, detecting incidents. Active infrared detectors operate similarly to microwave radar detectors but emit high frequency waves. Passive infrared detectors operate more similarly to acoustic detectors in that they do not emit energy but rather measure the energy emitted by the vehicles. Active infrared detectors are more successful at measuring vehicle speeds than passive infrared detectors.

For a full description of infrared detectors as an incident management strategy, refer to the "Vehicle Detection Technologies" document included in the Further Reading section of this module (California PATH Program 1996).

National Examples

Dedicated Incident Phone Lines in Oregon

The Oregon Department of Transportation is taking advantage of the increased popularity of cellular telephone usage by initiating a cellular telephone number dedicated to incident detection. Portland, Oregon, area motorists are instructed to call *77 if they encounter problems during their travel. Not leaving public education to chance, motorists are instructed to call

- if they see an accident or come upon one
- if they are or see a stranded motorist
- if they see a car blocking a lane
- if they see an abandoned vehicle.

Motorists are discouraged from calling *77 to report anything that is not an immediate transportation-related problem.

Cooperative Partnerships with Fleet Operations in Pennsylvania

A cooperative program of the Pennsylvania Turnpike Commission, Pennsylvania State Police, and Yellow Freight Systems, Inc., has helped to improve incident detection and overall safety along the Pennsylvania Turnpike. The program, entitled "Pike Watch," allows participating freight drivers to notify the Commission's Communications Center, State Police patrols, or Commission maintenance facilities directly via CB radio. Freight drivers report erratic or reckless drivers, accidents, disabled vehicles, and other emergency situations. The success of the "Pike Watch" program has resulted in the implementation of similar programs across Pennsylvania.

Aerial Surveillance in Delaware and Virginia

The Delaware Department of Transportation (DelDOT) and the Virginia Department of Transportation (VDOT) have undertaken a joint project to evaluate the use of DelDOT's Observation Balloon System (OBS) for incident detection and verification during special events. DelDOT provided the balloon, camera, command center, and two employees. VDOT provided six employees to assist with the launch and retrieval of the balloon. The OBS consists of a gyro-stabilized TV camera and mooring and communication cables. The camera, operated remotely with a joystick, has zoom capabilities. Despite problems with the camera gyroscope, initial response to the OBS was positive. "This is exactly what we hoped it would be," said a police spokesman.

Further Reading

"Calitri, Steven. "The dispatcher — taking command." American Towman, 1996.

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James, Robert B., and Anwani Hannan. "Summary of ongoing Mayday operational tests and Mayday related products." 1996 Rural Intelligent Transportation Systems Conference Proceedings.

"Incident Management News." SIM Committee Publication. Fall 1996.

SOURCE: American Towman 1996
Steven Calitri

THE DISPATCHER--TAKING COMMAND

The Dispatcher (with a capital D) is the command center of an emergency road service operation. His or her ability to be "in-command" is crucial to a towing company's success. Specifically, the Dispatcher's handling of the motorist will influence:

1. Whether or not your company services the call
2. The smoothness and efficiency of servicing the call
3. Whether the motorist ever becomes a "repeat" customer
4. Whether the motorist spreads the good word or the bad word to his friends and acquaintances about your quality of service.
5. Whether or not you keep a commercial account or even perhaps win a new account.

Wow! That's pretty crucial stuff, isn't it. Sure, how shiny and safe is your equipment and how professional are your drivers is important; but the finest of armies have been led into the valley of annihilation by an imprudent general. So how does your Dispatcher keep your company on a winning track?

Good performance in anything must have a foundation of understanding one's role. The Dispatcher and the company "Boss" comprehend the responsibility and value of dispatching. And we must start with the basics.

There are four people who "could" be in command of any given call: the motorist, the dispatcher, the driver, and no one. As you can imagine or may have experienced, havoc can reign if someone else other than the dispatcher is "in-command" of the call. But why is this? The Dispatcher is the only one who has a full perspective on all information pertaining to the call. The Dispatcher has spoken to the motorist and the driver. The Dispatcher knows the motorist's priorities and the tow company's as well: he knows the availability of trucks and works with a map of the area. While all this is obvious to you, consider how little it takes for the Dispatcher to lose control of a call, or never gain control in the first place:

Caller: Hey, I'm broke down on first and Market; how long will take to get a tow truck out here?

Dispatcher: 45 minutes.

Caller: I'll call you back (click).

Or

Caller: Hey, I'm broke down here on First and Main, how much to tow to Market and 40th?

Dispatcher: That"ll be about $50.

Caller: Alright, I'll call back (click).

Who's in control of these two calls? The caller. That's right, the one who knows all about emergency road service and what he faces in obtaining timely, professional service. Yep. On those calls, the motorist knew a lot about his situation and the Dispatcher knew nothing. The caller was the one asking the questions and the Dispatcher only gave answers. The caller immediately put himself in charge and the Dispatcher went along with it and both times lost the call.

In dealing with the caller, the Dispatcher must take control immediately. It may mean politely, thought firmly, brushing aside a caller's initial questions. But--this is exactly what must be done to establish control so that it is the dispatcher asking the questions, such as; "Sir, what is your name?" "First of all, ma'm, are you okay?" "Sir, where is the vehicle and where are you?" "Do you have passengers?" "Where is the vehicle?" "Sir, what is the year, make, and model of your car?" The one asking the questions has control of the call. He leads the conversation. He gathers critical information that will further allow him to control the call. Let's look at a key example of information gathering and how it helps keep the Dispatcher in control.

Dispatcher: Sir, do you have an appointment to get to?

Caller: Yes! I have a 3 o'clock appointment and it's imperative I make it; an account is riding on this meeting.

A moment later, after hearing the tow rate, the caller says he will call back. But: because the Dispatcher has a key bit of information, he takes a good shot at keeping the call and the business.

Dispatcher: Joe, when you're calling around, keep in mind that we have a vehicle with a trained tow operator who is available to service you now. You don't know what else you'll find out there as far as availability and reliability, and I don't know if we'll have this truck available for you when you call me back. Remember, you have a critical meeting to get to and you can't afford to lose any time here. Would you like me to sent my man out to you?

Well, as you can see, the Dispatcher has maintained control of the call and has a good chance of getting this customer's business. In a real scene, under these exact circumstances, the caller's final decision will depend on his personality and the personality of the Dispatcher (how friendly and persuasive he or she is). Some people at this point are going to say no, I'll call you back, but some--maybe most--are going to say "yes, I guess I better have you send me out your truck." But the point is, the call wouldn't have gotten this far if the Dispatcher did not take control.

Now let's look at the interaction between Dispatcher and the Tow Operator. Similar dynamics apply. The dispatcher needs complete information and must be in control of the conversation to properly dispatch the call.

Dispatcher: I've got someone broke down on First and Market.

Tow Operator: Okay, I'll get to him, over."

First of all, that "someone" is the businessman who has an important meeting to make, but because the Dispatcher wasn't in control of the call, there is no knowledge of this. Secondly, the Dispatcher doesn't know when the Tow Operator plans to service this call, or when he is capable of doing so. The Dispatcher simply threw the task into the Top Operator's lap, and gave him total control by not requesting any further information. What might happen? The motorist is finally serviced, but misses his appointment. In fact, he had no idea when to expect the driver to show up. So he ended up calling another company to do the job.

First and always, the Dispatcher must take command of all communication.

SOURCE: **1991 ITE Compendium of Technical Papers**
Charles H. McLean, P.E.

CELLULAR PHONES - A KEY TRAFFIC MANAGEMENT COMPONENT

Introduction

In August 1989, the Illinois Department of Transportation (IDOT) initiated a new communications link with Chicago Area motorists. Using the slogan "You are never alone on the expressway" this service allowed motorists with cellular telephones a method of obtaining assistance for other drivers or themselves while traveling on urban expressways. With area cellular phone ownership, over 200,000 and growing, IDOT decided to ask these users to help monitor the expressways. This would augment the Traffic Systems Center surveillance loop detectors which cover over 100 expressway miles as well as the Emergency Traffic Patrol (Minutemen) patrols which function to keep traffic moving, improve motorist safety and provide timely expressway traffic condition information.

Through an IDOT contract with Ameritech and Cellular One, the two Chicago Area cellular service providers agreed to provide free calls for cellular phone users to report observed expressway problems. By dialing *999, the calls were routed to the IDOT operated dispatch center where calls were received and the appropriate service agencies notified. A close communication link was maintained with IDOT's continuously manned District Communications Center. In the six county area covered by the *999 services, there are approximately 7 million people and 250 municipalities.

Initial *999 Program

Our specific *999 program objectives were:

- Minimize congestion and secondary accidents through rapid detection of disabled vehicles, accidents and road hazards.

- Reduce possibility of injury to motorists waiting at their disabled vehicle by quickly detecting their presence and relocating them to reduce their exposure to expressway traffic.

- Evolve the *999 service into a single IDOT sponsored center that would give the motoring public one place to call to report road hazards.

- Improve the motorists sense of security while establishing IDOT as being competent and caring.

Initial findings after the first few months of operation were:

- Though concerned that the public would perceive this project as a personal service to cellular phone owners, IDOT found that over 95% of the calls were the "good Samaritan" type, where callers reported incidents involving others.

- The immediacy of the *999 reporting system was clearly demonstrated in numerous major incidents where IDOT's first notification of a highway problem came from this reporting source.

- While the service attempted to limit calls to the IDOT and Tollway expressway system, cellular users expanded their reporting surveillance to the adjacent arterial highways. Many calls received were relayed to municipal and county enforcement agencies for follow-up action.

- An unexpected benefit from this service was the number of reports on traffic signal malfunctions; debris in roadway; vehicle losing load; and live animal in roadway incidents which could have had accident .. consequences.

- Encouraged by the free cellular phone link to government agencies, users displayed a traffic safety responsibility by making calls regarding suspected "driving under the influence" observations, which led to arrests when the other motorists could be apprehended. There were also "fight in progress" and "crime in progress" incidents reported.

- Both cellular phone companies were pleased with the results of the initial *999 Program and offered few requests for changes in the call handling procedures.

- There was a favorable reaction from the media regarding the benefits of the program.

- The publicity campaign comprised of expressway signing, cellular phone company billing notices and video/radio advertising quickly generated cellular caller response.

1990 Experience

During 1990, 115,845 cellular calls were received in the *999 Dispatch Center. Approximately 67% of all incoming calls were "original" calls while 21% were duplicate calls providing information received from previous callers. Incomplete transmissions, information requests, non-incident or road reports comprised the remaining 12% of the 12 month total.

A breakdown of the 1990 original calls is:

Type	Calls
Disabled Vehicles	33,224
Traffic Accidents	21,435
Ambulance Requests	1,470
Possible DUI	4,012
Reckless Driver	3,097
Road Hazard	2,875
Vehicle 'Fire	1,205
Fire, Not Vehicle	382
Pedestrian On Road	950
Live Animal	372
Animal Carcass	289
Crime in Progress	374
Hit and Run	280
Signal or Lighting Malfunction	1,662
Miscellaneous	6,077

A review of November 1990 incident calls dispatched to various agencies shows the following:

Agency	Percent of Calls Dispatched
I.D.O.T.	26%
Illinois State Police	22%
Illinois Tollway Police	18%
City of Chicago Agencies	11%
Counties and Municipalities	23%

Of special concern when establishing the *999 Program was the assumption of responsibility by IDOT for incident and accident notification to non-State agencies. The magnitude of outgoing dispatch center calls to affected agencies could only be estimated until the service was started in 1989. The 1990 experience reflects 81,162 outgoing dispatcher calls based on a total of 115,845 incoming calls.

The type of accident or incident determines the number of dispatcher calls generated by one incoming cellular call. For example, an-injury accident on a Chicago Expressway could result in a call to the Chicago Fire Department for ambulance response, one call to the Illinois State Police for enforcement presence and a call to the Emergency Traffic Patrol for vehicle relocation.

Dispatcher Procedures

The diversity in call type and the required dispatch action necessitated a high level of dispatcher training. Dispatchers were trained to be positive, cheerful and have an "I want to help" attitude. Since over 95% of all incoming calls were not from the involved motorist, but rather from the '*good Samaritans**, emphasis was placed on polite and efficient treatment so the caller was not discouraged in making future calls.

Due to the specific contractual obligations with the cellular service providers, no request for identification of the caller, including name, cellular number, home/office telephone number or cellular system may be made by the dispatcher.

While this is a deviation from conventional public safety practice, no significant consequences have yet been experienced as a result of the inability to call back the initial caller. If a crime is in progress or if in the judgement of the dispatcher, personal information will be needed by the police, the dispatcher has the ability to channel the incoming call directly to the proper agency via a "3-way call".

Dispatchers never tell a caller that they "already have that incident". Rather *999 dispatchers quickly extract the necessary information, taking control of the conversation and advising the caller "we will notify the authorities" as they conclude the conversation.

A *999 dispatcher never commits any services or equipment to a caller. The caller is informed that "we will notify the authorities". In the case of a caller who requests traffic information they are told "I am sorry I do not have that information available".

Future

The *999 reporting element has been successfully added to IDOT's Traffic Management Program in the Chicago Area. This unique management program blends advanced technology applications with basic operational strategies to help maintain urban and suburban mobility. Expressway traffic surveillance and control with 1800 detector locations and 95 ramp controls, 12 changeable message signs, 7 Highway Advisory Radio stations for roadside broadcasting and roving Emergency Traffic Patrol trucks are major components in the comprehensive effort to get better service from the existing highway system.

With a continuing expected growth in the use of cellular phones and the planned cellular industry expansion to serve broadening geographic areas, this link with the motorist should continue to be enhanced.

SOURCE: ITS International, 1996

Loops Live on Despite Niche for Video Imaging

A team from the University of Florida Transportation Research Center (UFTRC) that A recently tested video imaging systems available in the US sees them as a niche product which cannot be justified at present as a general replacement for in-road inductive loops.

Most traffic signals in the US Currently use loops to register the presence of vehicles on less heavily used approaches and advance the timing of the green signal.

Despite suggestions over several years that loops are obsolete, most US highway departments continue to use and install them. Replacement by video imaging has happened on a minuscule scale.

Video Image Detection for Traffic Surveillance and Control, by Ken Courage, M Doctor, S Mafulla and R Surapaneni, reports that the cost of video-imaging detectors (VIDs) has come down to one-third of their original price when introduced seven or eight years ago, but that they remain substantially more expensive to buy and install than loops. VID advocates counter that loops break down more frequently and are more expensive to maintain.

Team leader Courage admits that he is unable to resolve the issue. "Experience with loops seems to be extremely varied", he says. "Some agencies tell you that they don't last any time at all, while others say they give many years of reliable service. I suspect the reason is partly a function of the environment into which they are inserted and how well they have been installed".

Most highways agencies and cities, he says, are familiar with loops and are therefore comfortable sending their own salaried crews out to install them. With video imagers, however, they often have the manufacturer install them, accentuating the perceived cost premium.

The major conclusion of the UFTRC report is that: "It is difficult to recommend that state agencies such as the Florida Department of Transportation should immediately embark on an aggressive programme to replace ground-based detectors with video-imaging detectors. There is still a good chance, however, that reduced costs of VID systems - combined with their ability to deliver more intelligent information to a traffic management system - will give them a significant advantage at some point in the future".

The niche markets Courage sees for VIDs are:

- for use with traffic-actuated signals at intersections undergoing major repair or reconstruction, where the loops cannot be maintained operationally; and

- for intersections covered by traffic management centres, where the incremental cost of video is small.

At intersections undergoing reconstruction, loops are usually abandoned, and the choice is then to put the signals on fixed timing or to install video to maintain a system which is responsive to traffic flows. Cost-benefit studies, says Courage, then show the benefits of video running at ten times costs.

The study points out that current signal controllers have been developed around the capabilities and limitations of loops as single-point presence detectors and that VIDs will come into their own once smarter controllers with smarter signal control strategies are fully developed. "There exists both a strategic and a tactical role for VID systems in the next generation of traffic controllers", says Courage.

"The strategic role is built on their ability to cover a wider area, to change detection locations dynamically in response to traffic conditions, and to support the use of new measures such as queue length. The tactical role is built on their ability to extend the sensing capabilities of conventional point detectors within current strategies."

The 'dilemma zone', when a motorist seeing a yellow (amber) light has to decide whether to hit the brake or the accelerator, offers VID manufacturers substantial possibilities if they can show safety benefits. Courage points out that the worst crashes at signalized intersections occur when a motorist miscalculates and intrudes into the 'green phase' of crossing traffic; VID offers the possibility of detecting the intruder and extending the all-red phase.

Two problems remain: first, that motorists may gradually take more liberties in the yellow (amber) phase and keep extending the all-red phase; and second, the lack of proof that VID will work in all weather conditions. Courage was present in a Florida traffic management centre when torrential downpours completely closed out' video detection.

He notes that VIDs work on the infra-red side of visible light, and so are less vulnerable to rain and fog than pure video. But the issue remains as to whether VID is good enough in heavy rain to be relied on for dilemma zone avoidance control.

SOURCE: Traffic Technology International, Oct./Nov. 1996
Mike Juha, Odetics, USA

Succeeding with Video Detection

Video detection is a new technology offered as a cost-effective alternative to existing detectors in the ITS market. Sensing opportunity, many vendors have rushed in and are offering video detection products. Sensing risk and fearing liability, transportation agencies are asking: Does it work? This article discusses the little-known secrets that are the keys to success with this new technology

Let's look at the basic concept of vehicle detection. Actuated intersections need vehicle detectors to show where the traffic is, as well as how much traffic is present. Traditional vehicle detectors are wire loops in the roadway that sense a change in self-inductance whenever a vehicle is above the loop.

Inductive loop detectors, as these devices are called, work quite well in all kinds of weather and for all kinds of vehicles. Inductive loop detection accuracies have been measured at or above 99 per cent. The only limitation with the inductive loop detector is that it senses metal surface area in proximity to the wire loop, which can result in the detection of truck axles as separate vehicles and possibly missing vehicles with small metallic content.

WHY CHANGE?

Inductive loop detectors are imbedded in the roadway surface. Stresses imposed by heavy traffic deforms roadways, breaking wires. Weather and heavy traffic can lead to pavement failures and detector failures. Construction activity can cut through loop detectors.

Inductive loops work well, but they are entirely dependent upon pavement integrity. While agency budgets continue to tighten, detector usage is increasing in order to achieve more efficient traffic* responsive roadway operations. Agencies that use inductive loop detectors must budget for periodic replacement of failed detectors.

Some of these agencies must defer pavement maintenance to remain within budget, and find themselves installing or replacing detectors in unsatisfactory pavement conditions. Tight budgets and the recurring maintenance cost of inductive loop detectors are mandating agencies to seek lower life-costs, using above ground vehicle detectors.

There are many other detector technologies available, in addition to inductive loop detection. Some examples are: magnetometers, infrared, microwave, acoustic, pressure, piezoelectric, and sonar. There are vehicle detection products available today using all of these technologies.

None of these technologies has moved into contention with inductive loop detectors, largely because we tend to believe what we can see. Our human vision verities events around us and is the primary mechanism we use to learn about the world. We don't see infrared, microwave, acoustic, pressure, piezoelectric, or sonar images - at least, not without a lot of aid from external devices.

DOES IT WORK?

Our eyesight is the primary influence that has helped video vehicle detection advance relative to all other technologies. Only video relates well to our human visual experience. We can verify that video detection works by staring at a video image of traffic and watching the graphics on the screen confirm each detection.

Since we can see the traffic moving at the same time that we see the graphic confirmations of detection, we can believe that video vehicle detection works.

Vendors do not give a demonstration that makes their product look marginal. All vendors demonstrate their product in the best light and rarely, if ever, do demonstrations at night.

Even though a 30 minute evaluation of vendor's video detection may not include it, we expect that video detection will have our same human ability to see vehicles at dusk, at night, and looking into the setting sun. Unfortunately, nothing could be farther from the truth.

EYESIGHT AND VIDEO

The human eye is a superb imaging instrument. We see the world in color through an imaging array that is roughly 2000 pixels high by 3000 pixels wide in each of three colors. Our eyesight allows us to see clearly objects that are 1000 times brighter than the darkest resolvable object in our field of view.

We see this high quality image in bright daylight, as well as on a moonlit night. By comparison, a good quality video detection camera produces a grayscale image with an imaging array that is roughly 500 pixels high by 750 pixels wide. Further, this video camera can image objects that are roughly 100 times brighter than the darkest resolvable object in the field of view.

Affordable video cameras can produce this image in bright daylight, as well as in the muted light of dusk and dawn. Night time imaging requires artificial lighting, or expensive special cameras, for the video image to be useable. Vehicle headlights and/or street lighting must be on, for vehicles to be detectable in the images from affordable video cameras.

The difference in image quality between video and our eyesight is dramatic. While we may see vehicles clearly on a roadway at night, we cannot assume a video camera will see them equally well, or even at all. The driver who leaves work before sunset and proceeds homeward for the next half hour without turning on headlights creates the challenging situation of a vehicle without headlights at night.

While we may see this vehicle with our eyes, the camera often does not, and it is what the camera 'sees' that gets detected.

DO YOU KNOW IT WORKS?

Judging how well video detection works touches on the issue of human vigilance. We are all familiar with the phrase "asleep at the switch". We can watch events vigilantly for just a few minutes. After about 15 minutes, our attention wanes. After 30 minutes, we fail to notice important events occurring in the image.

This is why, after just a 'few minutes every agency user's standard of measurement for video detection evolves to: "Do the signals change in response to the presence if traffic?"

Asking if the signal runs well is a criterion at a site where vehicles arrive intermittently. However, most video detection systems are deployed at busy junctions where lots of detectors are used, such as shown in Figure 1. These intersections are often flooded with traffic, but they are not effective test sites.

Detector operation is not that critical when traffic floods the junction. This is shown in Figure 2. If two video detectors were to fail on this approach, detectors in adjacent lanes would make the call for service for each phase. The intersection would run well, despite awful detector performance.

An observer standing at the junction would not be able to tell that the detection system was missing vehicles. However, isolated vehicles will approach occasionally, and then detection must work well to ensure prompt service to their drivers. If errors continue, the arrival if other vehicles at the busy junction is likely to save the situation.

MEASURING VIDEO DETECTION ACCURACY

The issue is how to measure the accuracy if video detection. Since the standard of comparison is the inductive loop, several test sites were set up, like the one shown in Figure 3. At these sites, the detections registered by inductive loops were compared with those registered by video detectors.

Detections were compared on a vehicle-by-vehicle basis by viewing videotapes. After a few days it became apparent that our engineers' vigilance was insufficient for accurate scoring. To obtain accurate measurements of detector performance over long time periods, we developed the ability to record video with 24 detector inputs encoded digitally in unused lines in the video image.

These same detector inputs are also displayed on the image as a string of Is and Os, as shown in Figure 4.

Encoding detectors in the video let us quickly identify the few seconds or minutes when inductive detectors and video detectors disagreed in the hours or days of recorded video. This expedited our visual review of the video to determine which detector was correct.

When the video detector was in error, the recorded video also allowed our engineers to understand how to improve their detection logic to deal with the conditions that caused failure.

Key to effective detector testing was to use test sites not constantly flooded with vehicles. We selected sites where isolated vehicles approached the stop line. We also required reliable inductive detectors in the roadbed to validate video detection. For statistical significance, we performed this validation process for thousands of vehicles over long periods, spanning multiple days of daylight, dusk, night, and dawn.

Testing to date indicates video detection can approach accuracies comparable to inductive loop detectors. But accurate detection is acutely dependent upon camera location. Not all vehicle detection applications afford adequate camera locations. Some sites require added poles or mast arms to facilitate adequate mounting locations for video cameras. Otherwise, traffic in nearby lanes block the line of sight to distant lanes, causing false detections.

Mounting cameras on a street lighting mast arm, like that shown in Figure 5, can ensure good detection in a video image like that shown in Figure 4.

Mounting on a span-wire pole offset from the edge of the roadway can result in a marginally useful video image. Span wire junctions can be done with video detection, but usually these junctions require the addition if mast arms to mount the cameras over the roadway, as shown in Figure 6.

Just as placement of inductive loops is critical to their performance, so video cameras and video detectors must be placed carefully if video vehicle detection is to perform satisfactorily. The primary cause of poor video detection is unsatisfactory camera placement.

IS IT ACCURATE ENOUGH?

With video detection, like all 'machine vision' applications, the question arises: how accurate is good enough? Inductive loops do not work perfectly, and neither does video detection. Varying lighting conditions and weather at night challenge video cameras to make usable images of vehicles.

Glare from the setting sun reflected off the roadway makes imaging difficult late in the afternoon. Headlights reflected off the roadway, particularly in rain, makes detecting vehicles difficult at night. Vehicles can be detected reliably much of the time under these conditions, but some detector calls may be dropped prematurely. Occasionally, vehicles are missed because the camera is blinded by the sun or reflected headlights.

Surveys of transportation industry personnel indicate that 99 per cent detection accuracy (with no more than 3 per cent false detections when no vehicle is present)is the minimum level of performance for widespread acceptance of video detection. Weather, lighting, vehicle color, lane location, camera lens, and camera mounting location combine to make this level of performance difficult to achieve under all the conditions that prevail on roadways.

Advanced image processing techniques, like vehicle tracking, can make some improvements in detection performance; but there is no miracle technique. The quality of the video image is the critical issue. What the camera 'sees' is what can be detected.

If the vehicle image information is not in the video, no amount of computing power can manufacture that information after the fact.

HOW SUCCESSFUL?

The pioneering agencies that are the present users of video detection have learned to deal with less-than-perfect performance by assigning a minimum green time to each actuated phase. Video detector actuation is used to extend the phase time interval. This ensures each phase gets some minimal green time, regardless of whether or not vehicles are sensed as present.

As a safeguard against prematurely dropped calls, some of these users lock detector calls for protected left turns. While these techniques ensure safe operation, they can reduce the efficiency with which the total cycle time is used to serve traffic demands.

The consensus among transportation industry personnel is that detectors for conflicting movements, like left turns (the USA, like most countries, drives on the right) must work at least as well as inductive detectors. This means their objective is very close to 100 per cent accuracy. It also mandates a substantial improvement in video detection systems that are working at only a 96 or 97 per cent accuracy level today.

The video detection vendors are not the only ones with an obligation. Improvement in accuracy mandates that users invest in engineering each site installation. When users, in their haste to purchase, do not perform adequate site planning beforehand, the compromises made in performance become evident after installation - but only if the user is very thorough in testing performance, as noted above.

Video detection should be used only where unobstructed line of sight to detector locations is available. Video cameras do not look through trees, around curves, or through large trucks traveling in nearby lanes (despite claims to the contrary by sales people).

What the camera 'sees' is all that will be detected. When these caveats are considered in planning an installation, the user obtains a working detection system.

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Compressed Video in Traffic Management: A Cost Effective Approach to Visual Surveillance

Background

The origin of image compression techniques lies in the U.S. Space Program, where video images of distant planets were transmitted over narrow band radio links. Here, narrow band refers to the capacity of the transmission channel to transmit data, and regard for economical use of the channel is critical in many applications. Conversely, wide band data transmission facilities such as fiber optic, coaxial cable, and terrestrial microwave at times do not require as much detailed attention to minimizing data transmitted. To illustrate the data carrying capabilities of narrow versus wide band mediums, a telephone line represented as a pipe 1 inch in diameter would compare to a coaxial cable represented as a pipe 52 inches in diameter.

A video compression project has been ongoing in Dallas for the past four years. Funded by the Dallas District of the Texas Department of Transportation (TxDOT), this study has attempted to implement the latest video compression technologies as they come available as market products. The study was prompted by a previous study on slow scan television conducted by the Texas Transportation Institute in 1985.(1) This study found that slow scan was indeed too slow for useful traffic surveillance. At that time, the Maryland DOT was experimenting with a single camera monochrome compressed video system in Baltimore, as part of a Federal Highway Administration high technology transfer program through the Jet Propulsion Lab and Dalmo Victor. Recently, image compression has become much more prominent and cost effective, with emphasis on image database applications. The data representation of an image requires extensive storage requirements, and compressions is a tine necessity for archiving images in a digital format.

The Dallas study was implemented to explore the feasibility of using a dial-up telephone line to transmit compressed color video images. Acknowledging that such a system would operate at a reduced frame rate, the study sought to find the minimum frame rate acceptable for traffic surveillance and establish deployment costs of an operating system. While much hardware and software is now available for image compression in archival applications, it is only partially applicable to traffic surveillance. New products that permit video image transmission between personal computers are more easily adaptable for traffic monitoring. This includes videophone products. The component of this class of products that is missing however, is the reverse link for camera control. The video compression process as it relates to traffic surveillance will now be described, along with the equipment used in the Dallas study, which is referred to as "first generation" compressed video.

Remote Site Video Compression

The compression process, shown in Figure 1, consists of capturing a snapshot from the live video camera, a process called frame grabbing. The analog image is digitized in 1/30 of a second, and is then in a computer compatible format. The digitized image is then compressed by either a digital signal processor (DSP), by special purpose hardware, or simply by software, and this compressed image is transmitted by high speed modem to the monitoring site.

The decompression process, shown in Figure 2, is essentially the reverse of the compression process. The compressed image received at the decompression computer is passed to a DIP, special purpose hardware, or software, where it is expanded to a full digitized image. This digitized image is then placed in the memory of a display converter where the digital representation is changed to an analog representation, and in turn is displayed on a video monitor. In traffic surveillance, the capture+

compress+transmit+decompress+display process is repeated at a rate wholly governed by the data communication medium.

The video compression system in Dallas utilized a color camera in a weatherproof housing, mounted on a pan/tilt unit. The image captured by the camera was input to a compression computer, an industrial version of an IBM AT-compatible microcomputer. A Texas Microsystems 80386-based 20MHz industrial AT was enclosed in a NEMA 4 weatherproof cabinet with a heat exchanger. The industrial AT also contained the relays needed for controlling camera movement, as well as camera controls such as zoom, iris, focus, etc. A Telebit modem (13,000 bps throughput) connected to a voice grade dial-up telephone line linked the compression computer to an office site. As an alternate communication medium, a Telesystems wireless modem (15,000 bps throughput) was also used to transmit compressed images approximately 1,000 feet to the receiving site.

A Compaq 386 25MHz decompression computer at the office site was similarly configured with a Telebit modem to receive image data and transmit camera movement and control commands. The decompression computer performed the inverse operation of the compression computer and displayed the video image on a monitor. A touch screen was fitted to the computer's graphics display monitor, and served as the interface for controlling the camera as well as the source of various commands for specifying image size, quality and format.

Video Compression Technique

The compress/decompress technique is performed by mathematical transform. The discrete cosine transform (DCT) is presently being used, since it operates in the real number domain, is computationally more efficient, and thus is faster. Emerging standards favor the DCT for speech and still image processing. Other math transforms are available for image compression, as well as other classic image processing techniques. The latter methods, however, tend not to yield compression ratios as high as math transforms. In compressed form, the size of an image must be represented by a data block which represents each color picture element (pixel) as a fraction of a bit. For example, a scene represented by 256 x 200 pixels contains 51,200 elements. Each pixel has three color components: red, green, and blue. Each color may be represented by as few as 5 bits, or as many as 8 bits. Each pixel, in turn, requires as few as 2 or as many as 3 bytes to represent. Thus the captured image requires at least 51,200 x 2 = 102,400 bytes. A compression ratio of 50 will yield a file size of 2,048 bytes, or 0.32 bits per pixel. To achieve 1 second image intervals with the present communication link, a compression ratio near 65 was required. This remarkably high compression ratio does sacrifice image quality, and the tradeoff is quality versus speed.

Operational Experience

Extensive software was developed for the system, not only for image handling but also for touch screen and other operational feature programming. After a long period in the laboratory, a camera was placed on top of a lighting standard to test the configuration in an open environment. Figure 3 depicts the site for this experiment. A two year operational period yielded highly satisfactory results. It was found that a frame rate which allowed individual vehicles to be seen in at least two successive frames was adequate for traffic monitoring. Cabinet temperature was a problem for the computer system, and a thermoelectric cooler was proposed as a solution. However, the installation of a plywood sunshield on three sides of the cabinet lowered the temperature sufficiently to permit year round operation without problems.

Future plans include the construction of a trailer equipped with a portable power plant, telescoping mount for the camera, and a compression computer. This will add a final degree of portability for relatively quick deployment and setup. With the rapid deployment concept, a arises with regard to telephone land line access. Where the conditions permit, a wire cable link will run from the trailer to the edge of the right of way for connection to the commercial telephone network. Anticipating that this ideal situation may not always exist, several wireless alternatives are being investigated for relaying either compressed or uncompressed video signals to a remote site for access to land lines. The first case is when the compression computer is on the trailer and compressed images must be forwarded. Alternatives include the use of spread spectrum radio (unlicensed), optical modems, and satellite uplink. The latter would not use a land line, and instead would downlink compressed images to a central viewing site. The second case is when the compression computer is not on the trailer and uncompressed images must be relayed to a roadside location. Alternatives include the use of short haul microwave (5-10 mile range) and optical video (1 mile range) links.

In the case where twisted wire pairs are already in place along a freeway, the use of compressed video is appealing as an interim surveillance system until a wide band communication system is installed. Line drivers can be used to transmit digital data, and several factors determine the distance and speed of such a communication system. Among these are wire size, presence or absence of shielding condition of cable, and type of line driver. For cables with an excess of twisted pairs, more than one pair can be used with partitioned images to boost the data transmission rate.

This research project made some very preliminary efforts to process images directly at the camera site, without compression, and forward traffic volume and density information to the central site These early efforts were encouraging, particularly in using the video camera as a daylight vehicle detector. These studies were conducted with a color camera on the eighth floor of an office building, with the camera aimed at North Central Expressway. Inaccuracies were related to the office building's window glare, and also electronic jitter in the video image digitizer. Equally rewarding were the cursory tests run to measure relative traffic density, as a technique to have the computer and camera "watch" the freeway for incidents. While extensive testing is needed, the possibility exists for having the computer relieve the operator's tedium of having to observe multiple television monitors for long periods of time. Pavement loop detectors could augment such a system. Within a certain level of confidence, compressed images would only have to be transmitted to a central site to report abnormally high or low traffic densities. This could further reduce system data communication requirements.

Another area of research will be to evaluate camera types. Since color cameras have relatively poor low light level characteristics, some low light level monochrome cameras will be tested. With the possibility of local image processing to implement video detection functions, the use of remote head cameras will be tested for usefulness on sign support bridges.

Application

Compressed video systems are useful for traffic operations monitoring where a wide band communication system is unavailable to cities and state departments of transportation. While not as visually appealing as a full motion video image, the compressed video system is more than adequate for routine traffic monitoring, special traffic studies, and incident detection. The image provides the operator with sufficient detail to rapidly notify and dispatch emergency services or vehicles appropriate to the situation. Efficient operation of existing roadways is essential, and compressed video surveillance is a cost effective device for helping achieve this goal. The use of leased telephone lines or owned wire pairs, in the short term, is a much lower cost alternative to leasing or constructing wide band facilities. Compressed video can also be utilized as an incremental interim step to a permanent surveillance system. An advantage is that installation time of a semipermanent system is minimized. Trailer mounted units can be rapidly deployed, with the ability to move a camera across the street, across town, or across the state in a relatively short time period. Telephone access is the only requirement for site selection where trailer-mounted cameras are used, and even access to telephone service can be several miles from the camera.

The mobility of compressed video can be extended by cellular telephone. While data throughput over cellular links is highly variable with respect to the area, there is the expectation of improvement with digital cellular. The advantage of using cellular is that very short term setups can be made at accident sites or for site specific situations such as construction management. In the proper configuration, the camera can be taken below ground level for relaying visual status information to a remote site. The remote site may be another vehicle, similarly equipped with a cellular telephone and decompression computer. Since the only difference between the compression and decompression processes is software, either end can transmit or receive images. Another important point is that a central control center may be moved relatively quickly without disruption of the video surveillance process.

New Advances

With improvements in image compression techniques being researched in many different areas to serve the needs of various industries, new advances are imminent. Hardware chips are available to perform cosine transforms in real time. While this does not, in itself, alleviate the bottleneck of transmitting the compressed image over a narrow band telephone line, it helps to reduce the accumulated delay from camera snapshot to viewer sighting time. This is particularly important when the camera is being repositioned. Also, it removes the upper limit on speed of the transmission, should the user wish to utilize a higher bandwidth communication medium. In addition, claims are being made about the use of fractal geometry as an entirely different approach to image compression. This technique uses terse numerical descriptions of natural objects to describe complex scenes. An alternate technique that is emerging is the MPEG standard, which uses base frames and interframe interpolation.(2) Costs for the encoders are decreasing, and some application of this technique may be seen in traffic surveillance as well. One of the hazards of using some techniques is their dependence on interframe changes. A popular methodology is to send only the changes in an image from snapshot to snapshot, since this represents only a fraction of the data from a total image. This technique is frequently used in teleconferencing. The downside of using such a technique in traffic surveillance is that the cameras are not on a stable platform, and a windy day causes sufficient camera movement to change the entire scene, thus defeating the advantage of interframe changes.

With faster processor and higher speed data busses available, a software only solution may be practical in the future. A frame grabber would still be necessary, but the compress/decompress functions could be handled by software. Several software packages are currently available for this image manipulation. A high speed data buss would permit transfer of the substantial data quantities (up to 1 megabyte per frame) from the frame grabber to the central processor.

Costs and Deployment

The cost of the field equipment at a fixed (pole mount) camera site is approximately $30,000. This includes the pole, camera and enclosure, pan tilt unit, compression computer, camera interface, modems, cabinet, and installation. The decompression computer, modem, and TV monitor cost about $12,000. These costs represent extensions of the prototype design, and per camera costs will be reduced with multiple camera units and the availability of faster microprocessors. The current cost of a dial-up telephone line in Dallas is $35 on each end, or $70 per line per month. The use of a fractional T1 communication link is an alternative, as well as ISDN links, where available. These facilities offer a higher data (and frame) rate but at a higher cost.

A four camera system using compressed video will be deployed on North Central Expressway in 1994. This system will be based on a second generation equipment version. Higher speed modems (V.FAST, expected to be about 24,000 bps) will be used, as well as two dial-up lines per camera site. The dual line charges will be $140 per month per camera site. This is expected to yield a frame rate of frames per second for a 200 x 256 pixel image. The function of frame grabbing/digitizing and compression will be combined on a single card. This will remove any data bottlenecks within the computer, as well as lower the cost of the separate system

The cost of developmental software was low because of the research nature of the project. Many experimental trials were programmed to improve the speed and display of the images. This effort continued over a two year period. It is estimated that a comparable production software package could be developed for $50,000, which could be amortized the number of units in the system.

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STATE OF THE ART OF AVI TECHNOLOGY: POTENTIAL APPLICATIONS TO FLORIDA'S TURNPIKE

The Florida Department of Transportation, Office of Florida's Turnpike, contracted with the Center for Urban Transportation Research (CUTR) at the University of South Florida to conduct an analysis of automatic vehicle identification and its potential application on Florida's Turnpike. The project included three distinct but related phases:

- A review of the state of the art of AVI technology.
- Survey research relating to the attitudes and characteristics of current Turnpike patrons.
- An evaluation of the specific application of AVI technology to Florida's Turnpike.

AVI TECHNOLOGY

Automatic vehicle identification in the toll collection industry refers to techniques that uniquely identify vehicles as they pass specific points along a facility, without requiring any action by the driver or an observer. AVI systems consist of three basis functional elements: a vehicle-mounted transponder/tag, an adjacent reading device, and a master computer system for the processing and storage of data.

The AVI process is relatively simple: information that identifies a vehicle is encoded onto the transponder/tag. As the vehicle passes through the facility, the transponder/tag is activated to transmit the coded data to a roadside reading device. At this point, the data are checked for validity before being transmitted to the master computer for processing and storage. The entire transaction process is complete in a fraction of a second.

There are four major AVI technologies currently being developed and implemented around the world:

Optical/infrared (bar code) technology is an optical system that employs a vehicle tag, simply a bar code decal sticker. A laser scans continuously over the area where the tag is expected to be and the reflected signal is processed to extract the code which uniquely identifies the vehicle.

Inductive loop technology uses a loop antenna imbedded beneath the surface of the roadway, which communicates with a tag mounted on the underside of the vehicle. The antenna sends out an interrogation signal and the tag responds by returning a signal that is modulated according to the data stored in the tag.

Radio frequency (RF)/microwave technology. employs microwave frequencies to uniquely identify vehicles as they pass through a toll facility. The transponder contains a small internal receiving antenna, an internal transmitter, and solid-state electronic circuitry.

Surface acoustical wave (SAW) technology is similar to the RF in that it operates with a microwave frequency. However, under this system, a low power radio frequency signal from the AVI reader is captured by the transponder antenna, which energizes a lithium crystal, setting up an acoustical wave along its surface.

AVI IMPLEMENTATION ISSUES

CUTR examined a wide range of implementation issues, all of which are important in the determination of the feasibility of AVI for Florida's Turnpike.

Technology - Very little performance testing of the various AVI technologies has been formally documented. However, based on information provided by vendors, visits to various AVI facilities, and detailed discussions with recognized industry experts, relative comparisons were made. Seven major issues were identified and reviewed, and each technology was given a comparative score of high, medium, or low for each of the issues identified. These determinations are summarized below. It is important to recognize that the specific differences between high, medium, and low are not know at this time, only that they are relative rankings.

Payment System Issues - Issues related to payment systems include toll structures, prepayment vs. post-payment, and methods of payment. Three AVI toll structure options were evaluated: premium toll rates, discount toll rates, and normal toll rates. Advocates of a premium toll structure contend that AVI users should pay an additional charge for the convenience offered by the system. Others argue that discount toll rates should be offered in order to maximize participation since both AVI users and non-users benefit from the system. Finally, many contend that AVI users should pay the normal toll rate since the convenience offered by the system will provide enough incentive to participate.

The issue of a pre-payment vs. a post-payment system was also evaluated. It was determined that a post-payment system should not receive further consideration since the burden of collecting delinquent accounts would be an additional responsibility for the Turnpike. Methods of payment that should be provided under a pre-payment system include cash check, credit card, and electronic funds transfer. The credit card system would be ideal if the agreement were such that automatic replenishment of an account would be permissible.

Legal Issues - two major issues were identified and reviewed: the legality of offering AVI under a discount toll structure and the legality of enforcing violations through the use of photographic enforcement. The use of discounted tolls may violate the current bond indenture with respect to maximizing the collection of revenues. If the Turnpike desires to give further consideration to any discount toll structure, compliance with the Turnpike trust indenture will need to be established. Current Florida Statutes indicate that toll violations must be enforced on-site after the violation has been witnessed. For that reason, the main deterrence technique has been the use of gates on toll lanes. However, to realize the maximum benefit of AVI, gates should be eliminated, necessitating the use of active enforcement measures. Photographic enforcement is a viable alternative; however, legislation would need to be introduced that would permit ticketing the owner of a vehicle by mail when a photograph is taken of the violation and of the violator's license plate.

Ownership/Finance Options - There are three major ownership arrangements that could be used in the implementation of an AVI system on Florida's Turnpike. These include the agency owning and operating the system, a vendor owning and operating the system, and various lease agreements.

Traffic Operations - Traffic control procedures (pavement markings, adequate signing, channelization) and traffic rules (speed limits and passing areas) will need to be revised as necessary to safely and efficiently accommodate the use of AVI and to ensure the safety of Turnpike patrons and toll collectors. It is particularly important that a safe method for the movement of toll collectors across AVI lanes be identified as part of the reevaluation of traffic operations.

Computer system requirements - AVI can be added as an upgrade to a well-designed, modern toll plaza with state-of-the-art, microprocessor-based manual lanes and automatic coin machines, a microprocessor-based lane controller that is programmable, a plaza computer system, and a host computer system with network capabilities. The Turnpike is currently acquiring a state-of-the-art computer system which will be able to accommodate AVI.

Relative Comparison Of AVI Technologies

Issues/Technology	**RF/Microwave**	**SAW**	**Inductive Loop**	**Bar Code**
Reliability	High	Medium	High	Low
Resistance to Duplication (Security)	Medium	High	Medium	Low
Potential for Multiple Reads (speed vs. reliability)	High	High	Low	Low
Resistance to Interference (lane-to-lane)	Low	Low	High	High
Tolerance to Environment	High	High	Medium	Low
Simplicity of Tag	Low	Medium	Low	High
Health Safety	High	High	High	High

Dedicated vs. Mixed-Use Lanes - A dedicated AVI lane is one in which a lane is selected to accommodate only AVI users. This lane may be one within the conventional plaza configuration that would allow AVI users to pass through at speeds of 10 to 15 miles per hour or may be a newly-constructed lane separated from the conventional plaza configuration that would accommodate speeds up to 55 miles per hour (commonly know as an express AVI lane). Alternatively, a mixed-use lane is one that accepts AVI users as well as conventional patrons who pay a collector or use an coin machine.

Capacity by lane type - Typical capacities were estimated for each lane type, including manual (350 vph), automatic (500 vph), mixed AVI (700 vph), dedicated AVI (1200 vph), and express AVI (1800 vph).

FLORIDA TURNPIKE PATRON SURVEYS

Three survey efforts were conducted to help assess the potential of AVI on Florida's Turnpike: personal interviews, a mail-back survey, and focus groups. The interviews and mail-back surveys were conducted at eight plaza locations, including two mainline barriers (Tamiami, Golden Glades) and six exit plazas locations (Sunrise, State Road 84, and Commercial Boulevard in Ft. Lauderdale and Kissimmee/St. Cloud, Orlando South, and Interstate 4 in the Orlando area). The focus groups included commercial and commuter participants who resided in the South Florida area. The selection of survey locations was based on those sections of the Turnpike with the greatest percentage of users who travel the facility five or more days per week.

Personal Interviews - Over 7,000 personal interviews were conducted to determine user characteristics, including vehicle type, vehicle occupancy, Florida residency, purpose of trip, and days per week traveled on the facility.

Mail-Back Survey - Of the 10,000 mail-back surveys that were distributed, over 2,000 were completed and returned, resulting in a response rate of approximately 20 percent. In addition to confirming the finding of the oral interviews, the mail-back survey also established other patron characteristics and perceptions toward the concept of AVI. General Perception was positive, with 90 percent of respondents indicating they would use AVI if discount tolls were offered and 68 percent indicating they would use AVI if the toll structure remained the same.

Focus Groups - The purpose of the focus groups was to bring together a small group of individuals for two to three hours to discuss issues related to the implementation of AVI in Florida. Compared to other survey methods, this type of survey results in a higher level of detail regarding attitudes towards AVI and the preferred operational characteristics associated with an AVI system. Two focus groups were assembled, one representing commercial users and one representing private commuters, to develop a more-detailed profile of the characteristics and perceptions of commercial and commuter patrons. both groups reacted positively to the concept of AVI. Commercial representative indicated the most important advantages to be the ability to track vehicles and improved accounting procedures. The commuter representatives also reacted positively but were much more sensitive to the costs associated with participating in an AVI system.

COST-EFFECTIVENESS ANALYSIS

An analysis was conducted to determine the cost-effectiveness of the implementation of AVI at the plaza level. Specifically, Tamiami plaza in Dade County was selected for the analysis. The analysis compared the cost of construction programs with and without AVI to the "no build" alternative, through the year 2015. It compares the cost of implementing improvements with the road user benefits that would be realized. The analysis begins in 1994 and continues through the year 2015. The number of lanes required under each alternative is indicated below.

Because each improvement alternative is designed to maintain the FDOT standard queue length criterion of 300 feet, when compared to the no-build alternative, the estimated road user benefits will be virtually the same in each alternative. The true benefit results from the fact that AVI accommodates vehicles at a faster processing rate, therefore resulting in fewer toll lanes required to handle traffic growth.

Economic evaluation measures were computed for a non-AVI alternative and for an AVI alternative, allowing for three different levels of AVI participation. These economic indicators are summarized in the table at the bottom of the page. Based on the economic feasibility indicators, each of the alternatives is economically justified because benefits are greater than costs, resulting in benefit-cost ratios greater than one and net present values greater than zero.

It is apparent that the greater the AVI participation rate, the greater the potential savings in lane construction and operating/maintenance costs. Even with a minimal rate of participation, the AVI alternative is superior to the non-AVI alternative. In the absence of AVI, more lanes are required to maintain the same level of service.

Total Number of Toll Plaza Lanes Under Each Improvement Alternative

Year	Current FDOT Plan	10% AVI Participation	30% AVI Participation	50% AVI Participation
1990	12	--	--	--
1994	20	16	14	10
2005	22	18	16	12
2015	26	22	18	14

Economic Feasibility Indicators

	(1) Benefits (present value)	(2) Costs (present value)	(3) Benefit/Cost Ratio (1)/(2)	(4) Net Present Value (1) - (2)
Current FDOT Plan	$50,789,781	$30,789,055	1.65 ,	$20,000,725
10% AVI Participation	$50,877,415	$25,116,791	2.03	$25,760,623
30% AVI Participation	$50,946,719	$22,249,835	2.29	$28,696,883
50% AVI Participation	$51,016,022	$16,595,674	3.07	$34,420,348

CONCLUSIONS AND RECOMMENDATIONS

Based on the preceding analysis, several conclusions and recommendations were made as a result of the evaluations and findings of the feasibility study.

1. Florida's Turnpike should implement AVI. Phasing should be approached in three priorities.
2. The AVI system should be designed to accommodate both passenger cars and commercial vehicles (single-unit trucks and semi-trailer trucks).
3. Current Turnpike procedures related to traffic control (pavement markings, signing, channelization) and traffic rules (speed limits and passing areas) should be re-evaluated and revised as necessary to safely and efficiently accommodate the use of AVI.
4. The Turnpike should propose new legislation to permit photographic enforcement and to allow the fining of a vehicle's owner rather

than its driver. If the use of photographic enforcement is legalized, the use of gates at toll facilities should be eliminated.

5. A variety of pre-payment options should be offered to AVI users, including payment by cash, check, credit card, and electronic funds transfer.

6. Normal toll rates should be charge to AVI users; premium rates should not be utilized.

7. If either radio frequency or inductive loop technology are selected, the transponder should be provided to patrons under a lease agreement requiring a modest monthly payment of $2 to $3. If an optional scanner system is selected, a one-time fixed cost of $1 to $3 would be appropriate. In addition, an optional monthly account statement should be offered at an addition cost of approximately $2 per month.

It is important to recognize that there are a wide range of issues that need to be addressed for AVI to meet its potential. While technology represents one issue, other factors such as marketing, price structure, payment options, traffic operations, and enforcement systems are equally important to the successful implementation of AVI.

SOURCE: **1996 Rural Intelligent Transportation Systems Conference Proceedings**

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SUMMARY OF ONGOING MAYDAY OPERATIONAL TESTS AND MAYDAY RELATED PRODUCTS

Today an innovative series of public-private partnerships in the United States is working toward an infrastructure for an emergency vehicle location system that, when activated by the motorist or automatically due to crash, will transmit a request for help, along with the vehicle's precise location, to emergency services personnel. The projects are being coordinated by the federal and state governments and private organizations with the aim to spur the implementation of a nationwide emergency vehicle location system. Realizing the need for such a system, the I-95 Corridor Coalition has contracted with the Center for Transportation Research (CTR) and the Mobile and Portable Radio Group (MPRG) at Virginia Tech to define a Mayday direction for the I-95 corridor which encompasses both urban and rural environments. As part of the project, we are evaluating different Mayday technologies and programs. The most popular technologies involve position location methods such as GPS, cellular geolocation techniques, such as time difference of arrival (TDOA) and angle of arrival (AOA) methods, and a cellular and satellite communication system for voice and/or dam communication.

As part of the project, existing Mayday operational tests and deployments are being surveyed to determine which systems and technologies offer the strongest advantages in terms of cost, infrastructure requirements, compatibility with national trends, and performance in both rural and urban environments. Call processing within the existing PSAPs across the corridor are being studied and efficient protocols will be identified to make use of the new Mayday information. In addition, feasible technologies suitable for a wireless Mayday system which can evolve into onboard technologies capable of accurate position location will also be analyzed. Some 'examples include spread spectrum, PCS, CDPD, GPS, FM, LEOSAT, and cellular technologies. In order to determine the viability of cellular and GPS position location (two of the top candidates), coverage measurement across different terrain along the I-95 corridor is being performed. Institutional and networking issues concerning call routing need to be addressed. The public safety answering points (PSAPs) should have the capability to handle all the data that they receive. The jurisdictional boundaries and agreements among the PSAPs should also be well defined to quickly and correctly respond to or transfer a call. This might require the development of special purpose software to do the networking. This might also require increasing the efficiency of the PSAPs through technology. The research will compile detailed summaries of the current state of Mayday systems and will provide in-depth comparisons based on many factors of alternative Mayday technologies.

Mayday programs in ITS are approaching a rapidly changing communications and marketing landscape. Recent developments in this field have been in the combination of position location devices with selected communication systems associated with command centers providing specific services in the area of security and safety. One position location device is the TIDGET developed by NAVSYS Corporation, combining GPS with cellular communication. NAVSYS claims that the unit will sell for less than $500 when they go out on the market. The Colorado Mayday system is using the TIDGET device for its operational test. Test results of Phase 1 show that the system delivers highly accurate vehicle locations to an emergency services dispatcher when the vehicle is in good cellular coverage areas. The evaluation and testing process highlighted the need for more accurate maps. The full operational test is scheduled for late 1996. The PUSHME Mayday system is another project that has completed the full field operational test. It incorporates two differential GPS-equipped Mayday technologies: an analog cellular system (Motorola) and a two-way pager system using cellular digital packet data (CDPD) provided by XY-point. Preliminary results show that the cellular phone technology was highly useful. The two-way pager technology necessitated a series of questions to refine the location and convey the problem. Issues concerning differential correction of GPS data and adequate mapping were also very important. The PUSHME project aims to evaluate the performance of emergency and assistance communications system along with the institutional issues concerning call routing in the Public Safety Answering Points (PSAP). Calspan is also planning a test on a GPS-cellular system to be held at Erie County, New York with the added feature of an automated collision notification system using crash sensors and signal processors. The system development is to be completed by late 1996, and the operational test is scheduled for March 1997.

Some private organizations have also come up with their own Mayday products. Ford's RESCU (Remote Emergency Satellite Cellular Unit) system uses a GPS receiver and cellular communications. The message from the vehicle includes alarm type and vehicle identification, and latitude and longitude, as well as dilution of precision, velocity vector and time. The response center maintains voice contact with the motorist and also establishes a three-way call between the motorist, 911 center, and Lincoln Commitment Roadside Assistance Center. The RESCU system is only available in the United States and sells for under $1,000. Another impressive product is the GM OnStar being offered on 1997 Cadillacs. It uses Trimble's GPS for positioning and a cellular connection for position and status reporting. A map database onboard the vehicle distinguishes the OnStar from the other Mayday systems. The price of OnStar will be $895 plus dealer installation and a service fee of $;22.50 per month. The OnStar system links the driver and the vehicle with the OnStar center where advisors provide real-time, person-to-person contact. Another GPS-cellular system is also being offered by ATX Research known as the OnGard System, It has features such as a remote link to power windows and ignition, stolen car tracking, and automatic door unlocking. The basic unit with GPS will cost about $1,000. E-Systems, a Raytheon Company, has developed some vehicle location systems incorporating GPS and cellular technology. Products such as GEO-Trac and CELL-Trac provide vehicle location, speed, direction, and messaging. Security is enhanced by their ability to read remote sensors, such as alarm and panic buttons. Another E-system product is the CDPD-Trac designed to use the Cellular Digital Packet Data (CDPD) network. With the optional AMPS cellular backup, vehicle tracking can be done even where there is no CDPD coverage.

Rockwell International and ADT Security Systems are offering a GPS position location system with the distinguishing feature of emergency message transmission through a data link (packet radio) network rather than a voice system like cellular or mobile radio. They claim that the data link network is faster and cheaper than a cellular network. The system is supposed to be introduced to the market in the second half of 1996. A fully satellite-based position location and communication system is the Transcal Emergency Notification System (ENS). In the ENS system, the LEO satellites use triangulation to estimate the position of the vehicle that transmitted a distress message to the satellite network and then relay that position estimate to the ground station. The ground station establishes the three-way connection between itself, emergency services, and the vehicle. Early testing with a limited number of satellites is scheduled for late 1996 and early 1997.

Cellular Application to ITS Tracking and Location (CAPITAL) Beltway Project, completed recently, made extensive use of the existing cellular infrastructure for geolocation techniques. E-CAPS geolocation equipment developed by Engineering Research Associates was co-located on Bell Atlantic Mobile's towers to detect cellular usage and geolocate phones on designated roadways. The key features of this system are that no additions or modifications to mobile cellular phones are required, the technique is independent of signaling standards, and geolocation accuracy is within 100 meters in urban areas. The performance may vary with weaker coverage and mountainous areas.

The Associated Group Inc. has devised the TruePosition Cellular Location system that complements existing cellular and personal communication service network architecture. It is patented on Time Difference of Arrival (TDOA) location technology. The Associated Group Inc. and Comcast Cellular Communications, Inc. will launch a trial this fall in New Jersey to test the system

Tendler Technologies has developed and patented a system for reporting to dispatch centers the location of stricken individuals through informing the dispatcher in English where the caller is located. Fonefinder phones are provided with an internal GPS engine and EMS chip set. Because the transmission is in English and uses a normal audio' channel, cell sites do not need to be adapted to any particular digital format. The Fonefinder system can be provided to customers at either zero cost or no more than $100.00 additional cost due to a second Fonefinder system featuring the 911 Backup System. Tendler Cellular provides the Fonefinder function through its sale of chip sets to cell-phone manufacturers such as Audiovox, Nokia, Motorola, and Ericson. Comtrak is providing a vehicle location and communication technology using a network of radio transmitters and receivers. The system is known as Quiktrak and uses Time of Arrival (TOA) measurements for location determination. Northrop Grumman is developing an ITS IDEA Project combining GPS, cellular link, a groundwave transmitter, and a portable Radio Direction Finding (RDF) unit. It is developed to provide nationwide coverage in both urban and rural locations, heavy foliage, ravines, canyons and all crash geometries. A summary of different Mayday product is listed in the following pages.

Reference

1. 1-95 Corridor Coalition Technical Report, Summary of Mayday Initiatives, 1-95 CC 19-96-02.

2. Heading This Way: Affordable Security on the Road, Edward J. Krakiwsky, GPS WORLD, April 96

MAYDAY PRODUCTS

Participants	Sensors	In-Vehicle/ Highway	Scope	Time Frame	Comments
NAVSYS Corporation	TIDGET	In-Vehicle	Service area depends upon cellular coverage	Tested in Colorado	Cost of the TIDGET device lower than Mayday Project standard GPS receivers
Ford Rescu (Remote Satellite Cellular Unit) System	GPS technology integrated	In-Vehicle	Nationwide service	Installed in 1996	Answering point in Westinghouse Emergency Response center in Irving, TX
GM/Cadillac Onstar	GPS technology integrated	In-Vehicle	Nationwide service	Will debut later this year on 1997 Cadillacs	Automatic notification of airbag deployment, theft detection, remote door unlock, routing, roadside assistance
Northrop Grumman	GPS technology, combination	In-Vehicle	Not Available	Under negotiation	
OmniTRACS by QUALCOMM	Satellite system	In-Vehicle	Capable of providing nationwide service	In initial stages of being marketed	Vehicle location is provided hourly and in each message as part of the base service
Comtrak's Quiktrak	GPS technology	In-Vehicle	Stolen vehicle recovery, personal safety, emergency, roadside assistance throughout the coverage region	Operational in Mexico City and Sydney	Tracking and two-way communications using a network of radio transmitters and receivers.
Rockwell/ADT	N/A	In-Vehicle	National coverage	Under negotiations	Communication through fast and cheaper data network
Emergency Response Network - Tendler Cellular	GPS -based chip to be installed into cellular phones	In-Vehicle	National coverage	Under negotiations	No infrastructure cost, no changes to cellular
Fonefinder					Phone switches, no cost to the recipient of the message
TruePosition	Cellular technology	In-Vehicle	National coverage	Under negotiations	Will be used in New Jersey Operational Test
Enhanced Cellular Services E-systems	GPS technology integrated	In-Vehicle		Not Available	Available for use with cellular network Provides speed, direction, messaging, and enhanced security
ATX OnGard	GPS-Cellula r System	In-Vehicle	Not Available	Available in late 1996	Added feature such as remote door unlocking system

SOURCE: SIM Committee Publication, Fall 1996

INCIDENT MANAGEMENT NEWS

DelDOT & VDOT

The Delaware Department of Transportation (DelDOT) and the Virginia Department of Transportation (VDOT) have undertaken a joint project to evaluate DelDOT's Observation Balloon System (OBS) as a viable traffic management tool for planned events that generate large volumes of traffic. The OBS was originally developed by the Israeli Army for border surveillance and was purchased by DelDOT with a Federal grant designed to evaluate new technologies in traffic management. Since incidents can either be planned (a NASCAR race for example) or unplanned (a crash along the Interstate which closes all or most of the travel lanes), the SIM Committee felt that it would be in our interest to also evaluate this technology for planned events in Virginia. A request was then forwarded to DelDOT requesting the OBS for at least six events within the Commonwealth and they agreed. While DelDOT provides the balloon, camera, command center and two employees, VDOT supplies six employees to assist with the launch and retrieval of the balloon.

The OBS is an observation balloon system which consists of a gyro-stabilized TV camera suspended from a helium filled balloon. A single cable serves for power and for two way communication between the camera and the command center as well as mooring the balloon 500 ft. above the ground which provides an approximate 3 - 5 mile viewing area. The TV camera is controlled with a joystick, can "zoom-in", and the image' is displayed on a color monitor in the command center. Personnel in the command center (VDOT, police, etc.) can then monitor traffic conditions and make adjustments to traffic control quickly and accurately with this "eye in the sky".

The initial use of the OBS in Virginia was for the "move-in" weekend (8/24&25/1996) at Virginia Tech in Blacksburg. While difficulties with the camera gyroscope limited observations at midday on Saturday, the goal was achieved since a Virginia Tech police officer commented: "This is exactly what we hoped it would be.".

The next (tentative) flights of the DelDOT OBS are in Stafford County on Saturday, Oct. 5, 1996 (a section of Route 1 parallel to Route I-95 will be closed in order to have a parade honoring Olympic athletes) and on Saturday, Nov.23, 1996 in Blacksburg to monitor traffic at Virginia Tech - West Virginia University football game.

In order to continue with our evaluation of the OBS, the SIM Committee is still looking for at least three other planned events in the Commonwealth that either generate large volumes of traffic or create conditions that need this form of traffic management. Please contact Jon DuFresne (804-786-2885) if you know of such an opportunity and want to utilize this technology.

Module 5
Motorist Information

The goal of Module 5 is to describe the motorist information phase of the incident management process, describe specific challenges to effective motorist information, describe potential tools or strategies for improving motorist information efforts and provide the opportunity to examine local motorist information needs and potential tools/strategies for improvement.

M 5

MOTORIST INFORMATION

DEFINITION

Dissemination of incident-related information to motorists who are:

- **at the incident**
- **approaching the incident**
- **not yet departed from work, home, or other location**

OBJECTIVES

- **Reduce traffic "demand"**
- **Reduce secondary incidents**
- **Improve responder safety**
- **Reduce motorists' frustration**
- **Enhance motorists' ability to avoid congestion and reduce delay**

BENEFITS

Motorist delay decreased

- 17 minutes per incident
- 1,900 veh-hrs per incident
- 300,000 veh-hrs annually

- INFORM, New York

ISSUES AND BARRIERS

Providing accurate, real-time information

- Information should be 70% reliable
  - Kantowitz, et al.
- Improve communication among responders, dispatchers, and media

ISSUES AND BARRIERS

"Guestimating" incident duration

- Provide range of durations
- Don't underestimate duration
- Update initial estimate

ISSUES AND BARRIERS

Is it over yet?

- Needed by motorist who are delaying their trip.
- Facilitated through checklists

ISSUES AND BARRIERS

Message or no message during non-incident times?

- May reduce motorists' attention to the information
- May habituate motorists to observing the information

ISSUES AND BARRIERS

Media - friend or foe?

- Emphasize need for consistent, reliable traffic information
- May provide aerial surveillance
- Reduces public start-up costs

dispatchers, and the media are more often the reasons for poor motorist information. The accuracy or detail of information that is passed from responding personnel to the dispatcher is not always maintained when the information is passed to a third party. In addition, dispatchers and the media must try to assimilate information from a variety of sources; sometimes this information conflicts.

Formalizing communication procedures with step-by-step procedures or a standardized checklist helps to ensure that the most accurate and comprehensive information reaches the motoring public and does not "get lost" somewhere along the way. Included in the Washington State Department of Transportation's "Incident Response Guide" are step-by-step instructions on providing motorist information through variable message signs (VMS) and highway advisory radio (HAR).

1. Determine the specific locations of the VMS and HAR sites (See VMS and HAR vicinity maps).

2. Contact the Highway Radio Operator by radio or by phone.

3. Provide the following information:

    - specific incident details
    - the VMS sign number
    - the message number
    - HAR sites, when needed.

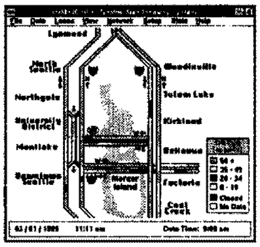
4. Inform the Highway Radio Operator when the incident has been cleared.

5. Request that the message(s) be deleted. The message will be deleted as soon as possible.

6. Conduct a follow-up to ensure that the message(s) has been deleted.

Similar guidelines can be developed for communicating with the media or

EMERGING TECHNOLOGIES



Before departing from home, work

- Informational kiosks
- Internet and computer bulletin boards

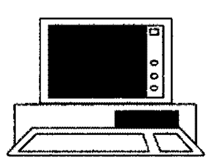
NATIONAL EXAMPLES

Improved media ties, Virginia

- All media report to a staging area
- Responders complete urgent tasks without media interruptions
- Media are escorted to scene for camera footage and sound bites

NATIONAL EXAMPLES

Chrysler Technology Center, Michigan



- Traffic conditions relayed on employee computers from 3pm to 6pm
- Computer-generated maps and text

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Module 5
Motorist Information

Definition

Motorist information includes the dissemination of incident-related information to motorists who are (1) at the scene of the incident, (2) approaching the scene of the incident, and (3) not yet departed from work, home, or another location (e.g., shopping malls). Motorist information should be provided as early in the incident management process as possible and should continue until the incident has been cleared and the traffic backup has dissipated.

To ensure motorist cooperation, motorist information tools or strategies should be designed to do the following:

Advise motorists of the nature and extent of the problem so that they may make intelligent choices about alternative routes or delayed trip departures. Information should include the location of the incident, its magnitude, and the amount of delay that can be expected.

Provide information on possible courses of action such as alternative routes. Don't assume everyone is a local traveler. Unfamiliar motorists need to not only be directed off their primary route but also back on. Those who are familiar with the area will be most able to make adaptations. The DIVERT advanced traveler information system, currently being tested in Minnesota, utilizes real-time traffic data collected through electronic loops and closed-circuit television cameras to direct motorists via variable message signs off the interstate, onto city streets, and then back onto the interstate. Positive reactions have been received from St. Paul, Minnesota, residents.

When motorists are required to take certain actions (e.g., a diversion), those actions should be described clearly. For example, if motorists are required to travel the wrong-way down a freeway on-ramp to improve emergency vehicle access to the incident scene, motorists should be clearly directed, and their actions should be carefully monitored.

Objectives/Benefits

The objectives of improved motorist information are as follows:

- to reduce traffic "demand" at the scene
- to reduce secondary incidents
- to improve responder safety at the scene
- to reduce motorist frustration (erratic behavior)
- to enhance motorist ability to avoid congestion and reduce delay.

Some previously reported motorist information-related benefits are summarized below.

INFORM (Information for Motorists), an integrated corridor on Long Island, New York, that provides (1) motorist information via variable message signs (VMS) and (2) traffic control using ramp meters has been estimated to

- decrease motorist travel time by 17 minutes during an incident
- decrease delay by up to 1900 vehicle-hours per incident
- decrease delay by up to 300,000 vehicle-hours annually.

A survey in Marin County, California, showed that if regular commuters had been presented with alternative routes, including travel time estimates, 69 percent would have diverted and would have saved an average of 17 minutes in travel time.

A survey conducted for the Atlanta Advanced Traveler Information Kiosk Project indicated that 92 to 98 percent of the participants found information on accidents, alternative routes, road closures, and traffic congestion to be useful and desirable.

Issues or Specific Barriers

Improving motorist information efforts must be preceded by efforts to improve "information management." Information management works most effectively when information goes to and comes from a single source. When this is not possible, procedures for the timely sharing of information is needed. As with other areas in incident management, improvements in motorist information can only partially be addressed through technological applications. Many improvements can be realized simply through a more formalized information exchange process. Below, the more common issues related to improving motorist information are described. When possible, suggestions for mitigating these issues are provided.

Providing accurate, real-time information

The key to having an effective motorist information program is to keep the motorists' faith in the information system. A rough estimate is that one false message does more damage to the credibility of a motorist information system than the good done by 10 accurate messages. A study on drivers' reactions to unreliable traffic information found that information that is less than 100 percent accurate can still be useful. However, traffic information reliability above 70 percent is recommended. Motorist trust in an unreliable system recovers when accurate information is presented, but the recovery is not always complete (Kantowitz, et al. 1995).

The capability to provide "accurate, timely information" is ultimately limited by detection and verification capabilities, as well as other traffic monitoring capabilities (i.e., surveillance systems). You can only provide information about what you know. If there are large "unknowns" regarding real-time traffic conditions in an area, then the ability to provide accurate information is limited.

However, often the lack of a sophisticated surveillance system is inappropriately blamed for poor motorist information. Miscommunication and a lack of communication among various responding agency personnel, dispatchers, and the media are more often the reasons for poor motorist information. The accuracy or detail of information that is passed from responding personnel to the dispatcher is not always maintained when the information is passed to a third party. In addition, dispatchers and the media must try to assimilate information from a variety of sources; sometimes this information conflicts.

Formalizing communication procedures with step-by-step procedures or a standardized checklist helps to ensure that the most accurate and comprehensive information reaches the motoring public and does not "get lost" somewhere along the way. Included in the Washington State Department of Transportation's "Incident Response Guide" are step-by-step instructions on providing motorist information through variable message signs (VMS) and highway advisory radio (HAR).

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4. Inform the Highway Radio Operator when the incident has been cleared.

5. Request that the message(s) be deleted. The message will be deleted as soon as possible.

6. Conduct a follow-up to ensure that the message(s) has been deleted.

Similar guidelines can be developed for communicating with the media or other public information agencies.

"Guestimating" Incident Duration

Some responders are hesitant to give information to the media or to the public because if the information is incorrect, it will reflect poorly on the informant and his or her agency. Incident duration is one of the most difficult pieces of information to report accurately, yet, it is one of the most important to the motoring public. For incident responders, duration is difficult to predict because of the dynamic nature of an incident (circumstances can always change that increase or decrease the incident duration) and the uniqueness of each incident (no two incidents are ever alike). Duration is especially difficult to predict at larger-scale incidents where a number of different agency personnel are performing many individual tasks. The ability to better predict incident durations improves with experience, but uncertainty still exists. So what do you tell the motoring public? The safest approach is to provide a narrow range of possible incident durations, say one to two hours, or under a half an hour. In this range, consider the best and worst case incident durations. A second approach is to consistently overestimate incident duration. Try never to underestimate incident duration; motorist frustration and resentment toward your agency may result. Regardless of the approach taken to initially estimate incident duration, as the incident progresses, the initial estimate should be updated to better reflect what you know.

Is It Over Yet?

Once all of the required actions have been taken in the field and the incident has been cleared, it is often easy to forget to report this information to motorists. At the start of an incident, responders feel a sense of urgency to report incident information to motorists; scene safety is improved through forewarning, and the traffic queue is minimized. Both responders and motorists benefit from motorist information at the onset of an incident. At the close of an incident, respondents are no longer faced with a sense of urgency. After they have completed their more immediate tasks (i.e., ensuring safety, attending to injured, logistically managing incident clearance), providing motorists with incident clearance information may seem insignificant. And in the short term, this relay of information may be insignificant. However, in the long-term, a good record of service to roadway "customers" can help to ensure their support for your agency's efforts. Motorists who are delaying their trips until traffic flow improves are especially in need of incident clearance information. Therefore, it is important to provide continuing updates on congestion and queues after incident clearance.

The best way to ensure that incident clearance information is reported is to incorporate it into step-by-step procedures. Note steps four through six from the above example of the Washington State Department of Transportation's "Incident Response Guide" instructions on providing motorist information through the VMS and HAR:

4. Inform the Highway Radio Operator when the incident has been cleared.

5. Request that the message(s) be deleted. The message will be deleted as soon as possible.

6. Conduct a follow-up to ensure that the message(s) has been deleted.

Not only do the procedures account for reporting incident clearance information, but they also provide for a confirmation of the accuracy of the information.

Message or No Message During Non-incident Times?

There is considerable discussion and disagreement regarding the message to put on a sign when there is no incident-related information to give. There are essentially two different schools of thought regarding whether non-emergency messages should be displayed (VMS) or announced (HAR). The first insists that only emergency or incident-related messages should be displayed or announced so that when it is necessary for motorists to be alert or take action they will actually pay attention to the sign. Repetitious non-emergency messages are thought to dull motorists' sensitivity to the message when it is incident- or emergency-related and to reduce motorists' respect for the sign's purpose.

The second school of thought views repetitious observance of the sign as a benefit. Non-incident -related information, such as carpool information or safety reminders (e.g., "Buckle Up") habituate motorists to observing the signs or tuning into the messages for traffic-related information. During an incident, it is likely that they will, out of habit, turn to VMS or HAR for information. In addition, leaving the sign blank may lead drivers to believe that it is not working.

Given that motorists begin to ignore static warning signs (some don't even recall passing them), it is likely that motorists will also start to ignore messages provided through VMS or HAR. However, sometimes "bargaining" with additional messaging, such as safety reminders or even advertising, can help to ensure the funding and implementation for a VMS or HAR system. There is no uniform practice.

Media — Friend or Foe?

An adversarial relationship may develop between incident response personnel and the media. Misperceptions by both parties often lead to this less than ideal relationship. Incident responders may feel that the media is "out to make them look bad" and as a result are less willing to openly share information. The media perceives this unwillingness to share information as an indication that the incident responders are "doing something suspicious or inappropriate." Much can be gained by both parties through an improved relationship.

The media, through radio, television, newspapers, has the potential to reach a large number of motorists either at or approaching an incident scene (through radio) or before departing home, work, or some other location. Immense public sector funds would be required to provide comparable coverage. In addition, better utilizing the media for motorist information means the elimination of start-up costs and delay. The media already has infrastructure in place and a well established customer base. In addition, it has the ability to address customer needs by "packaging" information in a format that a specific customer will want. Not everyone needs or wants the same information. The media can also provide aerial surveillance. In most major urban areas, one or more radio or television stations provide their own aerial coverage of traffic. Not only is this beneficial for motorist information efforts, but communication with media aerial surveillance personnel can improve decision making abilities by incident responders at the scene of an incident. For example, the media aerial surveillance personnel can report the extent of traffic backups, secondary incidents, or improved access routes for responders not yet at the scene.

As described, this relationship seems one-sided; what does the media have to gain from this relationship? Given the competitive nature of the media industry, improved, consistent, and reliable traffic-related information would provide an edge over competitors.

Improving the relationship between incident responders and media personnel requires an understanding of each others perspectives and limitations. Media personnel need to be more sympathetic to the urgency with which incident responders must complete their actions; repetitively calling or contacting incident personnel only takes them away from their duties at hand, aggravates them, and makes them less likely to be cooperative. Incident response personnel need to be more sympathetic to the informational needs of the media. Interdisciplinary training or the involvement of media personnel in administrative traffic management teams may help to increase awareness of both parties and improve relationships.

Limitations to using media for providing motorist information include the following:

- traffic reporting may not receive high priority
- traffic reports may not be provided frequently enough to be useful
- traffic reports are often restricted to peak periods; at 7 PM, motorists may be "out of luck"

- formats and accuracy vary among media stations

- media reports may focus only on the largest incidents (reporters are news people and big incidents are news items); other incidents and consequent traffic information may be overlooked

- traffic reports may lack specificity; information that has a "news" format may not be specific enough for motorists to act on.

- motorists without radio or television, or not tuned into radio or television, are unreachable

Tools/Strategies for Improving Motorist Information

A number of tools or strategies can be used, and are currently being used around the country, to improve motorist information. Many of these are listed below.

Non-technical Tools/Strategies

- Cooperative Partnerships with the Media

Technology-based Tools/Strategies

- Variable Message Signs (VMS)
- Highway Advisory Radio (HAR)
- Telephone Dial-In Services

Emerging Technologies

- Automatic Highway Advisory Radio (AHAR)
- Radio Data Systems (RDS)
- Personal Communication Devices (PCD)

- Route Guidance Systems
- Informational Kiosks
- Internet and Computer Bulletin Boards

Each of these is described more fully below.

Non-technical Tools/Strategies

Cooperative Partnerships with the Media

Cooperative media partnerships help to ensure that public sector agencies are fully utilizing resource opportunities that exist. To shift much of the incident-related information dissemination from public agencies to private media agencies is efficient for everyone. Most motorist information is now broadcast over commercial AM and FM radio stations or related on television newscasts. Cable television stations, in some markets, provide traffic information and, in some cases, are able to displayed traffic conditions graphically. Videotext, the method by which text messages are displayed over regular television broadcasts, can be used as well.

As an indication of the importance of providing traffic-related information, private traffic reporting firms that collect, package, and "sell" traffic information to the broadcast media have developed in many urban areas. Metro Networks is the largest supplier of local and regional traffic, news, weather, and information, providing information to more than 1,500 radio and television stations in the world.

Improving media relationships requires an improved understanding of media perspectives, needs, and limitations, as well as a media education effort to stress the importance of accurate and timely information. Interdisciplinary training or administrative traffic management teams may provide convenient forums for improving media relations. For a full description of improved media ties as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included at the back of this notebook.

Technology-based Tools/Strategies

Variable Message Signs (VMS)

Variable message signs (VMS), also known as changeable message signs (CMS), are most useful for providing dynamic information regarding unusual conditions (incidents, construction and maintenance activities, special events, access to parking), guidance information regarding diversion (local and regional information, alternative routes), and warning of conditions ahead (end of queue - stopped traffic, lane closure).

Some things to consider before purchasing and implementing VMS include the following:

- sign type
- sign location
- sign visibility and readability
- sign wording and messages
- system operation plan.

Each of these considerations is described in more detail below.

Sign Type

Drum type signs consist of fixed messages on two or three revolving drums. The drums have three or four sides. There is limited message flexibility; however, these signs are less expensive to buy and to operate. Matrix type signs form messages from a fiber optic or disk-based (i.e., flip-disk) matrix of dots. A much wider variety of messages is possible with matrix signs than with a drum sign.

Signs can be permanently installed at fixed locations or they can be portable, on a trailer or mounted on a truck.

Signs can be operated from a variety of power sources, including battery and solar.

Sign Location

To ensure its maximum effectiveness in communicating with the motoring pubic, not only does the information have to be accurate and up-to-the minute, but the signs have to be located carefully. If they are too far ahead of a decision or diversion point (i.e., freeway off-ramp), information is forgotten or the reference is confusing to drivers. If they are too close, there is not enough time for motorists to take appropriate action (i.e., reroute). In Baton Rouge, Louisiana (1990 population 219,531), personnel are investigating dual-direction, permanently installed VMS signs. The VMS sign would be installed in a median area of a divided facility and would provide messages to traffic traveling in opposite directions. This approach is being considered in an effort to reduce the initial capital investment for the VMS system.

Sign Visibility And Readability

VMS sign visibility can be affected by ambient conditions (i.e., bright sunlight, fog) or by other external lighting sources. The visibility of flip-disk matrix VMS signs has been improved by combining fiber optic technologies and the flip-disk design. The traditional flip-disk design relies on a series of disks painted black on one side and a visible color on the other. To form the various messages, a combination of disks forming the various characters are "flipped" so that the visible side faces outward; the rest are "flipped" to their black side. To improve the readability of the visible color, a light-emitting, fiber optic "spot" is placed in the center of each disk.

Readability of the sign can be limited if the characters used on the message are too "blocky" (e.g., is it an 8 or a B?). Readability is also limited by the size of the sign and the resulting characters and the speed at which vehicles pass the sign.

Sign Wording And Messages

Determining the appropriate wording of VMS messages seems like a simple enough task. However, as the example below demonstrates, the same information can be worded in numerous ways. A national survey was recently conducted on ice warning sign messages (Washington State Department of Transportation 1997). Survey results indicated that 23 different messages are used across the country to warn motorists of potentially hazardous, ice-related conditions (see below).

- BRIDGE DECK FREEZES BEFORE ROAD SURFACE
- BRIDGE MAY ICE IN COLD WEATHER
- BRIDGES FREEZE BEFORE ROAD
- BRIDGES FREEZE BEFORE ROADWAY
- BRIDGES FREEZE FIRST
- BRIDGE(S) MAY BE ICY
- CAUTION BRIDGE MAY ICE IN WINTER
- CAUTION ICY BRIDGES
- ICY
- ICY PAVEMENT ZONE
- ICY ROAD
- ICY SPOTS NEXT _ MILES
- REDUCE SPEED DUE TO ICE AND SNOW
- REDUCE SPEED DUE TO ICE AND SNOW OR "DUE TO ACCIDENT"
- REGIONAL ALERT - ICE MAY BE PRESENT ON ROADWAY
- ROADWAY ICY CHAINS ADVISED
- ROADWAY ICY IN SHADED AREAS
- SLIPPERY WINTER CONDITIONS
- WATCH FOR ICE
- WATCH FOR ICE ON BRIDGE
- WATCH FOR ICE ON BRIDGES
- WATCH FOR ICE ON ROAD - BRIDGE
- WATCH ICE IN SHADED AREAS

This example clearly demonstrates the potential for variation in message wording. Planning must ensure that the message contains essential information and is clearly understood. The message must also be short enough to be read by a motorist in a moving vehicle, since attention is shared by the driving task. Length greatly diminishes in message utility.

When possible, specific diversionary information should be provided. An analysis of the INFORM (Information for Motorists) program, an integrated corridor on Long Island, New York, that provides (1) motorist information via variable message signs (VMS) and (2) traffic control using ramp meters, has estimated that drivers will divert 5 to 10 percent of the time when passive (no recommended action) messages are displayed and 10 to 20 percent of the time when messages include diversion information (1996)

System Operation Plan

VMS signs should be located and used in a planned and coordinated manner to obtain desired cooperation from motorists. Signs should be used in a system rather than independently. This requires an operations plan for deploying messages that are consistent. Dispatch procedures should be established for portable VMS. If messages are not computer selected, criteria and responsibilities for message selection and display should be established.

For a full description of variable message signs as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included at the back of this notebook.

Highway Advisory Radio (HAR)

Highway advisory radio (HAR), similarly to VMS, provides traffic information to motorists at or approaching an incident. Benefits can be realized if HAR is used as a supplement to VMS. Advantages of HAR include the following:

- HAR has larger area of coverage than VMS and can reach motorists farther upstream of an incident

- HAR can provide longer, more detailed messages
- Bilingual messages can be broadcast.

Disadvantages to HAR include the following:

- proper HAR operation is personnel-intensive
- updating HAR messages sometimes can be a secondary responsibility
- HAR quickly loses credibility if false or untimely messages are played
- HAR is only effective if the motorist tunes the radio to the proper HAR frequency.

Some things to consider before purchasing and implementing HAR include

- HAR type
- HAR frequency and range
- FCC regulations and licensing
- HAR signing requirements

HAR Type

Both permanently installed and portable HAR systems are available. Permanently installed HAR systems have a longer transmission range (typically 1 to 4 miles), but once they are installed, they only benefit a limited area. Portable HAR systems consist of small, low-powered units that are placed in a pickup truck or other vehicle and taken to an appropriate site during an incident. The range for portable HAR systems is more limited, up to about 1 mile. A plan for deployment should be developed for portable HAR systems to be used most effectively.

HAR Frequency And Range

HAR primarily broadcasts at 530 or 1610 kHz on the AM broadcast band, although the FCC will allow the use of other frequencies that are available. Use of 530 or 1610 kHz may be limited by other communications users such as airports or amusements parks. The Virginia Department of Transportation has acquired a license to operate on 650 AM in Northern Virginia to improve signal quality (Virginia Transportation Research Council 1995).

Broadcast ranges typically run from 1 to 4 miles, depending on equipment and local conditions. The broadcast range can vary greatly with topography, antenna location, and weather conditions. In addition, certain car radios can limit the reception of HAR; some factory radios provide more FM reception by decreasing sensitivity to AM stations.

FCC Regulations And Licensing

To establish a HAR frequency, application must be made to the FCC by the operating agency. Once a frequency has been assigned, an evaluation period takes place to ensure that there is no interference with other stations on the same or adjacent frequencies.

HAR Signing Requirements

Signing is usually helpful to let motorists know that HAR is available and to tell them the frequency. Flashing amber lights are frequently used to alert motorists of new and/or important information. Signs advise motorists to tune to the HAR frequency "when flashing."

For a full description of Highway Advisory Radio as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included at the back of this notebook. For further operational guidance, refer to "An Investigation of Operational Procedures for Highway Advisory Radio Systems" (Virginia Transportation Research Council 1995) included in the Further Reading section of this module.

Telephone Dial-In Services

Through telephone dial-in methods, motorists are allowed to call for information when it is needed, either by conventional telephone or cellular phone. Some areas have traffic information prepackaged to be route or trip specific; listeners don't have to listen to traffic conditions across an entire area to pick out the routes of interest. Other areas have traffic telephone numbers that provide area-wide information. Some areas charge a fee to motorists for a call.

Telephone dial-in services for motorist information are provided by both the public and private sector. The Smart Traveler program in Boston, Massachusetts (1990 population 574,283), offers real-time, location-specific traffic and transit information such as conditions, travel times, and accident reports in the Boston metropolitan area via telephone. Since 1993, Smart Traveler has experienced a large increase in calls and users, especially in the cellular telephone market. It is currently offered as a free service as a result of public and private support. ROAD WATCH AMERICA provides regional road information such as current weather, road closures, construction, accident, and road condition information by calling 1-800-DRIVERS.

Emerging Technologies

Many new technologies are being developed to provide real-time traffic and road condition information to motorists.

Automatic Highway Advisory Radio (AHAR)

Automatic highway advisory radio (AHAR) improves the timeliness, accuracy, and usefulness of existing HAR technologies by automatically updating information and linking a series of HAR sites. As a motorist approaches an incident scene, he or she may have passed through a number of HAR transmission ranges. The first message heard by the motorist may indicate that there is an incident 7 miles ahead and that the motorist should think about rerouting onto a particular route. The next message heard by the motorist is that there is an incident 3 miles ahead and that there is only one more opportunity to reroute onto an alternative route before the traffic queue will be reached. An operational test, DIRECT, along sections of I-75 and I-94 within the city of Detroit, Michigan (1990 population 1,027,974), will evaluate several alternative low-cost methods of communicating advisory information to motorists, including Automatic Highway Advisory Radio (AHAR).

Radio Data Systems (RDS)

Radio data systems allow the temporary interruption of standard FM radio broadcasts to relay incident-related traffic data. RDS relies on digitally coded traffic-related data, an adapted car radio capable of decoding the signal, and data transmitters along the roadway. When the pertinent traffic information has been relayed, the FM broadcast is automatically resumed.

The DIRECT operational test described above will also evaluate the use of the Radio Data Systems (RDS) as a low-cost method of communicating advisory information to motorists.

For a full description of radio data systems as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included at the back of this notebook.

Personal Communication Devices

Personal communication devices, such as personal digital assistants, notebook computers, and alpha-numeric pagers, can be used to receive motorist information. One drawback to this technology is that service is limited to subscribers of communication services (i.e., cellular or digital service).

An operational test, Genesis, in Minneapolis/St. Paul, Minnesota (1990 population 368,383/272,235 respectively), is considering the distribution of real-time traffic information through personal communication devices (PCDs) such as personal digital assistants, notebook computers, and alpha-numeric pagers. A second operational test, SWIFT, in Seattle Washington (1990 population 516,259) is integrating traffic and transit information, including incident information, for broadcast over the Seiko High Speed Data System (HSDS) for delivery to drivers and transit users via three devices: a portable computer, a vehicle navigation system combined with a car radio, and a Seiko's wristwatch pager.

Route Guidance Systems

Route guidance systems rely on in-vehicle devices and externally communicated, real-time traffic information to recommend traffic routes on the basis of current conditions. For example, if a roadway is experiencing heavy congestion because of an incident, a motorist might be recommended, through his or her in-vehicle device, to take an alternative route. The in-vehicle device can offer recommendations for route diversion in graphical or text format.

The ADVANCE operational test in Chicago, Illinois (1990 population 2,783,726) is evaluating vehicles equipped with in-vehicle computers and radio communications that act as traffic probes to provide traffic information. Actual travel times are determined by these probe vehicles as they traverse the test area. The information is then transmitted over a radio system to the Traffic Information Center, where it is processed to detect traffic incidents and to predict current travel times. Revised estimates of travel times are transmitted back to the probe vehicles to determine whether the traffic information affects the route that has been selected. If there is an impact, the on-board equipment will provide alternative routing for the driver to avoid the traffic incident or congestion. The routing information is presented to the driver through voice instructions and in the form of arrows depicting the required turning movements.

Other route guidance operational tests include FAST-TRAC in Oakland County, Michigan, SWIFT in Seattle, Washington (1990 population 516,259), and TravTek in Orlando, Florida.(1990 population 164,693).

For a full description of route guidance systems (listed as externally-linked route guidance systems) as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included at the back of this notebook.

Informational Kiosks

Real-time traffic information can be sent via a communications link and displayed on a kiosk-mounted video monitor from an external traffic information source. Kiosks can present a consistent program of information or can be interactive, allowing the motorist to pick and choose relevant information. A kiosk can be located at any public place that travel originates from. Typical locations include shopping centers, employment centers, airports, hotels, and car rental agencies.

An operational test, Smart Traveler, in Los Angeles, California (1990 population 3,485,398), is evaluating interactive kiosks that allow travelers to view up-to-the-minute freeway conditions throughout the Los Angeles area. The kiosks are currently located at office complexes, shopping malls, and transportation centers. Site selection was based on the density of foot traffic, hours of public availability, security, and a willingness to participate.

Internet and Computer Bulletin Boards

The Internet was originally used to connect a U.S. Defense Department network (ARPAnet and various other radio and satellite networks) 20 years ago. Today, it is a global resource connecting millions of users. A variety of new capabilities in the network, including a directory, indexing, and searching services, has enabled exponential growth of the Internet.

The ability to disseminate transportation information through the Internet has allowed transportation agencies to provide the public with information such as real-time traffic congestion, incidents, updates on construction activities, and other transportation-related information. The information is available 24 hours a day at a relatively low cost to the providing agency, and it can be accessed by users from home or work via computer.

The providers of traffic information services on the Internet must expend extensive manual effort to reformat traffic data into appropriate and useful information for motorists. The public has high expectations of the accuracy, the look, and the transmission speed of the traffic information. For additional recommendations on how to improve the dissemination of transportation information to motorists via the Internet, refer to "The Use of the Internet as an Effective Tool for Disseminating Traveler Information" (Schull 1996) included in the Further Reading section of this module.

Phoenix, Arizona's (1990 population 983,403), Trailmaster Internet site features a map of the freeway system, which contains average traffic speeds and alerts drivers to areas of heavy congestion. A still-frame photo of the area's freeway conditions is also available by clicking on a specific camera location. Traffic conditions and camera photos are automatically updated every 5 minutes. The Internet site is very popular, with more than 23,000 hits a day.

National Examples

Improved Media Ties in Virginia

Incident response personnel in Virginia found an excellent way to ensure that the needs of both incident responders and media personnel are met at the scene of an incident. At major incidents, local media report to the scene in hopes of getting camera shots of the incident and sound-bites from personnel managing the incident. Traditionally, media personnel from many stations would arrive throughout the incident, approach incident response personnel, and if turned away, approach someone else. Incident response personnel would get annoyed with the interruptions and be concerned over the media personnel's safety at the scene.

An improved approach requires all media personnel to report to a staging area near the incident scene. When incident responders have completed urgent tasks at the incident scene, a group of media personnel are escorted to the incident scene so that they may interview incident response personnel and get camera footage of the incident. The media personnel receive the information that they require, and the interaction with incident responders is much more efficient and productive.

Internet and Computer Bulletin Boards at Chrysler

Chrysler and the Road Commission for Oakland County (RCOC) introduced a traffic program called FAST-TRAC TV to alert employees to traffic jams on county roads. The information is disseminated via computer-generated maps and text messages, which are broadcast on computer monitors throughout the Chrysler Technology Center from 3 PM to 6 PM. The RCOC plans to expand the program to benefit other motorists via cable television, home computers, kiosks, and other media.

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SOURCE: Washington Post
Michael D. Shear and Leer Smith

Gridlock on I-95 Drove Motorists To Extremes

Stranded Saturday in 20 miles of bumper-to-bumper traffic caused by an overturned tanker carrying toxic chemicals, thousands of travelers on the East Coast's busiest thoroughfare spent hours barely moving an inch and coping as best they could.

Some coped with more grace than others.

As gridlock extended northward on Interstate 95 in Virginia from Fredericksburg to Dale City, hundreds just turned off their engines and dragged picnic fixings onto the nearest patch of grass, according to police. Others were less patient; some tried to drive on the shoulder, while a few took off across the median and drove south along the northbound section of the busy highway. There were reports of angry motorists brandishing handguns at those who blocked their way.

Police said about 100 tickets went to drivers whose tempers and instincts led them in the wrong direction-literally or figuratively.

At least a dozen people got so frustrated they walked away and abandoned their cars.

Plenty of stranded drivers stretched their legs, strolling along the interstate with their pets or children. And when all else failed, some partied.

"People were really in a good mood about it," said Debbie Harrelson, 29, who sat for three hours trying to get to a high school football game in Stafford. (She never made it.) "They knew they weren't going anywhere, and they had gotten past the mad stage. People knew they had been defeated."

But the biggest problem many faced, according to police, was biological.

Hidden in bushes on the median, beside cars standing idle in a virtual four-lane parking lot, and--for a few immodest types--in full view of fellow motorists, men, women and household pets relieved themselves.

“They were going behind cars, upon the embankments looking for trees, any kind of privacy they could find,” said Virginia State Police spokeswoman Lucy Caldwell. “It's a violation of state law to urinate in a public place, but under the circumstances, no summons were issued.”

The problem is understandable, according to specialists in anxiety disorders. Feeling trapped can make people sense that they have to go.

“It was truly unbelievable,” said Lon Anderson, whose bloodhound, Ellie, got an unscheduled stroll down the middle lane of I-95 during the four and a half hours the two spent trapped in the gridlock. “She relieved herself, which was something I couldn't do.”

Anderson, who happens to be a spokesman for the Potomac chapter of the American Automobile Association, said that there were too few police directing traffic at key intersections and that people should have been allowed to cut through the median by using emergency vehicle access roads to turn around and head north.

He also said state police should have tried harder to inform those stuck in the mess what was going on.

“They could have sent a cruiser up and down the median using a loudspeaker ,” he said. “They could have done that from a helicopter and broadcast the information to thousands of people.'

Police said the median cut-throughs were not used because of safety and logistical concerns. They said there were 12 officers for the 20-mile backup, including extra troopers who were called in to help manage traffic.

“We followed our incident management plan as it was written,” Caldwell said.

State officials will critique the incident on Friday to discuss any possible improvements, but, Caldwell said, "motorists were very agitated."

John Undeland, an official at the AAA, said motorists stuck in traffic for more than 15 minutes should turn off their engines to preserve gasoline and prevent overheating.

"The thing to do in these situations is accept the fate that you are stuck and not let your temper get the best of you," he said.

That may be hard for many people to do, especially after sitting for hours in traffic that isn't going anywhere, said Jerilyn Ross, a Washington psychotherapist who deals with anxiety disorders.

"People have a tough time dealing with feeling trapped and out control, and that's what a traffic jam is, the ultimate trap," she said.

Ross suggested that stranded travelers play word games with license plates to take their minds off the situation. She said breathing slowly and deeply can help calm frazzled nerves. And she said motorists should roll down their windows or, if safe, get out to talk to each other.

"Human contact helps you feel less alone and isolated," she said.

State police have been unable to confirm reports made via cellular phones of armed confrontations between disgruntled motorists who wanted others to get out of their way. None was apprehended. The 100 or so tickets issued went for making illegal U-turns and parking and driving on the shoulder of the road.

Officials at Bell Atlantic-Nynex Mobile said cellular calls on their network increased by 10 times the normal load in the area of the traffic backup, which was the largest since a truck containing toxic materials caught fire on I-95 in July 1991, trapping thousands of motorists in Fairfax and Prince William counties for more than four hours.

SOURCE: Emergency Response & Research Institute, 1991
Clark Staten, EMT-P, I/C
District Commander, Bureau of EMS
Chicago, IL. Fire Department

EMERGENCY SERVICES GUIDELINES FOR MEDIA AFFAIRS

Today's world is in an information age; the events in the Persian Gulf war have accurately demonstrated the public's "thirst for news". It that seems to be endless. The methods of gathering news have also drastically changed in recent years. Electronic news gathering (ENG) means that more and more news-gathering outlets are seemingly... constantly....everywhere. The availability of audio and video satellite "up-links" means that news can be covered...any where.... any time. Experience suggests that major disasters occurring in even extremely rural areas will be covered by helicopters, "satellite dish" trucks, and reporters with radio and cellular telephone capabilities which often exceed the resources of the agency attempting to manage the incident.

It would also seem that reporters have a deep and unbridled interest in any type of incident that involves......gore, dismemberment, dying, or death. While human suffering has been a continual source of morbid curiosity since the beginning of time, it is far more likely that the true story rests in the need to complete the blank spaces in the pages of the paper, fill the endless hours of news radio, and to stir the emotions of television viewers.

A question that is frequently asked is; why do reporters seem so insensitive to the plight of victims of injury or illness? The answer may partially rest in the process of continued exposure to horrendous sights and sounds and the desensitizing (and emotionally saving) effect of psychological denial. A secondary answer, undoubtedly involves some of the same motivations that allow emergency responders to continue to function....it's their job. Just as emergency responders are required to attend to the often senseless mayhem and tragedy of disaster, reporters may not relish the thought of "wading through the `mud',`guts', and `blood' of today's major incidents, but, it is their livelihood.

In light of this conflict of the public's right to know and the emergency responder's desire for patient confidentiality and "freedom to function without restriction or interruption", a common ground of understanding must be reached. Regardless of whether or not an emergency responder wants the "media" to participate at an incident....they will!! Therefore, it behooves the prudent emergency responder and/or manager to learn to understand and manage their response to the "media" rather than to allow the "media" to dictate the terms under which the relationship will take place.

Several suggestions (Do's & Don't's) may prove useful in responding to inquiries of the press during and after an emergency incident. In order to assist in this interchange, the following items are submitted for consideration:

DO's

1. Do have a media affairs plan that details who will be responsible for the dissemination of information at an incident. Remember that reporters will want to speak to someone who can make an "official statement". If possible, designate an identifiable individual as the Public Information Officer (P.I.O.). This person should normally be prepared to issue periodic statements on behalf of the agency that has jurisdiction for the management of the incident. It is suggested that this person be in a middle-management position and wear something distinctive to make him/her easily identifiable.

2. Do issue a statement at the earliest possible on-set of the incident and try to update it as circumstances permit. Attempt to establish an area for the media and attempt to restrict them to that area. Safety is paramount, and most media personnel are not aware of the dangers of an incident scene. Explain it to them that way. Normally, the incident commander (I.C.) is not the person to answer questions during the continuation the incident. He/she is, presumably, too busy managing the scene to spend time answering questions. After the "action" is over or at least under control, The I.C. should then be briefed by pertinent officers and then give a statement to the press. Questions can be answered, and the agency view of the incident provided in an organized manner.

3. All other emergency responders, at the scene, should know who the P.I.O. is and that they should refer anyone asking questions to that person. Individual medics, firefighters, or police officers should be discouraged from "ad-libbing" answers to "potentially loaded questions", largely due to their limited view of the overall operation. Avoid contradictions by channeling requests for information through senior managers and the P.I.O.. All providers should try to avoid the impulse to be rude, curt, or impertinent to anyone asking questions at the scene.

DON'T's

1. Don't use the expression; "No comment". To do so, can be likened to "waving a red flag in front of a bull". The reporter needs information in order to fulfill his/her responsibility, just as you need to perform certain actions to manage and cause the ultimate success of the rescue.

   The age-old, "No Comment", is likely to provoke a negative view of your operation, regardless of it's real quality. Instead, refer the media-person to the P.I.O. or a supervisor. Don't delay your rescue services to take time to talk to the press, but, also don't alienate them with short negative replies. A far better approach is; "We are currently gathering information about that...I'm sure that we will be releasing information about that as soon as possible". Or say, "Please see the P.I.O. about that, I'm sure that he/she has more information than I do".

2. Never lie!! If you don't know the answer to a question, say so. It's better to look stupid than be proven untruthful No one knows everything. A conscientious effort is all that can be expected.....even though a callous or unthinking media-person might suggest otherwise, or imply malfeasance, ineptitude, or a "cover-up". You can only address the facts as you know them. Don't guess, promise to get a correct answer at the earliest opportunity and then do so. Continued antagonistic or untruthful responses to press inquiries will undoubtedly impact your service in a very negative way in the future.

3. Don't avoid the press or forever sequester them in a "Press Area", that will prevent them from getting a real perspective of the "story". Conduct a "tour" of the incident scene, when it is safe to do so. Point out pertinent locations and give details of what occurred there. Remember, that if you (or rather your spokesperson) don't give them a "story", they may be encouraged to "make it up" or present it in a manner that may be inconsistent with the ultimate goals of your career or your organization. Practically all emergency services exist with the "consent, goodwill, and support of those who live in that jurisdiction". Without this "goodwill", which is generated in part by the press, it is unlikely that necessary funding will be obtained or that the service will receive the political support to effectively perform its essential services without interference.

It is recommended that the P.I.O. or a senior level supervisor should give "stand-ups" interviews or photo opportunities on a frequent basis. Someone should conduct a tour of the site, and give a briefing of what occurred, and present your "side of the story" in a positive light. By providing the complete details from your organizational viewpoint, it is likely that you will benefit from the experience, rather than suffer from it. Media relations can be a very positive asset to your organization or a devastating public debacle. As with any other emergency response problem, media affairs can be adequately managed and prove an asset to you and your organization.

One of the keys to effective participation with the press is to establish a friendly relationship prior to the event. Reporters are people, just like everyone else and should not immediately be viewed as an adversary. By carrying out an on-going program of interaction and information sharing, emergency agencies can help to insure that they will at least "get a fair break" when the unconventional or controversial incident occurs. Always try to provide the local media sources with continual stories and news releases that portray the service in a favorable light.

For example, pictures of ambulance crews with "mom and a newly born baby" (promptly provided to the press) are far more positive and beneficial to the reputation of the service than the dramatic overturned car with its dead and dying. The eventual outcome, however, of your overall media affairs program is dependent upon the training, preplanning, and conduct of all emergency personnel at the scene. Only by being educated and trained about the expectation of media involvement can the emergency responder or supervisor be prepared to manage the incident to the greatest benefit of the responder and the service that he/she serves. By being prepared for the eventuality of press coverage, an improved image and perception of your emergency services can be achieved.

(Ed. Note: The author served as a "media affairs officer" and senior EMS supervisor for one of the nation's leading fire departments and has managed the media at hundreds of incidents).

SOURCE: Forbes March 10, 1997
Christopher Palmeri

THE KING OF GRIDLOCK

Jackknifed tractor-trailers and rubberneckers.
A pain to you commuters, but money in the bank for David Saperstein,
the king of radio traffic reports.

If You live in San Francisco and tune in to the top news/talk radio station, Joseph McConnell is your traffic reporter. If you prefer the soul music station, McConnell still delivers your traffic report- Golden oldies, You still get your morning rush hour report from McConnell.

From a central studio in downtown San Francisco, McConnell delivers traffic and news Reports to six radio Stations and an ABC television affiliate. Through the course of a morning rush hour, McConnell regularly changes the meter of his voice and occasionally his name, using Joe Vincent instead. -I try to blend in, McConnell says, explaining how. he manages to banter with disc jockeys in formats from classic rock to religious. "Each station has a different ,personality, but most want their traffic straight."

McConnell works. for Metro Networks, Inc., the nation's largest provider of radio traffic reports. Metro fields 76 airplanes, 17 helicopters, 30 cars and vans and 19 fixed-position cameras (one of them atop the Empire State Building). Metro delivers reports to more than 1,300 radio stations, roughly half of all the stations in major U.S. markets. It also services 114 TV stations.

Thanks to customization, few listeners suspect that the reports they're, getting are canned. In Houston, Metro delivers broadcasts in Spanish and Vietnamese. In Chicago, news on the latest rubber-necking is available in Polish. Listeners in several cities – New York, Washington and Chicago among them – can call in to special traffic information hot lines affiliated with their local radio stations but staffed Metro employees.

Metro is the creation of David Saperstein, a tireless salesman. A fitness nut, Saperstein eats the same salad with diced chicken every day for lunch and dinner. his approach to business is just as obsessive; To make that sale, he'll trade radio time for just about any good or service. A onetime Ford dealer, Saperstein got the idea for metro while stuck in a Baltimore traffic jam in 1978. He figured he could get free advertising for his car lots if he assembled traffic reports and offered them to radio stations in exchange for airtime.

Within a month, Saperstein had signed up three stations and two traffic reporters. As payment, Saperstein asked for ten seconds at the end of each broadcast. " It helped that I didn't know a lot about radio," Saperstein says today. "no one thought you could do anything creative in ten seconds."

Ideas are money, if handled properly. For the year just ended metro Networks produced $25 million in cash flow on revenues of more than $100 million. In October, Saperstein, now 56, sold half of the company to the public, putting $58 million of the $132 million raised into his pocket. He still owns the other half of Metro, a stake recently quoted at $180 million

Saperstein's pitch to his radio clients is that he doesn't compete with them for local advertising. He goes after national and regional advertising from companies like Albertson's supermarkets, ABC television and America West Airlines. An advertiser who wants to hit potential customers in Cleveland, for example, pays $37,500 for 500 ten-second spots over the course of a month. That $37,500 gets you 24 radio stations, reaching and audience of more than 1.5 million people – a cost per thousand that Metro claims is 20% less than similar exposure in the Cleveland *Plain Dealer.*

The ten-second spot allows for local customization. When the city of San Antonio banned the use of sprinklers during a drought last summer, advertiser Builder's Square shifted its message to pitch special "soaker hoses" that use less water. 'We sold out our entire inventory in two days boast's Builder's Square Chief Executive Frank.

Nothing this good lasts long without attention from competitors. As the radio industry consolidates, it's likely that large station groups will bring traffic reporting back in-house or at least extract tougher from Metro Networks. Jacor Communications, the nation's second-largest radio group, brought traffic reporting back in-house at its Atlanta stations recently.

Similarly, Saperstein's biggest competitor, Shadow Traffic, is now affiliated with broadcasting giant Westinghouse Electric Corp. Saperstein has 30-odd Westinghouse stations under contract, and Metro could make a big hit as the Westinghouse business dwindles.

But Saperstein is nothing if not resourceful. When he built his $3 million home in Houston's posh River Oaks neighborhood, local legend has it that he was so good at bartering radio time for goods and services that you could tell what stage of construction the house was in by the ads that ran on Metro's traffic reports-from roofers to pool men to electrical contractors. Expect him to be just as nimble now that he's under fire from competitors.

He has diversified into news, sports and weather programming. And has started applying the formula that's worked so well in radio to television stations. In Houston, for example, all seven of the TV stations that put together local news shows augment their coverage with a Metro run video service. It sends camera people out to shoot routine events like press conferences and city council meetings, enabling the stations to save their expensive crews for more important stuff. The TV stations pay in a mix of cash and airtime, which Saperstein resells.

Today television brings in less than 10% of Metro's sales, but Saperstein says it could account for half within five years. Wall Street is counting on it. With the stock up nearly 40% from its initial offering price, Metro recently traded at 15 times estimated cash flow for the year just ended. Implied in that price is a hefty 30% increase in cash flow that Wall Street analysts are projecting for this year.

Can Saperstein deliver? He's smart and lucky, but tactics sometimes backfire. At a party he threw five years ago, he and his wife Suzanne came dressed as cavemen. Saperstein, being Saperstein, couldn't let it go at that. For extra flash he hired a family of tigers and a trainer. The fun was nearly ended when on of the cubs bit into Saperstein's behind. moral: There's such a thing as pushing your luck too far.

SOURCE: **1989 ITE Compendium of Technical Papers**
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CHANGEABLE MESSAGE SIGNS FOR FREEWAY OPERATIONS--PRELIMINARY RESULTS OF SIGN USAGE IN THE LONG ISLAND FREEWAY CORRIDOR

Each month, thousands of messages are being displayed on changeable message signs in the Long Island freeway corridor. Each message on each sign is a part of an overall strategy to alleviate traffic congestion on Long Island. According to an independently conducted market research survey of drivers who travel the instrumented roadways, 96% of the drivers' surveyed have seen the signs and 49% have used the sign messages to avoid delays. Of those who used the information, 87% responded that the information was helpful (1). These statistics are the result of careful planning, dedication to accuracy, and proper application of transportation engineering principals. Although quantitative results of :the effectiveness of sign operation in reducing delays are not yet available, a number of conclusions can be drawn from the operational experience to date.

INFORM

INFORM is a corridor traffic management system located on Long Island in New York State. The corridor begins in Queens County east of Manhattan's river crossings, and extends further east on Long Island approximately 35 miles (56 kilometers). The corridor centers around the Long Island Expressway (1495) and Northern State/Grand Central Parkway in the northwestern quadrant of the island. One hundred and thirty miles of highways are instrumented with system equipment. The objective of the system is to manage the flow of traffic in and through the corridor with regulatory traffic control (ramp metering and intersection control) as well as gathering and disseminating of traffic information to drivers. In addition to its 74 changeable message signs, the system has the following features:

- 2400 Vehicle Detectors: Provide data by which traffic flow characteristics can be measured and calculated.

- Operations Facility for Data Processing and Communications: The facility houses all of the data gathering, processing, and control equipment. A twenty four hour staff is Provided 365 days each year.

- 64 Ramp Meter Sites: Initial operations have demonstrated a 13% reduction in travel time for metered motorists, and a 20% reduction in travel time for non-metered motorists.

- Radio Communications Monitoring: INFORM operators monitor citizen band and police radio communications primarily for incident Verification and management.

- Intersection Control: INFORM controls 110 intersections in the corridor. Intersections on Long Island Expressway service (frontage) roads as well as intersections on key arterial routes are included.

- Contracted Operations and Maintenance: The' INFORM system is maintained by three contractual agreements obtained through a competitive bidding process. The changeable message signs are maintained by the sign manufacturing vendor who supplied the signs. System operation is accomplished by a transportation engineering consulting firm. The firm planned and accomplished the start-up of operations. The firm supplies and supervises the twenty four hour control center staff. In addition, the firm supplies traffic engineering services, software engineering services, system integration services, problem diagnosis and repair needs determination, inventory management, and inspection of maintenance activities. This method of providing operations center coverage has proven to provide an effective and continuous operation of the system.

CHANGEABLE MESSAGE SIGNS: THE PHYSICAL PLANT

There are currently 74 disk matrix type changeable message signs in the INFORM system. The majority of signs consist of three message lines, each line having sixteen characters. Each character is sixteen inches high, made up of seven rows and five columns of reversible yellow reflective disks one and one half inches in diameter. There are 2 four line signs with twenty eighteen inch characters. The remaining 48 mainline freeway signs are three lines each. In addition, there are 8 two line sixteen character per line signs, 15 single line eleven character signs, and 1 three line arterial sign.

The mainline freeway signs are mounted on overhead spans, and feature a walk-in type cabinet. The three line signs have six plexiglass panels designed for a wind speed loading of at least 90 miles per hour.

The signs are externally illuminated with photocell switched luminaires mounted on brackets below the sign.

The two four line signs are placed at the freeway to freeway direct connector diversion points where it is desirable to disseminate information simultaneously about multiple routes. Nine three line signs are located on north/south freeway. routes that intersect with the two major east/west parallel freeway routes. These signs are placed in advance of the first east/west freeway interchange, and display traffic information for the route bearing the sign, as well as both directions on both east/west freeways. The 39 signs on east/west freeway mainlines are located in advance of exits to arterial (or freeway) routes which serve as diversion routes to the parallel freeway. The 8 two line signs are placed on arterial approaches that intersect with freeways or a major arterial diversion route. The 15 single signs are located on service roads parallel to the Long Island Expressway in advance of entrance ramps. Finally, the 1 three line arterial sign is on a major east west arterial, where information is provided about the arterial and both parallel freeway routes.

"Trailblazer" type fixed message guide signs have been installed on all diversion routes to guide diverted traffic.

CHANGEABLE MESSAGE SIGN OPERATION

The strategy behind the INFORM changeable message signs is to provide as much accurate and timely information to the motorists as possible. The information reflects the current conditions (the processing time for automated data gathering and information dissemination tasks is one minute).

The present popularity of the changeable message signs on Long Island is demonstrated by a recent event. The system was "down" during the morning peak period due to a power failure in central, and no sign messages were being displayed. A number of calls were received from the public requesting why the signs were not working. One commuter was angry because he was not able to choose the best freeway for 'his trip because "His sign" was blank.

The current operational procedures for signing are based on the human factors research that preceded the system design (2), with refinements and changes based on the resolution of a myriad of both technical and social issues that have arisen during actual operation.

The mechanism for forging the operational procedures has consisted of engineering staff presenting problems, issues, and possible solutions to a standing "Variable Message Sign" committee formed by NYDOT. The type of information displayed on the signs is limited to that which is approved in advance by the committee. The committee consists of both management and engineering personnel, including a representative of the system operations contractor. Specific sign texts are discussed in this forum only if they are deemed to be controversial. Otherwise, general operational policies are reviewed and revised if necessary. It is the responsibility of the operations contractor both to advise the committee, and carry out the decisions made.

Operating within the established limits, the operations contractor determines the appropriate strategies for system operation. Presently, information disseminated is limited to the following types:

- Delays due to recurring congestion.
- Delays due to non-recurring congestion: Accidents, Roadwork
- Absence of delays (Average speed ahead in excess of 30 m.p.h.)
- Weather conditions that may impact traffic flow.
- Future construction activities involving lane closures.
- Implementation of new devices.
- Catastrophic events requiring evacuation of or severely limited access to areas which are probable destinations. (e.g. bridge failure, fires, hazardous material clean-ups).

Use of descriptors like "TRUCK ACCIDENT" or "CAR FIRE" are not used. Although the system operators generally have this type of information, the committee was split between the view that such information would aid the motorist by employing his experience with delays caused by similar accidents, and the view that the incident was being made "interesting" and many motorists would choose to see it rather than divert. In the absence of unanimous opinion, a conservative approach was retained, and the information is withheld from the signs (although it is shared with the media).

Some of the social issues dealt with by the committee have resulted in decisions that have further shaped operational strategies. An example is the decision that "Normal Traffic Conditions Ahead" be displayed on signs when no delays exist between the sign and the next downstream sign. The desired result was achieved; people ceased complaining that the signs "don't work". The media and the public have struggled with the definition of "Normal Traffic", but have not complained about its use. (The mechanism for displaying this message will be discussed later.) Another result was more subtle, it appears that a slight increase in average vehicle running speed tends to occur immediately downstream of the sign (this is an observation, not a measured result). It is safe to say that the use of default messages such as "Normal Traffic Conditions Ahead" is not recommended by the transportation engineering community. The prevailing thought regarding this practice is that use of a changeable message sign when there is nothing important to say will desensitize motorists to sign messages, and they will not react to important sign messages because they will begin to ignore the signs. The fact is, that the message "Normal Traffic Conditions Ahead" is meaningful and is conveying traffic information. The commuter will eventually develop his or her own connotation for the phrase based on their experience with the road conditions after viewing the sign. Another consideration is that the absence of delays is experienced by a minority percentage of the average daily traffic, and it is equally possible that a commuter would become desensitized to "Delay" messages. It can be deduced from the Long Island experience that the use of signs to display information regarding the absence of delays has not diluted sign effectiveness. Since many motorists in this corridor viewed blank signs for years during project construction, the use of the "NORMAL TRAFFIC CONDITIONS AHEAD" signs has contributed to the system's credibility and therefore sign effectiveness.

A similar decision involved use of the word „Delays" rather than "Congestion" and "Long Delays" rather than "Heavy Congestion" in standard sign texts. The rationale for this decision was that the word "Delays" is more meaningful to Long Island motorists than „Congestion", because it is used more frequently in conversation. As a result of the change, complaints regarding sign wording have diminished.

A decision that resulted in a major software development effort was that Exit numbers, rather than distances in miles, should be used when possible to identify the geographical location and extent of delays. The change is typified as follows:

Original:	Revised:
CONGESTION	DELAYS
NEXT 3 MILES	EXITS 50-54

The rationale is that flexibility in describing delays is increased, and serious delays far downstream can be described on an upstream sign that might otherwise be blank. Motorists familiar with the roadways can effectively plan diversions to alternate routes, and the point at which to return.

INDIVIDUAL SIGN MESSAGE CREATION

Each changeable message sign is exercised for fifteen minutes every morning at 5:00 am in order to loosen up any "stuck" dots. After the exercise, the operator downloads an approved sign message library to the field controller. If the sign fails during the day, it must be "initialized", meaning that its library is again downloaded. The sign library can be accessed by the system software automatically, or manually by an operator. The operator also has the option of manually creating a unique message and sending it to the sign. As a general rule, the first line is a problem statement, the second is a location, and the third, if used, suggests a diversion route.

Roadway Delay Analysis, the Input to Signing: The INFORM system operator performs delay analysis by "keeping an eye" on the system wall map during off-peak hours, and watching it continually during peak hours. The operator can quickly scan the wall map and determine what "red lights" (system detector zones with speeds under 30 m.p.h.) are normally recurring delays, and what red lights are unusual for that period and may represent an incident. Each system operator has learned what recurring delays can be expected in various parts of the system on his or her shift. The operator is trained to be curious about unusual conditions, and may call up additional information regarding the' delays on a video display terminal.

As a rule, the operator will take remedial action when two or more consecutive indicators on the map are illuminated. The operator can mentally process the severity of the delays by watching how quickly the delays propagate upstream of the incident. An experienced operator can usually predict:

- The nature of delays (recurring or non-recurring)
- Severity of capacity reduction
- Rubbernecking
- The potential delays involved

The ability of the operator to predict the potential delays as a result of an incident will doubtfully ever be replaced by automation. The experienced operator will quickly determine the appropriate measure of response based on:

- The location of the incident
- The temporal proximity to the peak hour
- The direction of travel
- The geographical proximity to alternates
- The condition of alternates
- Weather conditions
- The day of week, time of day, season
- Any special conditions

The operator will act on his roadway delay analysis by placing certain signs under automatic control and controlling others manually.

Automated Signing: One of the unique features of the INFORM system is the use of automatic sign message generation, display, update, and removal. A good deal of operational testing was needed to arrive at proper operation, and the need to maintain system credibility limited the amount of testing employed. The breakthrough in automated signing came after a year of operational experience, when the original software was rewritten to mimic what the system operators were doing manually with the signs, placing messages based on speeds rather than occupancies. Starting in 1988, limited use of automated changeable message sign text production was incorporated into the operation. Initially, only 37% of the automated sign messages generated were accurate compared to human sign message generation based on the same data. This accuracy level has been increased to the 90% level by software improvements and operational testing. Unfortunately, the automated modes do not distinguish between recurring and non-recurring congestion.

The four automated modes of operation are as follows:

- Intervention: In this mode, the operator receives an audible and visible "prompt" that the system is ready to place a sign message. The operator may then accept or reject the prompt. If the prompt is accepted, the message is sent out, and all updates will then occur automatically. This mode is frequently used for mainline signs in areas where delays are complex and difficult to analyze, and the system is less likely to generate an accurate message.

- Semi-Automatic: In this mode, the system sends the problem statement line and the problem location line (i.e., Line 1: "DELAYS" Line 2: "EXITS 50 TO 54"). Updates are automatic. No diversions are processed. See Figures One and Two.

- Use: In this mode, lines one and two are handled identically as in Semi-Automatic, however diversions are processed and prompted for line three (i.e. Line 3: "CARS USE N. PKWY" alternated with "VIA EXIT 44").

- Automatic: In this mode, all sign messages are sent and updated automatically for all lines with no prompting.

The system is presently operated in a combination of Semi-Automatic and Intervention modes for those signs not under manual control. Each sign in the system can be placed in any of the modes, providing a mixed mode operation. Operation of all signs simultaneously in the Intervention mode is not possible with only two operators.

While in any of the automated modes, the system will display a message reading "NORMAL TRAFFIC CONDITIONS AHEAD" if the following conditions are met:

- There are no delays between the sign in question and the next downstream sign.

- Sixty percent of the zones on the path are reporting valid data.

The INFORM system has a fixed data base of travel times for each zone by time of day and day of week. The system continually calculates travel times and compares them with the fixed data base values to determine delays for each zone. The delays calculated are presently used by the automated sign message algorithm to quantify the degree of delay.

The automatic signing algorithm is keyed to zone speeds. Once delay signing is activated based on low speeds, calculated delay information is then used to determine the sign message that corresponds with the length of delays. This information is also processed to evaluate possible diversion paths.

Sections of highway that are influenced by a changeable message sign are called sign paths. Each sign in the system has a unique set of sign paths, called the sphere of influence. Motorists move out of a sign path when they reach the system boundary or enter the sphere of influence of another sign. Criteria that are evaluated for all sign paths are:

- Average speed of zones in the section
- Percentage of failed zones in the section
- What delays are greatest on the path

Presently, INFORM considers mainline speeds below 30 m.p.h. delays. If cumulative calculated delays on a path exceed 15 minutes longer than the historical travel time, the delays become "long" delays.

Manual Signing: In manual mode, any sign message can be typed in and displayed. This gives the operator flexibility for broadcasting any type of specific traffic information that any situation requires. In order to broadcast a specialized sign message, an operator is encouraged to have concurrence from another operator on the shift. Manual signing is used for:

- Accidents
- Road Work
- Road Closures
- Specific Diversions
- Lane Closures
- Special Events
- Conditions on Multiple Roadways

One disadvantage of manual signing is that no automatic updating or sign message removal is possible. The system operators on duty must keep the manual messages current and remove them at the appropriate time.

Manual sign message construction obeys the following prioritized rules:

1. No sign shall divert trucks to a parkway.

2. Only approved words are used. First precedents require supervisory approval.

3. Line one is a problem statement.

4. Lines two and three are location statements.

5. Line three is an alternating diversion/location statement.

A specific diversion is one where the appropriate exit number, alternate route name, and type of vehicle (if necessary) is broadcast. Three types of specific diversions are employed:

- Direct Freeway to Freeway
- Freeway to Freeway via Arterial
- Freeway to Service Road

A general diversion is one where no specific route can be recommended. Two types of general diversions are used:

- "Use Alternate"; The condition of alternates are congested or unknown, yet diversion is justified.

- "Avoid Area"; Used for gridlock condition.

A third type of diversion used very frequently tells motorists to stay on the route they are on because of problems on an alternate. See Figure Three.

The following general rules apply to use of ; diversion texts:

- A road closure of substantial projected duration justifies a specific diversion.

- Diversions should be used when alternate freeway capacity exists.

- When alternates have delays yet a diversion is justified, a general diversion is used.

- Truck routes should be provided when possible. (i.e. "CARS USE N. PKWY"/"TRUCKS USE SVCE RD").

- General diversions are used while operators are devising specific diversions.

DIVERSION EXPERIENCE: INERTIA SEEMS TO GOVERN MOTORIST ACTION REGARDING DIVERSION.

Motorists are hesitant to divert when they are moving forward at speeds greater than 30 m.p.h.. Once involved in delays, a higher Percentage of motorists will divert. Preliminary observations indicated that approximately 15% of motorists approaching a road closure but not yet involved in delays diverted to a "good" alternate route voluntarily before they were forced to divert to a "bad" alternate route downstream at the closure. These observations were made during the summer of 1988 when the Long Island Expressway was closed nightly for construction activities.

Motorists are much more likely to stay on a route they would normally leave if they are informed of delays on the parallel route. Operators have made good use of this general principle to prevent bad situations from becoming worse. When a message regarding delays on an alternate route is displayed, the downstream exit ramp volumes will drop quickly, and are consistently less than historical volumes.

In terms of the relative "strength" of sign wording, "ROAD CLOSED" has the greatest impact, followed by "ACCIDENT", "LONG DELAYS", "ROAD WORK" and "DELAYS". These words tend to convey to the commuter a sense of the magnitude of the problem. Peak period commuters are less likely to react to a "DELAYS" message than off-peak commuters, probably due to a general expectation of delays during peak periods. The effect of sign message wording on diversion percentage may not be as critical from an operational standpoint as had once been thought. A "weakly worded" sign message will divert a lower percentage of traffic. The effect is that the diversion sign will stay up longer until the alternate route reaches capacity. A strongly worded message will achieve a slightly higher diversion percentage causing the alternate route to reach capacity more quickly. The incremental benefit has not been quantified but has been observed to be marginal.

The variables that effect diversion percentage are time of day and day of week (trip types and driver familiarity with alternates differ with these variables), type of alternate route (freeway or arterial), length of alternate route, congestion known (or suspected from experience) on the alternate, type of incident, media confirmation from radio reports, percent trucks (trucks may not be authorized to divert), and the present running speed and level of service when diversion is suggested. Traffic volume changes that indicate motorist reaction to signing have been measured. With all of these variables in play, however, it is challenging to predict the diversion percentages that will be obtained with specific sign messages.

CONCLUSIONS

An extensive evaluation of the system is being performed by the Federal Highway Administration. The evaluation will consider practically all aspects of the system operation and will quantify many of the preliminary results presented herein. Until the evaluation is completed, a few preliminary conclusions may be safely drawn as a result of the first eighteen months of operation.

Changeable message signing can be an effective strategy to help alleviate traffic congestion. A project to install a freeway management system including changeable message signs can achieve the "popularity" needed to obtain the government and public support necessary for installation and continued operation and maintenance of the system. This is the case in the Long Island freeway corridor.

An integrated system can be used to automatically generate and display problem and location information to define delays. The use of automatic sign message generation is an aid to the system operator, but is limited in its application and must be operator supervised.

Sign messages should be composed with words that are used in everyday conversation by the motoring public (connotations may differ in various parts of the country). Formation of a committee to formulate and periodically review sign usage policies is an effective way to provide consistent and well considered sign messages.

The use of signs to display information regarding the absence of delays has not diluted sign effectiveness in this corridor, possibly due to the fact that the absence of delays is experienced by a minority percentage of the average daily traffic.

Since many motorists in this corridor viewed blank signs for years during project construction, the use of the "NORMAL TRAFFIC CONDITIONS AHEAD" signs has contributed to the system's credibility and therefore sign effectiveness. It is similar to a default message, however it does convey valid traffic information.

Diversion percentages are effected by many variables and even though the percentages are measurable, it will be difficult to develop a prediction methodology to achieve a desired percentage. However, the result may tolerable from an operational perspective because in a congested urban corridor the utilization of spare capacity on alternates is quickly achieved even with low diversion percentages.

Approximately fifty percent of Long Island Motorists surveyed have reported that they use changeable message sign information to avoid delays. Voluntary diversions are obtainable, have been measured, and can consistently be initiated with changeable message signs.

Changeable message signs are a proven method of dissemination of traffic information. Benefit versus cost data based on measured results are being prepared but are not yet available. The projected benefits from ramp metering alone based on initial operations have indicated that a 3 to 1 benefit/cost ratio for the system may be obtainable, including sign costs but exclusive of sign benefits. Regardless of the resulting ratio, the changeable message signs in the Long Island freeway corridor are operationally useful and have gained wide public acceptance.

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SOURCE: **1991 ITE Compendium of Technical Papers**
Habib Shamskhou

TECHNOLOGY EVALUATION OF VARIABLE MESSAGE SIGNS: A COMPARATIVE ANALYSIS OF LED VS. FIBER OPTIC TECHNOLOGY

INTRODUCTION

Variable Message Signs (VMS) represents the primary source of real-time motorist information system widely used in many heavily congested freeway corridors throughout the United States. The number of VMS is expected to increase significantly during the 1990s and into the next century as a part of the implementation of new advanced highway technology namely "Intelligent Vehicle Highway Systems" (IVHS). Currently, the application of Fiber Optics and LED (Light Emitting Diodes) VMS for highway use have gained wide acceptance by various authorities around the world, particularly the United States, Canada, Europe and Japan. A number of these signs have been installed and are proving to be functionally superior to 'most of the earlier technologies (i.e., neon signs, light bulb matrix signs, flip disk matrix signs).

However, in light of the recent development of LED as an emerging VMS technology for highway (outdoor) applications compatibility in performance with Fiber Optic technology, various highway transportation agencies planning to use VMS in their facility are faced with the dilemma of choosing between LED and Fiber Optic VMS. Based on the recommendation of sign manufacturers, many of the authorities are setting up test programs to compare various aspects of these two technologies.

We evaluated the LED technology for one of our major tunnel projects currently under construction. This project specified Fiber Optic VMS technology, but the contractor requested it be substituted by LED technology. We also conducted a comprehensive study that involved a detailed comparative analysis of LED vs. Fiber Optic technology for the Central Artery/Tunnel project in Boston, where more than 150 VMS have been proposed for installation as part of a traffic surveillance and control system for this major $2.5 billion urban freeway improvement project.

The objective of this study was to evaluate these two technologies on the basis of their general features, legibility/brightness, color, component reliability, power consumption, temperature sensitivity, viewing angle and other operational/performance characteristics including maintenance and life cycle expectancy. Other considerations included human factor requirements and environmental sensitivity issues.

Based on the evaluation analysis of this study, no fatal flaw or superiority was found in the performance of either technology. The study highlights all advantages and disadvantages associated with each technology, and provides a framework for understanding the critical issues surrounding them.

It is important to note that the FHWA realizes the importance of real-time motorist displays for the future of our highway system, and has contracted with Texas Transportation Institute to conduct a new VMS Technology Evaluation. This document is being completed this April 1991 and should be distributed by the time this paper is being presented.

STUDY APPROACH AND METHODOLOGY CONCEPT

The study was conducted based on the following major tasks:

1. Review of the most current research and literature available concerning VMS technologies.

2. Review of the physical and functional details of each technology from manufacturers' literature and specifications. In addition, leading manufacturers of LED and Fiber Optics VMS were invited to Parsons Brinckerhoff's New York office to demonstrate their respective signs in order to gain first-hand experience.

3. Evaluation of the physical and operational features of the subject VMS

technologies.

4. Telephone interviews with users who have day-to-day operational experience as well as with agencies that have interest and involvement in VMS technologies.

EVALUATION

Based on an extensive review of technical literature and interviews with facility operators, an evaluation methodology was developed to compare the two VMS technologies with respect to their operational characteristics, as well as maintenance and life-cycle. The functional characteristics that are common to both VMS technologies, and also considered a critical basis of comparison, are: legibility/brightness, viewing angle, color, power consumption, temperature sensitivity, maintenance issues, parts reliability, life cycle cost, and character matrix. Each of these characteristics is discussed below and summarized in Table 1.

Legibility./Brightness

Legibility refers to the ability to read a sign and is dependent upon sign size, brightness, and color, as well as letter height. The brightness of both LED and Fiber Optic VMS have proven to be sufficient for highway environments. Brightness is usually most critical when considering daytime operation. This criticality is a result of glare from the sun striking the sign face and severely reducing the brightness contrast between the sign legend and background. To reduce this "washout" effect, special non-glare sun screens are usually mounted on the sign faces of both LED and Fiber Optic VMS. Furthermore, an increase in luminance to 20 cd/m" (light output measured in candela per square meter) has been found sufficient to overcome sun glare for both LED and Fiber Optic VMS. Superbright LED with maximum output, and Fiber Optic VMS with the backup lamp activated, can easily achieve the above brightness requirement.

Both technologies in general will produce excellent "punch" or visibility. However, in LED technology, as the size of the LED pixel is reduced the brightness intensity decreases. The brightness of an LED also decreases over time. It is important to note that the decrease in brightness depends on the interior temperature and the operating current, differing between red and green

LED, as shown in Figure 1.

Viewing Angle

The viewing angle for LED is generally wider than Fiber Optics. The viewing angle produced by the focused fiber is relatively small and consequently the off-axis viewing is somewhat restricted. Both VMS technologies have proven to produce an adequate reading angle for the highway environment. Viewing angles of side-mounted signs and 12 degrees cone angle are usually found to be sufficient for a 6-lane highway.

For highways with geometrical constraints such as significant horizontal curvature, the viewing angle adequacy as related to legibility distances must be determined for each specific sign placement site.

Color

Each diode on an LED sign has only one color, either red or green. Other colors such as yellow are currently being experimented by a major Japanese manufacturer. Variations of the spectrum between red and green are obtained by using different combinations of red and green diodes. Red provides the greatest brightness for the LED sign, and for a given pixel size, the more red diodes the brighter the pixel. Analysis of human eye sensitivity to the color spectrum for sign legibility indicates that amber is a preferable color in the highway environment. Amber is attainable with LED technology by decreasing the number of red diodes and increasing the number of green diodes for a given pixel. However, it is important to note that this is accomplished at the expense of losing much of the brightness of the LED. This practice is not recommended, nor highly advised by the manufacturers of LED. This issue is particularly important where there is a character height limitation on sign message text.

Furthermore, while the use of red LED for highway signs may be considered satisfactory for important system messages, the traditional use of red to denote danger on the highway may prohibit its use for messages of lesser importance or for graphic symbols.

In contrast, fiber optic glass color filters are an integral part of the light projection assembly. This causes emitted light to be true green, yellow, or any other color that is desired.

Power Consumption

The overall power consumption of LED and Fiber Optic VMS is low, and standard electrical services will suffice. For example, a 3 module Fiber Optic display unit is lit with a 50-watt quartz halogen lamp under normal usage. The comparable unit of LED signs requires wattage of 37.8 to vary, depending upon the character size desired and specific manufacturer recommendations.

CONCLUSION

Based on the evaluation analysis of this study, there is no fatal flaw in the performance of either technology or any superiority in establishing a clear preference of one over the other. However, the study highlights all advantages and disadvantages associated with each technology, and provides a framework for understanding some of the critical issues surrounding them. All performance criteria established in this study should be evaluated in detail with respect to specific project requirements. For projects that require a large number of VMS, such as Central Artery/Tunnel project in Boston, it is highly recommended that a comprehensive test program be conducted for a period of at least six months in order to select the most appropriate technology. This is particularly important in the evaluation of sign performance in the tunnel environment, which we dealt with.

TABLE 1

EVALUATION ANALYSIS OF FIBER OPTIC VS. LED TECHNOLOGY

COMPARISON SUMMARY MATRIX

	LED	FIBER OPTIC
Legibility/ Brightness	Very good legibility; LED plastic encapsulations require a sun hood over each pixel to reduce sun reflection; brightness decreases over time.	Good quality under most conditions, the 'punch" or visibility under sunny conditions, fog, etc. are good.
Color	Red LED gives the highest brightness output. It is difficult to get true amber/yellow; amber/yellow and green are not as bright as with Fiber Optic.	Quality product, shutters mechanism subject to failure, long life expectancy and high reliability.
Component Reliability	Completely solid state. Long LED life; sign performance deteriorates as LED reaches life expectancy.	Quality product, shutters mechanism subject to failure, long life expectancy and high reliability
Power Consumption	Very low and standard electrical services will performance and LED life.	Low; is comparable with LED.
Temperature Sensitivity	High ambient temperature affects sign performance and LED life	Sign performance not as sensitive to temperature as with LED.
Viewing Angle	Generally wider than that of Fiber Optic. Off- axis +/- 10°	Relatively small and consequently the off axis viewing is somewhat restricted.
Maintenance	Long LED life and low failure rate means low maintenance. LED deteriorate over time; overhaul maintenance required when LED reaches its life expectancy.	Mechanical parts require maintenance; lamp also requires scheduled / preventative maintenance.
Life Cycle Cost	Capital Cost comparable with Fiber Optic. Limited data available for maintenance. Operating cost difficult to quantify.	Appears the same as LED.

SOURCE: Oregon Department of Transportation

Incident Response

COMET is here!

ODOT'S Incident Response Program is designed to remove road hazards, provide motorist assistance, and improve incident management on *designated segments of Portland-area freeways.*

It's help!

COMET trucks have special padded bumpers for pushing disabled vehicles safely out of travel lanes. They are also equipped to handle minor emergencies like running out of gas, flat tires, overheating and jump starts.

It's simple! Just call 283-5859 to report a traffic problem, a stranded motorist, or abandoned car. (Watch for a special cellular phone number soon.)

It's safe!

Don't worry about who will assist you, Responders are experienced ODOT personnel specially trained in highway operations. Responders wear distinctive uniforms, carry photo identification, and drive clearly-marked vehicles.

It's free!

COMET is on patrol 24 hours a day, 365 days a year, and is provided free of charge. (If services beyond those offered by COMET are required, Responders will help you get assistance *at your expense.)*

IF YOU HAVE CAR PROBLEMS....

- REMAIN CALM
- WATCH OUT FOR TRAFFIC
- MOVE YOUR VEHICLE FROM TRAVEL LANES (If possible)
- DISPLAY DISTRESS SIGNALS (Emergency flashers, raised hood, cloth tied to antenna, etc.)
- STAY WITH YOUR VEHICLE

TO REPORT A TRAFFIC PROBLEM CALL 283-5859

- WHAT IS THE TRAFFIC PROBLEM?
- WHERE IS IT LOCATED?
- WHAT IS THE TRAVEL DIRECTION AFFECTED?
- ARE TRAVEL LANES BLOCKED?
- IS MEDICAL HELP NEEDED?
(IF SO, HAVE YOU CALLED 911?)

SOURCE: **Traffic Technology International. Oct./Nov. 1996**

SURF THE NET TO TRAVEL THE HIGHWAYS

Phoenix's Freeway Management System utilizes advanced CCTV and fiber backbone technologies to provide round-the-clock surveillance and control over 29 miles of key arterials. A live CCTV link onto the World Wide Web now attracts up to 40, 000 visits per day

An urban freeway traffic management system using strategically-placed video cameras provides a great deal of information to a state department of transportation. In Phoenix, Arizona this same information is also provided live to local television stations and sent over the Internet to interested drivers. The Arizona Department of Transportation (ADOT) system combines technology and public communications providing drivers with information in a variety of formats digital signs; up-to-the-minute television traffic reports; and even the convenience of sitting in front of a home computer, coffee cup in hand, to check the latest road conditions.

ADOT personnel saw a phenomenal growth in Phoenix as more and more people headed to the "Valley of the Sun". In May of 1988 planning began for the new Phoenix freeway traffic management system. "We knew from the beginning that video would be at the center of our design," says Jim Shea, ADOT traffic operations center chief.

"With incident confirmation being the basis of the system, video had to be at the very foundation of the functional design," he went on. Kimley-Horn and Associates, Inc., a national transportation firm with a regional headquarters in Phoenix, was awarded the design contract. Henry Wall, project manager for Kimley-Horn, was the contact with the Phoenix office.

"We created the design after listening to ADOT's needs and studying other freeway management systems," says Wall. Systems in Baltimore, Minneapolis and Honolulu were among the cities studied. Taking bits and pieces from other systems while adding newly developed concepts, Wall and his team were ready to complete the design.

"The next stage," Wall explains, "was to subcontract for various system needs." Sundt, Holmes and Navare, Wilson served as the general contractor who in turn utilized the services of ASSI Security of Arizona to install and coordinate the original 29 camera system. ASSI, a security company well versed in video security systems, worked with their supplier, Javelin Systems, to make the natural transition from video security to video traffic management.

"The implementation of this project was a unique opportunity to build a system providing freeway video surveillance along with enhanced traffic contort," states Mike Hacker of ASSI. "The undertaking was an incredible blending of companies, talent, and technology," he says.

IN THE FIELD

The field equipment centered around the Javelin JE3662HR color CCD camera equipped with a 10 times zoom lens and housed in a pressurized, nitrogen filled, housing on heavy duty pan/tilts. Each camera in Phase I of the project was to be mounted atop 30-55ft high poles along 29 miles of Phoenix freeways. The camera assemblies were configured to accept 10, four-function, preset commands from the Javelin OMNI 1500 system controller as well as controls for power, iris control, white balance control, lens speed, and relay contact control. Video, 120V ac and low voltage line protection was accomplished through the use of surge arresters installed in a NEMA enclosure mounted on the same pole, directly below the camera assembly.

Hacker was especially impressed with the efficiency of the erection of the poles. He explains, "The pole erectors enable the erection of both pole and camera assembly, simultaneously. The mounting poles were prewired and fitted with the camera assembly, receiver driver, air terminal and surge suppressor equipment prior to erection." Each camera was powered and tested via the use of a laptop controller prior to moving on to the next installation.

As installation of the system took place, Kimley-Horn undertook the building of the communications center working with subcontractors to receive the most favorable pricing for sophisticated building materials and systems. Equipment included cameras transmitting communications to the center via copper to its assigned node building.

From the node building to the ADOT Traffic Operations Center (TOC), communications is via a full duplex fiber system. The node building is a hub for video collection and data distribution to as many as eight camera sites from the TOC. The node is equipped with rack mounted Javelin control receiver drivers, fiber optic transmitters and data modems.

OPERATIONS CENTER

Within the center, operators work around the clock to manage the Phoenix freeway system. ADOT TOC has seven operator stations, two of which are currently manned on a 24-hour basis. Manpower is reduced to a single operator on low peak times such as Sunday afternoons. Operator stations face a video display wall, custom-designed to accommodate 32 Mitsubishi Diamond Scan 37in color display monitors in a 4x8 wrap around configuration. The Diamond Scan is compatible with IBB, CGA, EGA, VGA, as well as S-VGA and Macintosh II. Heat generated by the 32 monitors was a major engineering concern resulting in the installation of 16 cooling fans within the structure.

"With hundreds of pieces of equipment including communications, cameras, fiber, ramp metering and switching, the project was a masterpiece of integration," says Wall. Kimley-Horn coordinated all of the equipment integration including the software systems to complete the system on time. With Phase 10f the system successfully operating for over a year, ADOT is already planning a second phase to the Phoenix system and looking to other Arizona cities such as Tucson to eventually connect the major population centers in the state.

Shea points to his city's system with pride as he explains, "The highway detection system is embedded in every lane, a third of a mile apart. We can tell how fast a vehicle is traveling and even what size vehicle." Utilizing special logarithms, whole groups of cars can be studied to arrive at the average highway speed. The information received from the system is immediately dispatched or relayed to the proper authorities. "We notify the Highway Patrol who can dispatch units or even a helicopter," Shea explains. "The video allows us to inform the fire department or haz mat team of what they will face upon arrival," he goes on. In addition, the ADOT traffic team responds to many of the situations on a 24-hour basis. "We are the first response team using our own eight vehicles to respond to a situation," Shea says. It is this understanding of the people issues involved in a freeway system that prompted Shea and his team to enter into a handshake agreement with local television stations. "We at ADOT currently have five stations with live access to the system with three utilizing it on a daily basis," Shea proudly claims. ADOT provides live feed directly to the stations giving a popular twist to morning traffic reports.

In addition, Internet surfers can call up specific cameras on that certain piece of highway they are about to travel. Web address www.azfms.com brings up a menu offering such choices as a map of the system indicating specific cameras to view. Video snapshots are provided at eight minute intervals. A 20-second view offers a picture perfect highway scene. Current usage of the system is variable but is proving quite popular with over 40,000 hits per day to the address. Estimation is that over 700 people per day take advantage of the web site. Glenn Jonas, senior system engineer with ADOT, says it best when he commented that "detection and information are the heart of the system."

Module 6
Response

The goal of Module 6 is to describe the response phase of the incident management process, describe specific challenges to effective response, describe potential tools or strategies for improving response efforts and provide the opportunity to examine local response needs and potential tools/strategies for improvement.

MODULE 6

RESPONSE

DEFINITION

Activation of a "planned" strategy for safely and rapidly deploying the most appropriate personnel and resources to the incident.

OBJECTIVES

- **Speed response to the scene**
- **Save lives through rapid EMS response**
- **Be continually "ready" to deploy appropriate resources**
- **Make efficient use of resources**

BENEFITS

Dedicated roving patrols reduced response time by

- 16.5 minutes per breakdown
- 12.6 minutes per accident

- Hayward, CA

BENEFITS

Per Crash	20 veh-hrs of delay = $200
Per Disablement	42 veh-hrs of delay = $420 31 gallons of fuel = $35.65 3.5 kg of HC 35.8 kg of CO 8.9 kg of NOx

ISSUES AND BARRIERS

Achieving "optimum" response

- Under-response vs. over-response
- Improved verification
- Better awareness among responders

ISSUES AND BARRIERS

Mistrust of other responder's incident assessment

- Interdisciplinary training
- Describe capabilities and resources of each agency
- Encourage trust in another's assessment of the situation

ISSUES AND BARRIERS

Inability to communicate via radio with other responders en route

- Alternative communications devices
- Cross-installation of radio among response vehicles

ISSUES AND BARRIERS

Indirect communications when requesting response

Personnel/equipment resource lists

- Include phone, radio, fax, etc.
- Keep up-to-date

ISSUES AND BARRIERS

Access to the incident scene is difficult

Dual dispatch procedures

- **Heavy traffic**
- **Long distance between interchanges or crossovers**
- **Unknown incident location**

ISSUES AND BARRIERS

Inadequate or *inappropriate infrastructure to meet responder needs*

Administrative traffic management teams

- **Bring local issues to light**
- **Identify potential solutions**
- **Identify resources**

NON-TECHNICAL TOOLS/ STRATEGIES

- **Dedicated roving patrols**
- **Major incident response teams**
- **Personnel/equipment resource lists**
- **Identification of fire hydrant locations**

NON-TECHNICAL TOOLS/ STRATEGIES

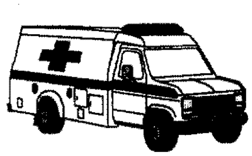
- Equipment storage sites
- Interagency agreements
- Tow truck/removal crane contracts
- Emergency vehicle access
- Public education

TECHNOLOGY-BASED TOOLS / STRATEGIES

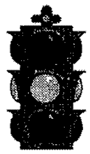
- Alternative communication devices
- Cross-installation of radios
- Trunked 800 Mhz radio systems

EMERGING TECHNOLOGIES

- Automatic vehicle location for response vehicles
- Geographic information systems
- Inter-operable radio systems



NATIONAL EXAMPLES



Emergency Vehicle Access
Milwaukee, WN

- **Fire and ambulance priority**
- **Select emergency routes equipped with special traffic-signal controls**
- **Improves response time and safety**
- **Approximate cost: $1.5 million**

NATIONAL EXAMPLES

High-Tech 911, Chicago, IL

- **Automatically locates response vehicles**
- **Identifies closest available responder**
- **Electronic map using GIS**
- **Automatically routes calls to dispatchers**

The ICS should be viewed as a set of guidelines. It does not provide detailed procedural or contact information but rather provides a general set of procedures to follow.

As incident responders you also have guidelines for response. The purpose behind introducing the ICS is not to replace your existing response procedures - it is merely to provide you with a better understanding of other agencies' response operations.

Objectives

The ICS developed as a result of the wild land fires in Southern California in the 1970s. The response of multiple agencies was required - management problems resulted, command was not clearly defined, communication problems were monumental, and resources were not fully utilized.

Originally called FIRECOPE, the ICS has gradually developed to apply to all emergency and all agency situations. The ICS has now been adopted by the National Fire Academy, endorsed by the Commission on Accreditation for Law Enforcement Agencies Incorporated, and endorsed by the American Public Works Association. In addition, the use of ICS by agencies responsible for handling hazardous materials is required (by OSHA in OSHA states and by the EPA in non-OSHA states).

The objectives of the ICS are to

- clearly define command
- improve inter-agency communication
- more fully utilize resources.

Components

Eight components lead to the success of the Incident Command System.

(1) Common Terminology

Table of Contents
(Continued)

Module 6
Response

Definition

Incident response is initiated after an incident has been detected and verified. Response is the activation of a "planned" strategy for the safe and rapid deployment of the most appropriate personnel and resources to the incident scene. Information management plays an important role in response; providing the necessary information to the appropriate personnel is critical.

As discussed in Module 1 — Introduction to Incident Management — "planning" for incidents is difficult because they are frequently unpredictable and unique. However, careful examination of local incident characteristics can uncover certain patterns in incident occurrence that can help to predict incident response needs.

Objectives/Benefits

The objectives of improved response are as follows:

- to save lives through more rapid EMS response in remote areas
- to make more efficient use of personnel and resources through "appropriate" response
- to ensure that responders reach the scene before the traffic backup becomes lengthy
- to achieve a state of continued readiness for the rapid deployment of the appropriate resources to the incident scene and the area affected by it.

Incident response measures, specifically, dedicated roving patrols, implemented in Hayward, California (1990 population 111,498), were estimated to reduce response times by 16.5 minutes per assisted breakdown and 12.6 minutes per assisted accident. The benefits resulting from this reduction in response times include the following reductions:

- 42 vehicle-hours of delay or $420 per assisted breakdown
- 20 vehicle-hours of delay or $200 per assisted accident
- 31 gallons of fuel or $35.65 per assisted breakdown
- 3.5 kilograms of hydrocarbons (HC) per assisted breakdown
- 35.8 kilograms of carbon monoxide (CO) per assisted breakdown
- 8.9 kilograms of nitrous oxide (NOx) per assisted breakdown (California PATH Program 1997).

Issues or Specific Barriers

Attempting to improve incident response may raise a number of issues. Improvements in incident response are often limited by geographic constraints, poor information management, and a limited sense of urgency to respond. Issues that often arise when jurisdictions look to improve incident response efforts are discussed below. When possible, specific examples of how other areas have dealt with these issues are provided.

Achieving "Optimum" Response

Accurate information about an incident, such as its location, traffic impacts, vehicle types involved, presence of an injury or a fatality, and other special conditions (e.g., hazardous material), is essential in determining the proper response. The level of response is typically determined by someone already at the scene (i.e., a police officer, transportation agency supervisor) or by a dispatcher at a central communications center or a traffic operations center.

Two common, less than desirable situations often result when incident response is initiated: under-response and over-response. Under-response results when too few resources (e.g., equipment and/or personnel) or inappropriate resources are dispatched to the scene (e.g., dispatching a light-duty wrecker to an incident involving an overturned semi-truck). Typically, the inadequacy of the personnel or resources first dispatched is not realized until after they have arrived at the incident scene. When additional personnel or equipment are requested to the scene, the "second" response usually takes much longer because traffic congestion from the incident reduces accessibility. Under-response more than doubles necessary incident response times.

An inappropriate solution to the problem of under-response is to dispatch excess personnel or equipment to the scene, in essence, "covering all the bases." Over-response occurs when too much equipment or too many people are dispatched to the incident scene. Equipment and personnel that are not needed at the scene can cause a bigger congestion and accessibility problem than the incident itself. In addition, over-response greatly reduces an agency's efficiency by committing personnel and resources unnecessarily. Whatever is not needed should be sent back as quickly as possible. Additional resources can be staged nearby where they can be quickly obtained if necessary.

What agencies should strive for is optimum response. Optimum response results when the correct equipment and appropriate number of people are dispatched to the incident scene. Optimum response is not always easy to achieve but can be attained through improved incident verification techniques and better awareness among responders of the different information needs and capabilities of each agency.

Mistrust of Other Agency's Incident Assessment

Responding personnel from one agency often don't trust the first assessment of a responder from another agency. As an example, a police officer may be the first to arrive at an incident scene. The officer may request that a transportation department sand truck be dispatched to the scene to cover spilled oil. Instead of immediately dispatching a sand truck to the scene, a transportation department supervisor may feel it necessary to report to the scene in person to confirm that, in fact, a sand truck is needed. Although the transportation supervisor's motive is to ensure the efficient use of agency resources sending someone out to verify another's assessment wastes time and extends incident duration. Inter-agency training that describes the capabilities and resources of each agency can help to encourage trust in another's assessment of the situation.

Inability To Communicate Via Radio With Other Response Personnel En Route

En-route to the incident, speed and convenience could be improved if response personnel from other agencies were able to communicate directly with one another. For example, police personnel already at the scene of an incident may want to inform the dispatched wrecker to take a different, more time-efficient route. Instead, the wrecker may lose 15 minutes or more weaving through the traffic backup.

Ideally, incident response personnel should have compatible radio systems to facilitate communication. However, radio systems require a large capital investment, and it is unlikely that agencies will opt to change systems. Many agencies, typically initiated at the field level, have been very creative in dealing with the field communications problems. The use of alternative communication devices, such as cellular telephones or alpha-numeric pagers, has proven somewhat promising. Cross-installation of radios among response personnel vehicles is another approach (e.g., a transportation radio is installed in a police vehicle in addition to the police radio, and vice versa). Cross-installation of radios is limited by physical space in the vehicle and requires the identification of the most critical communication links. Another technique for information exchange is to link agency CAD systems. Most of these are proprietary but the linkage is usually done through a "block-box interface."

Indirect Communications when Requesting Response

Both dispatchers and field personnel have been faced with (1) not knowing whom to call, (2) not calling the appropriate person, and (3) not having accurate numbers for contacting the appropriate person. As a result, multiple calls are often made to reach the appropriate personnel. These multiple calls waste time and heighten frustration. It is important to know not only whom to call but under what circumstances. For example, during normal operating hours, transportation department supervisors may want incident response requests routed through them, but this chain of command is likely to change during after-hours operations; few supervisors volunteer to route calls at 3 a.m. Instead, request calls may be routed directly to the transportation department field personnel. Locating infrequently used equipment, such as heavy-duty wreckers, may also require several calls before the equipment can be successfully dispatched. Personnel and equipment resource lists describing methods for contact via phone, radio, or other during both daytime and nighttime operations are a useful and inexpensive strategy for reducing indirect communications. Personnel and equipment resource lists must be kept up to date to maintain this utility.

Access To The Incident Scene Is Difficult

Roadway design and traffic congestion are the primary reasons for limited access to the scene for incident responders. Ensuring that the shoulders remain open for incident responders is important. However, shoulder width is limited in some areas by geographic constraints. For example, many of the roadways in Baton Rouge, Louisiana (1990 population 219,531), are elevated because of saturated ground conditions. Additionally, in many urban areas where efforts to ease traffic congestion are a priority, wide shoulders are being converted to high occupancy vehicle lanes. Traffic congestion also complicates access to the scene for responders. Flashing lights, especially amber-colored flashing lights, seem to have little effect on traffic movement (i.e., few people move to right when a vehicle with flashing lights approaches from the rear).

To ensure the quickest response to an incident, the Pennsylvania Turnpike

Commissions' follows dual dispatch procedures. In areas where (1) traffic is heavy, (2) there is an unusually long distance between interchanges or crossovers, or (3) the exact location or direction of an incident has not been confirmed, the dual dispatch procedure is used. Response units are dispatched in both directions; the first unit to locate the incident responds to it, and the other units return to their station. Dual dispatch has proven to be successful in improving response times to incidents.

Inadequate Or Inappropriate Infrastructure To Meet The Needs Of Emergency And Support Responders

Roadway design indicates a traditional lack of interaction among various public agencies. The needs of emergency responders such as police and fire have often not been considered in the planning and design of roadway facilities. For example, water accessibility for fire personnel on lengthy elevated structures is often a problem. Additionally, access to and from an incident scene for all response personnel can be limited without emergency crossovers.

The formation of an Administrative Traffic Management Team can help to bring local issues to light, identify potential solutions, and identify resources that can be used to alleviate the problem.

Tools/Strategies for Improving Response

A number of existing tools or strategies can be used, and are currently being used around the country, to improve various aspects of incident response. Many of these are summarized below.

Non-technical Tools/Strategies

- Dedicated Roving Patrols
- Major Incident Response Teams
- Personnel and Equipment Resource Lists
- Identification of Fire Hydrant Locations

- Equipment Storage Sites
- Interagency Agreements
- Tow Truck/Removal Crane Contracts
- Emergency Vehicle Access
- Public Education

Technology-Based Tools/Strategies

- Alternative Communication Devices
- Cross-Installation of Radios
- Trunked 800 MHZ Radio System
- Linked CAD Systems

Emerging Technologies

- Automatic Vehicle Location for Response Vehicles
- Geographic Information Systems
- Inter-operable Radio Systems

Each of these is described more fully below.

Non-technical Tools/Strategies

Dedicated Roving Patrols

Dedicated roving patrols are described more fully in the previous module, Module 4 - Detection and Verification, in the Further Reading section of Module 4 - Detection and Verification, and in the "Framework for Developing Incident Management Systems" included at the back of this notebook.

Beyond their detection and verification benefits, dedicated roving patrols can respond in less time to an incident scene (personnel are already in the response vehicles and the vehicles are already on the roadway), can initiate early traffic control measures, can provide the first assessment of the incident, and can initiate response from other pertinent agencies.

Major Incident Response Teams

Major incident response teams improve not only response to an incident scene but also personnel interaction at the scene (i.e., site management) and incident clearance. There are variations in the composition of major incident response teams, but they typically consist of individuals from a variety of disciplines (e.g., police, fire, transportation) who train for and respond to major incidents together. The level of familiarity among the various team members is high. Therefore, in the event of a major incident, it is readily apparent whom to call.

For a full description of major incident response teams as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included in the back of this notebook.

Personnel and Equipment Resource Lists

Problems with indirect communication and unnecessary calls to request personnel or equipment can be minimized through the use of personnel or equipment resource lists. Much information on resources may have been already compiled by local emergency management agencies who do emergency response planning for hurricanes, tornadoes, earthquakes, chemical disasters, etc. Resource lists should be regularly updated to ensure continued benefit. Information compiled in the resource lists may include the following information.

- who responds in each geographic or jurisdictional area
- phone numbers
- fax numbers
- pager numbers
- procedures for radio contact (if available)
- alternative contacts
- available equipment
- available supplies or materials
- anticipated response times

This information should be provided for both daytime and nighttime conditions, particularly for emergency support agencies (e.g., transportation departments) that do not operate 24 hours a day.

Identification of Fire Hydrant Locations

Often, response can be delayed because of an inability to locate fire hydrants. A list of the exact locations of all fire hydrants easily accessible from the roadway can be compiled. Such a list should be supplemented by visible signing in the field near each fire hydrant.

For a full description of the identification of fire hydrant locations as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included in the back of this notebook.

Equipment Storage Sites

Quick response is limited by the geographic distances that responders must travel. Roving patrols can minimize response times by reducing the time required for personnel to get to the vehicle and for the vehicle to get to the roadway, but they do not reduced the distances that must be traversed to reach the incident. Equipment storage sites help to reduce the distances between resources and an incident. Successfully placed equipment storage sites require an examination of local incident conditions to identify areas that have a high frequency of incident occurrence or severe incident impacts.

For a full description of equipment storage sites as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included in the back of this notebook.

Interagency Agreements

Incidents that occur near a jurisdictional border can often be attended to more quickly if response units from the adjacent jurisdiction respond. Response personnel in the affected jurisdiction may be required to travel a long distance to reach the incident or may be occupied with another incident, whereas response personnel from the adjacent jurisdiction might have to travel a much shorter distance to reach the incident. Their assistance not only assists the affected jurisdiction, who will likely return the favor, but also helps their own jurisdiction by ensuring that excess traffic congestion caused by the incident does not affect their roadways. Most police and fire departments have mutual-aid agreements for providing assistance to adjacent jurisdictions. Similar agreements can be developed among a variety of incident management agencies and companies to ensure that the most rapid response to incidents is available.

Tow Truck/Removal Crane Contracts

Contracts between public agencies and private companies can ensure equipment availability and timely response. Many areas specify, through a contract, acceptable response times to incident scenes. Reasonable response times should be established; input should be solicited from the private company response personnel. The response times must be strictly enforced so that the sense of urgency is not lost.

For a full description of tow truck/removal crane contracts as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included in the back of this notebook.

Emergency Vehicle Access

Access to an incident, especially for large fire and towing equipment, is often a problem. Roadway geometrics or traffic congestion pose particular problems for large response vehicles. Movable median barriers and emergency cross-overs (U-turns) at key locations can significantly reduce response times for emergency and support vehicles. To accurately identify the most appropriate locations for improved emergency access, historical incident location data and input from all responding agencies should be considered. Procedures for ramp closures and the "wrong-way" escorting of response vehicles can also be developed to reduce response times to incidents.

For a full description of emergency vehicle access as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included in the back of this notebook.

Public Education

A renewed emphasis on motorists' responsibility to move to the right and stop when a vehicle with flashing lights is approaching from behind may help to improve traffic movement en route to the incident scene. Many motorists likely believe that by moving to the right and stopping they will be delayed more than if they keep driving. In reality, by allowing the responders to more quickly access the scene, incident duration and consequent traffic delays are reduced.

Technology-Based Tools/Strategies

Alternative Communication Devices

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

Cross-Installation of Conventional Radios

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

Trunked 800 MHZ Radio Systems

Trunked 800 MHZ radio systems use the increasingly limited radio spectrum more efficiently and allow more users onto the airwaves. Trunked 800 MHZ radio systems use a pool of frequencies rather than a single dedicated frequency. When a responder wants to relay a message, the trunked 800 MHZ system searches for an underutilized frequency, quickly assigns the frequency, and relays the message. After the message has been fully relayed, the frequency is once again available for use. Interagency communication is facilitated through "talk groups" that comprise response agency personnel in need of communicating at or en route to an incident. Talk groups are assigned an identification number recognizable by the radio system's computer. When a message is relayed, the radios assigned to the particular talk groups are automatically switched to the temporarily assigned frequency for transmission. Drawbacks to trunked 800 MHZ radio systems include incompatibility across manufacturers and system costs. More information related to trunked 800 MHZ radio systems can be found in the Further Reading section at the end of this module.

Emerging Technologies

Automatic Vehicle Location for Response Vehicles

Automatic vehicle location (AVL) technologies verify a response vehicle's location through the automatic transmission of location data. The more popular automated vehicle location technologies include global positioning systems (GPS) and cellular geolocation techniques that rely on the time difference of cellular signal arrival and the angle of arrival. When dispatchers are privy to the location of all AVL-equipped response vehicles, they may request response from the vehicle closest to the incident scene, thus reducing response time. AVL technologies are also helpful for fleet management purposes, especially for special events like snow removal where it is essential to keep track of who's where and what's been treated.

For a full description of automatic vehicle location as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included in the back of this notebook.

Geographic Information Systems

Geographic information systems (GIS) provide a detailed visual display of a transportation network, including its infrastructure, resources, and utilities. Using geographically referenced data, different types of information can be "layered" on the same "map." For example, fire hydrant locations can be layered onto the roadway network for easy identification of the most convenient water source. In essence, GIS allows for the quick identification of resources nearest to the incident scene.

For a full description of geographic information systems as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included in the back of this notebook.

Inter-operable Radio Systems

Rome Laboratory, in conjunction with the U.S. Army, Navy, and the Advanced Research Projects Agency (ARPA), is developing the next generation of field radio. Known as "Speakeasy," the radio offers new capabilities, including inter-operability in different frequency bands. The radio includes software reprogrammability that allows modifications to the radio in the field through software downloads. Speakeasy means that people will not only be able to "reach out and touch someone...they will be able to reach out and touch everyone." Speakeasy is being designed so that any manufacturer will be able to produce modular upgrades, improvements, and enhancements to the system to prevent obsolescence. For incident management, an inter-operable field radio could greatly enhance operations en route and at the scene of an incident.

National Examples

Emergency Vehicle Access in Wisconsin

To speed rescuers to the scene, Milwaukee, Wisconsin (1990 population 628,088), identified primary emergency response routes and equipped these routes with special traffic-signal controls that give fire and ambulance vehicles priority over other non-emergency vehicles. At signalized intersections along these selected routes, optical detectors read signals emitted from the approaching emergency vehicles. Normal traffic-signal operation (i.e., red and green times) is preempted following the detection of these response vehicles. Cross-street traffic is stopped, and standing vehicles are allowed to clear the intersection before the emergency vehicle arrives. The system has improved response times to fire and medical emergencies and has enhanced public safety by eliminating conflicts between emergency vehicles and cross-street traffic. The system cost was approximately $1.5 million.

High-tech 9-1-1 in Illinois

The high-tech 9-1-1 system in Chicago, Illinois (1990 population 2,783,726), aids in reducing incident response time by combining automatic vehicle location technologies for response vehicles and geographic information systems.

An electronic map of Chicago contains over 20,000 street segments, 20,000 alleys, the locations of fire hydrants, footprints of almost one million buildings, and the exact location of fire and rescue vehicles in realtime. The map can show the entire city or zoom in for a close-up, 16-block view. As 9-1-1 calls are received by the center, a computer automatically routes them to fire or police dispatchers and identifies the available vehicle closest to each scene. Dispatchers can approve or override the computer's instant routing decision. More information regarding Chicago's high-tech 9-1-1 system is provided in the Further Reading section of this module and in Module 9 - Traffic Operations Centers.

Further Reading

Allen, Gary, "Advances in Automated Vehicle Location Technology," 911 Dispatch Services, Inc. 1992.

"Trunked 800 MHZ Features High Tech," 911 Dispatch Services, Inc. 1990-1994.

The Towing & Recovery Association of Georgia. "Suggestions to be included in a model county contract dealing with incidents on the Interstates."

SOURCE: **911 Dispatch Services, Inc. 1992**
Gary Allen

Advances in Automatic Vehicle Location Technology

It might seem easy--where are you? But it can be a difficult question when you're following a suspect in an unfamiliar city, performing reconnaissance for a drug raid or tracking a pursuit from the communications center. Fortunately, technology is providing some very accurate answers.

Automatic vehicle location (AVL) has evolved slowly, but now it includes satellites and high-frequency radio networks that can pinpoint a vehicle or officer to within inches. Combined with sophisticated software, these systems are being installed in vehicles, slipped into drug cargoes and even carried in briefcases.

Satellites Track Vehicles

In February 1992 the Schaumberg, Ill. Police Department rolled out 40 patrol cars with an AVL system based on Global Positioning System (GPS) satellites. Now, dispatchers know exactly where the cars are every moment.

"We went from the stone ages to the future overnight, all in one major step," says Lt. Tom Ostermann, who handles Schaumberg PD's technical services. Schaumberg, a 26-square-mile suburb of Chicago, spent $3.5 million to upgrade their computer-aided dispatch (CAD) software, convert to 800 MHZ trunked radio and mobile data terminals (MDTs), and build a new communications center.

Their AVL system integrates equipment from three companies--GPS by Trimble Navigation, CAD software by Integrated Computer Concepts, Inc., and MDTs and radios by Motorola.

GPS receivers in each patrol car receive signals from a network of overhead satellites, compute the car's location and transmit the data to the communications center via the MDT radio link, where it's displayed on an electronic map of the city. The CAD software then uses the data to determine which unit is closest to an incident.

Ostermann says that commonly used police beats just can't account for adjacent beat officers when making CAD recommendations. With AVL and GPS, the dispatchers are always certain they're sending the closest unit, making an apprehension more certain.

As for accuracy, Ostermann says they have never noticed a case where the map showed a patrol car far from its actual position. "I'd say they're within 50 feet of that intersection without a problem."

Besides providing real-time tracking of patrol cars, Ostermann says the system can store vehicle locations and play them back later at higher speed for training classes, examination of critical incidents or response time analysis. The software can even compute a vehicle's speed and the distance it covered between any two points.

Beyond all the hoopla of technology, what's the system do for dispatchers? "It's unbelievable," says Ostermann. "When you're in a dispatch center, you've got a blanket over you. It's like lifting that blanket."

But more than just providing the dispatchers with a tool to help speed an emergency response, Ostermann sees a more personal benefit. "When the dispatchers know where those cars are, I sense a lessening of anxiety."

"I think anxiety plays a part in dispatching a lot. This is just one level of anxiety that can be removed from that job," Ostermann says.

GPS Technology

The Global Positioning System (GPS) was developed by the Department of

Defense (DOD) for $8.5 billion as a way to absolutely pinpoint locations anywhere on earth, in three-dimensional space. It improves upon other navigational systems designed primarily for mariners, such as Loran-C and Omega.

The 19th satellite was launched into orbit 10,898 miles above earth in early 1992, providing 24-hour coverage to the entire globe. Each of the satellites, controlled by a ground station in Colorado Springs, is expected to stay in orbit 7-1/2 years.

Simply put, GPS satellites generate very accurate time signals and continuously broadcast them over a line-of-sight path in the 1200 and 1500 MHZ band. GPS receivers decode the time signal, perform some sophisticated math, and derive the receiver's location.

If you venture beyond this fundamental explanation, you get caught up in ephemeris, orbits, differential processing and trigonometry. But there are some complex GPS issues that are essential to understand.

Accuracy is the most-asked question by law enforcement agencies, but it has an answer with the most explanation.

"It's not a simple answer," says John Wenzel, Trimble Navigation's product manager for public safety. He's not trying to hedge, hoping to make a sale. There are lots of considerations here, not the least of which is the Department of Defense (DOD).

When the GPS system was first conceived, two signals were provided--one coded signal just for the military (P-code) and one uncoded signal for civilians (C/A). The two are broadcast on different frequencies but provide similar accuracy.

As more sophisticated GPS receivers became available for the civilian market, the DOD realized that even the C/A signal was accurate enough for military purposes by unfriendly nations. So they ordered so-called "selective availability" (S/A) of the civilian signal--they randomly vary the accuracy of a particular satellite, and turn it on and off at intervals.

You're not supposed to know when S/A is turned on or how much the variance is, although sources say the signal change is easy to detect and the variance can be corrected out of the final fix. But even so, civilian users must always assume a lower accuracy, even though the signal you're receiving may not be degraded at that particular moment.

With S/A turned off, Wenzel says civilian GPS systems in vehicles typically have an accuracy of about 20 meters anywhere in the world. With S/A turned on, accuracy jumps to about 100 meters. However, there's a trick to improve both of these figures--differential processing.

Differential is a way of taking GPS readings from a known location, then applying any error readings as corrections to readings made by other mobile GPS units. The Coast Guard is already building a network of six coastline differential stations that will provide error data to anyone within a 1000 kilometer range.

"By adding the differential capability, even on the degraded civilian signal, we can get the accuracy down to below 10 meters, so it averages about 5 meters," Wenzel says. Want even more accuracy? If you're not mobile and can take a fix every second or so, accuracy is improved to two meters.

And, using a properly equipped GPS receiver, and taking fixes every second over 15 minutes, you can obtain readings accurate to a centimeter--about one-third of an inch. "Comparing it with any other technology that's ever been available, it's an order of magnitude better," Wenzel says.

Trimble Navigation's newest GPS receiver includes dead reckoning software, so a patrol car driving into a garage or blocked by an overpass doesn't interrupt the AVL computations. The unit reads the speed, distance and direction of the vehicle from sensors and continues to compute the car's location. When the satellite signal resumes, it updates the location data from the GPS satellites.

GPS-AVL receiver prices start at about $1,200, to which you must add the cost of mobile radio transmitters, a base station receiver, comm center hardware and software. If you want the dispatchers to poll the mobile units for their location, you'll need to add the costs of a transceiver in each mobile unit and a two-way base station back at headquarters.

Don't Build Your Own

But what if you can't afford the time and expense of bidding, installing and operating your own AVL system? How about buying the service from someone who already has the technology, experience and personnel? PacTel Teletrac offers just such a service in six of the country's biggest metropolitan areas.

If you live in or near Los Angeles, Chicago, Detroit, Dallas/Ft. Worth, Houston or Miami, Teletrac provides an AVL service with an accuracy of 150 feet, comparable to GPS-based systems. They're currently marketing their service to consumers and fleet managers, but their system also has direct applications for public safety agencies.

Their AVL system marries Teletrac's mobile transmitters and radio location network with PacTel's paging and telephone network. When a vehicle tracker is activated either manually or remotely by a paging signal, its 900 MHZ signal is detected at several receiver sites. Its location is then calculated and displayed on a digital map at Teletrac's headquarters, along with the unit's direction, speed and ID code.

Teletrac first began marketing this capability as part of a consumer vehicle security service. A small transmitter is installed in your car by a security or electronics store and the vehicle is registered with Teletrac. If the transmitter is activated by a thief, Teletrac immediately begins tracking the vehicle. Their dispatchers notify the vehicle owner and the police by telephone and relay the vehicle's year, make, model, color and license number to help intercept and recover the vehicle.

In some cities, police departments have taken the next step and installed Teletrac terminals right in their communications center so dispatchers can directly view the location of stolen vehicles in real time, which speeds the interception of the vehicle and suspects.

Portable transmitters allow law enforcement to track suspects, contraband, ransom drops or anything else that moves. PacTel maintains location records to support personal testimony in court proceedings. In fact, PacTel says the Los Angeles County Sheriff used the system to track a suspected child molester, then later presented the Teletrac location logs to link him to actual crime scenes.

Now Teletrac is expanding their AVL service with Fleet Director(TM), which combines AVL with two-way mobile data communications. There are two versions: a status-only terminal that allows transmission of pre-defined messages from the vehicle, and a full-text terminal that can send and receive text messages on a 2-line, 48-character screen.

Using Fleet Director(TM), you eliminate the time-consuming approval of radio frequencies--if you can find any--and the expense of setting up your own radio system. You simply install a Teletrac terminal in your communications center and units in each patrol car and begin communicating.

Teletrac's services are priced similarly to cellular--you buy the device, pay a one-time start-up fee, then make monthly payments for the locating service. Fleet Director(TM) customers pay about $2,000 for communications center software, $750 for each mobile terminal, and a $30 monthly fee for each tracked vehicle.

Take It With You

Of course, you're not always tracking vehicles with an AVL system. Sometimes you need to track yourself. In that case, you'll want to tote the PCW-2000, a briefcase-sized unit by EER Systems.

Besides a GPS receiver, this professionally integrated unit contains a 25 MHZ 80386 computer, 80 Mb hard disk drive, black-and-white VGA display, 360 dpi plain-paper printer, 2400 baud data modem, Group III fax modem, and 3-watt cellular telephone.

Armed with this suite of technology, you can write, calculate or draw in the field and print-out what you produced. You can connect to headquarters, electronic mail or information services via the cellular phone and exchange mail or transfer data files. You can also send and receive faxes anywhere in the world.

If you're responsible for intelligence gathering, stake-outs, mobile surveillance, drug interdiction, or special operations, you can pinpoint your location to within 10 meters with the GPS unit, and then use the data to plot, calculate, draw or send the data using the PCW-2000.

If your investigations take you beyond the U.S. cellular system, just plug the PCW-2000 into any compatible INMARSAT terminal and you're connected worldwide, with all the same capabilities. If you need to capture and send images, EER supplies the Dycam digital camera, which takes up to 32 black-and-white, 400x300 dpi images. The camera connects to the PC for viewing or image enhancement, and then you can send the photos as data files or fax documents via the cellular phone.

The system fits into a 6"x12"x18" case and weighs about 23 pounds. EER offers many memory, display and power options. The basic PCW-2000 with GPS option costs $8,195.

AVL technology will continue to improve, but even now it provides law enforcement officers with all the capabilities for getting the edge you need to fight crime more effectively.

SOURCE: 911 Dispatch Services, Inc. 1990-1994

TRUNKED 800 MHZ FEATURES HIGH TECH

The words "800 MHZ" have become the buzzword of police departments lately, but behind the words lies a jungle of high technology, federal regulation and politics that few police agencies have the experience to conquer.

Trunked 800 MHZ radio systems are slowly shaping the way all public safety agencies are organized, dispatched and operated. The Federal Communications Commission (FCC) is determined that trunking will be the radio standard into the 21st century because it uses the radio spectrum more efficiently and allows more users onto the airwaves.

But for police officers working the front lines against crime, the arrival of this new radio technology had better mean just one thing--better performance. Yet a complicated process of specifying, purchasing, installing and maintaining such systems may mean that police agencies will have to use existing systems for several more years.

The Advantages

Besides making greater use of an increasingly limited radio spectrum, trunked radio systems generally permit a larger number of users than a conventional system. For some police departments, this alone is justification enough to spend the money on trunked radio.

The key to this capability lies in the ability of a trunked radio system to use a pool of frequencies for any of the system's users. When an officer wants to transmit, a trunked system simply looks at which frequency is unused and quickly assigns it to the officer for the duration of the transmission. Since field units infrequently transmit at the same time and most police transmissions are relatively short, frequency sharing can create more on-air time.

Another advantage of trunked systems is their flexibility. They're controlled entirely by computer, so it's easy to set up complex channel assignments, and to reconfigure the system as needed without the services of a technician. Police departments can quickly "create" an additional channel to handle a hostage situation or change channel assignments to allow public works or other city agencies to communicate on the police channel during natural disasters.

In contrast, a conventional system limits each user to just their assigned frequency. If the police channel is busy, officers just have to wait their turn, even though the fire or public works channel is going unused at the moment. And in most systems, channel assignments can't be easily reconfigured or shared with other city agencies.

The Questions

But with this increasingly complex technology comes some pretty stiff questions about the ability of 800 MHZ to adequately serve law enforcement. It's generally more expensive, more complex, takes more training to understand and operate, and must be engineered well to operate successfully. The companies that sell these systems, who have a natural stake in seeing 800 MHZ succeed, have tweaked the technology to answer most of these questions, but many pitfalls remain.

The first question police officers usually raise about 800 MHZ trunked relates to safety. "How can we guarantee access to a radio channel?" they ask. The radio marketers have answered this concern with several schemes that designate certain agencies as "priority", which insures they always have an available channel with they press the XMIT button.

Lock-out can occur when several police units attempt to transmit at the same time. For example, most trunked systems are configured in groups of four voice channels. If five units transmit at once, one unit won't go on the air. In a well-configured system with sufficient channels, this outcome can be minimized, but the possibility always exists.

But establishing priorities can also create its own problem. If certain agencies are designated as "priority", others must be declared as "non-priority" units, capable of being bumped off the air. That concept, and the thought of being denied access, may be procedurally or politically unacceptable to the other agencies sharing the trunked system with the police department. The only solution, purchasing additional channels, is costly.

Money is always an issue with police departments--there's never enough of it. And 800 MHZ radio systems are expensive to purchase and maintain. Existing systems are never compatible with new trunked systems, so old radios and equipment can't be salvaged. The line-of-sight characteristics of 800 MHZ radio demand more receiver sites, linked to the communications center by expensive telephone lines or microwave links.

Loaded with extra features, trunked systems are inherently more expensive, simply because they represent the "latest technology." When confronted by glitzy features, and an array of convenience and technical options, an officer suddenly designated as the department's "expert" might approve thousands of additional dollars for features that will never be used.

Trunked radio raises another set of questions that don't relate to the technology at all, but to another issue critical to the success of any system: inter-agency cooperation.

It's common for individual agencies to meet, draw up specifications and to implement technical systems. It's even fairly common for police and fire agencies to cooperate on operations and support systems. But it's quite another matter to bring police, fire, public works, electrical and other city agencies together into one room and decide on a single radio system.

The first difficult step is gathering all of the parties down at a single table. For some cities or counties, this may be the first such meeting they've held. For others who have shared microwave or other communications systems, or who have a jurisdiction-wide communications manager, such a meeting may be routine.

But either way, the difficulties of dealing with more than one agency are concrete. As the numbers of agency heads goes up, the likelihood of a consensus goes down--this is true for any organization. Second, the number of agendas increases as you add agencies. And third, the differences in perceived priorities among the agencies may create friction that may submarine the radio project before it's implemented.

Each public safety agency is likely to already have has its own radio system. The systems may have been installed by different companies and most likely on a different radio band. Each system manager may have his/her own preference for how the system should operate and what company should provide it.

Since each agency has different duties and a different set of "customers", the tasks that the radio system performs in vastly different for each agency. The police obviously have a need for clear, reliable communications for the protection of life and property, while the public works department requires a system capable of reaching into sewers, tunnels and near power lines.

As talks progress, the participants are bound to discover there is a perceived difference in which agency is leading the project. They will sense which agency is considered to have priority in deciding system questions and which is at the bottom of the totem pole. Naturally, these differences often spark resentments and political turmoil.

Compatibility is a big issue with 800 MHZ, both across model lines and with other agencies. Eventually third-parties will supply mobile radios that work with one or more company's system. But for now, the big guys--Motorola and GE--make distinctly different systems that force a police department to purchase subsequent hardware from the same company. And if you're trying to configure your trunked system to talk with another agency, just hope they purchased their system from the same company or you're locked out.

And lastly on the list of trunked questions, engineering is a critical issue for all 800 MHZ systems because of the line-of-sight characteristics of high frequency mobile radio systems. An experienced radio technician might be able to best-guess the specifications for a lower frequency system, but not for 800 MHZ.

The radio transmission paths must be plotted on maps using either theoretical data or live tests. Satellite receiver sites must be located accurately by computer and the use of multiple base transmitters must be considered. The effects of trees, foliage, rain, and even high humidity must be considered on reception. After all this, system managers should anticipate changes in system configuration after the radio system is operating based upon actual working conditions.

Besides money, the biggest hurdle facing police departments has been obtaining the required FCC approval for 800 MHZ radio plans. The paperwork is copious and demanding, even for an experienced radio technician. The approval process must pass through several layers of local, regional and federal coordinators before it reaches the FCC.

As background, the concept of 800 MHZ trunked radio was born from the need to provide more channels for public safety users. Over the years, public safety allocations have shot up the spectrum like a thermometer--from VHF to UHF, then displacing some unused UHF television frequencies and finally into the 800 MHZ band. Of course, major advances in radio technology allowed this movement to continue to higher and higher frequencies.

But when the requests finally hit 800 MHZ and the FCC decided to allot a section of the band for public safety, they also dropped a very heavy requirement on the requesters--you must develop regional plans for usage to insure maximum use of the frequencies. In effect, the FCC told public safety, "Here you are, but make the most of it because there's no more."

Since that initial plan, each area of the country has been grappling with how to best allocate the band among its many public safety agencies. Following the strict guidelines set out by the FCC for submitting plans, the process has been slow. At least three plans have been approved, but a FCC backlog is keeping many others from being finalized.

Technically Speaking

Trunked radio is synonymous with the 800 MHZ band, although the technology can be applied to frequencies in any radio band. Only FCC rules and channel availability currently make the 800 MHZ UHF band the most efficient for trunking. In the future, trunking may become the standard in all radio bands.

Like most other UHF systems, 800 MHZ trunked systems are designed to be repeated and to use satellite receivers to provide complete coverage. Each trunked channel consists of a pair of frequencies--one base station frequency and one mobile frequency spaced 45 MHZ apart.

After the FCC allocated a portion of the 800 MHZ band to public safety, they mandated a complex planning process for each region of the country which wanted to use the band. They established 240 channel pairs for police, fire and related agencies with 12.5 KHz spacing in the 821-823 band. They also established five specific channels that all agencies must have for mutual aid and coordination.

So far, submission of regional plans is going slow and the FCC approval process even slower. A few regions have had plans stamped "OK" and individual agencies are now beginning to install trunked systems. But most police and fire trunked systems are still in the early planning stages.

How Does It Work?

Despite its sophistication, trunked 800 MHZ is designed to shield the user from the all the technology. A radio operator needs to know nothing about how the system works or why, but simply presses the button to receive the benefits of years of research.

Basically, trunked radio is method of making a group of radio channels available to several different groups through an electronic switching system that is controlled by a computer.

For the end user, trunked radio systems don't have traditional channels. Instead, each mobile radio in the system is assigned a "talk group," which is simply a programmable, internal identification that is transmitted each time the radio begins a broadcast. The ID is not heard by the dispatcher, but it's recognized by the computer controlling the radio system.

For the radio techs, trunked systems really do have channels, which are typically provided in groups of four or five. One channel is arbitrarily designated as the control channel and the other four are available for voice communications.

In a conventional, one-channel radio system all mobile radios listen for a transmission the single channel. Everyone checks for a clear channel before broadcasting. When someone pushes the XMIT button, all other radios on the channel hear the transmission. Another user pushes the XMIT button to respond and everyone hears that transmission, too.

In a trunked radio system, every radio is tuned to a control channel. When someone pushes the XMIT button, the mobile radio transmits its individual ID and assigned talk group ID on the control channel to the base station. It's heard only by the trunked radio system computer and the data is decoded. The computer does some "thinking", and instantly transmits a digital message back out on the control channel to all the system's radios.

The digital message says, "Every radio on talk group XX, switch to channel 1 (or 2 or 3 or 4). Again instantly, every mobile with the same talk group code as the transmitting mobile switches to the assigned channel and they hear the calling mobile unit's voice transmission. Radios assigned to other talk groups continue to monitor the control channel and do not hear the voice transmission.

When the transmitting mobile releases the XMIT button, all mobiles resume listening to the control channel -- and the process starts all over again if another unit transmits. A transmission can occur on any of the assigned voice channels. A user never knows exactly what frequency is being assigned--and doesn't have to know, either.

This complex channel-switching process happens in just milliseconds--so short a delay that users don't notice that it's happening under most circumstances.

But what happens if you turn on your radio during a transmission directed to your talk group? Or what if you drive out of radio range when your group receives a transmission? The radio companies have come up with various schemes to handle these situations, but there's always the chance that your mobile radio will loose track of which channel it's supposed to be listening to.

Typical System

Most trunked systems are designed to incorporate several jurisdictions or agencies. The most common example is a city's police, fire, ambulance agencies and public works department.

Most medium-sized cities could easily justify obtaining separate frequencies for each of its departments. Some of the frequency assignments might be in different bands -- police in UHF, fire, EMS in VHF-high and public works in VHF-low. But in a trunked system, all four agencies would be equipped with 800 MHZ radios, and each would be assigned a different talk group ID.

Normally all four agencies would operate on different talk groups and essentially have separate radio systems. But during planning for a Fourth of July parade, for example, you decide that all three agencies should be on a single channel to coordinate their activities. You simply create a new talk group, program the mobiles and portables from all four agencies with the new group ID and establish a command post using the same ID. Presto! You have a new July 4th-only channel. With a conventional system, you'd have to go out and find a new frequency--slim chance.

Of course, you can apply this same type of coordination to normal situations, too. For example, you might program the public work department's street sweeper radio to allow access to the police talk group, so the operator can report problems when he/she is working in the early morning hours. The possibilities for cooperation are endless once you have the technology and it's easy to use.

Some user of trunked radio say this reorganization process is complex and hard to perform on a routine basis. Others counter that it simply takes thorough training, strict system administration, and that the system's flexibility overcomes any increased complexity.

Fail Safe

As a cautious police officer, you might feel that putting an entire city's public safety agencies on one system would create a tremendous opportunity for disaster if the system fails. But trunked radio systems are designed so that a failure of one or more components doesn't affect communications.

Back-up power supplies, such as batteries or a generator, insure that the system is always powered. Redundant radio components for each radio channel insure that a failed circuit board or electronic part doesn't cause that channel to go off the air.

And since a trunked system is controlled by computer software, when failures do occur they can be handled automatically in an "intelligent" manner. For example, if the control channel fails, its duties can be shifted in seconds to one of the remaining communications channels. Channel availability is decreased somewhat, but no one suffers from an outage.

Conclusion

So far, trunked technology has outpaced the ability of police agencies to get approval for its use, to specify systems and to appropriate money to build the systems. But large trunked systems for both single and multiple jurisdictions are now beginning to go on the air. Shortly, we may realize the promise that promoters have long made --to improve communications and service.

SOURCE: The Towing & Recovery Association of Georgia
Bill Brown, Chairman TRAG Task Force
Incident Management on the Interstate Highways
January 22, 1991

SUGGESTIONS TO BE INCLUDED IN A MODEL COUNTY CONTRACT

DEALING WITH INCIDENTS ON THE INTERSTATES.

In the 1990 Incident Management Study for the American Trucking Research Institute, the industry of towing and recovery is discussed in the following manner:

1. There is sufficient technology and equipment to adequately clear accidents and breakdowns in an acceptable fashion and within a time frame that is also satisfactory (by present standards).

2. The current system (rotation lists, private enter rise competition, etc.) does not encourage the immediacy demanded in the study.

3. Current "towers" (WS) are insufficiently trained, motivated and equipped to meet even the present quick-clearance demands. Since the number of such incidents are growing exponentially to reach an expected 8 billion vehicle-hours lost and $88 billion costs by 2005, something must be done to spur the private sector to take on the challenge or the system will have to be duplicated by some governmental or quasi-governmental agency.

A Task Force called by TRAG president has reviewed these statements and this Task Force readily agrees that technology and equipment are available to deal with incidents that are a result of heavier roads, lighter weight and strengthened trailers, limited accesses, greater numbers of vehicles (and incidents caused by them), and the more frantic pace of our modern day. This technology is growing and the skills of its operators (where they are properly trained) are extraordinary. Rescue attempts are occurring on a daily basis where loads are being up-righted with no additional damage to the vehicles and cargo. Wreckers have become recovery vehicles that can reach over bridges and lift tremendous weights from great heights. New and more sophisticated equipment is already beyond the testing stages that appears quite capable of matching tile growing transportation needs for the foreseeable future.

As with most Technological Societies, machines often outdistance the capabilities of the human systems that are necessary to support them. As Einstein related when he ushered us into the Atomic Age:

> *The world we have made,*
> *as a result of the level of thinking we have done thus far,*
> *creates problems we cannot solve*
> *at the same level at which we created them.*

Therefore, our organization realizes that we must address the human system problems with innovative approaches not mere repetitions of the past. The challenges of tomorrow are too great to use the same old thinking.

Further, we feel it is simplistic to say that private enterprise lacks the motivation and incentive to meet the "immediacy" demanded by the current incident management approach. Wrecker operators in all quadrants of the Atlanta Region report they are responding to calls well within a 15-minute-time factor. However, they sit two to three times that long waiting to hook-up. The "thinking" and socio/political/economic approach to incident management must be altered in Atlanta and the State if we are to reach our mutual incident management goals. The Towing & Recovery Association of Georgia is pleased to be an active participant m the planning and re-organization of the methods.

TRAG's Responses to Questions Raised by the Wrecker Contract Subgroup:

General:

A new cooperative system needs to be entered into between the State (all involved governmental authorities) and the towing and recovery industry. Old mind-sets must be set aside and the long range goals take precedence. Such existing beliefs that need to be re-thought are:

1. The automobile has everlasting value. The State is charged to maintain records (for security and economic reasons) on motor vehicles. Therefore, one cannot just throw away a 2,000 pound vehicle like one would a worn-out refrigerator. However, the present system of discarding motor vehicles is ridiculous and bureaucratic. The current thinking is that the wrecker companies are going to eventually make a for-tune on the scrap and junk that they haul away, so all of the responsibility for finding the discarding owner, lien holders, etc. falls upon the WS. Also, an air of suspicion that these same wrecker companies are going to obscure the fact that they have these valuable items on their wrecking yards in order to profit from high sales of the involuntary abandonment by owners who cannot afford to pay the storage charges.

   Therefore, there is an adversary relationship between WS's and the different governmental agencies which on the one hand, wish to have the vehicle removed quickly and easily and, on the other make demands that arduous and expensive ($109 per vehicle) paperwork be filed to eventually sell a vehicle for $40 scrap. With every succeeding legislature and county/city commission, more restrictions are placed upon the WS in disposing of vehicles.

   This over-legislation stems from the common belief that all vehicles are very valuable and that the wrecker company bears the sole responsibility for care and custody of these pieces of junk. The wrecker industry allowed this attitude to grow through complacency. It accepted the piles of scrap in order to get a towing fee and/or governmental contracts. Back then, land was plentiful and cars could be placed over wide areas of Georgia land (it is estimated that over 500,000 vine covered can rest on very valuable Georgia soil). Some cars have not been claimed for 10-15 years. Now with the specter of EPA, the cost of "storing" these vehicles could become prohibited.

   The public must be made aware, of the "cost" of their "fliver" sentimentality and their mistaken beliefs in the value of 'wrecked' or 'broken down' cars. The $20,000 Cadillac is only worth $100 when it is burned and $40 when it is 10 years old with a broken crankcase. The State must assume responsibility for the disposal of the vehicles. Other states around Georgia have already bitten the bullet. South Carolina, for instance, now fines persons who discard derelict cars $100, plus makes the owner pay for the towing charges and storage fees, plus the court costs for disposing of the un-wanted vehicle. In Georgia, by contrast, a lien holder can demand and get a towed car without paying a dime. Insurance companies can walk away from a total loss claim by notifying the storage lot that they don't want the car and it's his for salvage.

The incentive for maintaining a Quick Response team and for being a responsive partner in incident management is dampened when that partnership exists only in getting the vehicle out of the way, and then dissolves when the WS wants help in disposing of the vehicle in the end. It is like calling a mortuary service to pick-up a dead body,. and requiring all kinds of paperwork from him, then asking him to bury the remains at his expense in a certain way, in certain limited plots, etc.

2. Like contaminated waste, no one wants a wrecker storage yard in their neighborhood. Land is unavailable at any price within much of the area covered by the ARC. Regulating authorities arc working against themselves and the WS's who wish to provide safe, secure storage facilities.

   Demands for a towing service to have a yard within the city where the tow occurs, may not be possible in the near future around Atlanta. Somehow this inconsistency of the right hand of the law demanding a tower to move vehicles to clear the roadway and the left hand "punishing" the tow company with unworkable regulations and even putting owners in jail for failing to take checks from out-of-state drivers must be reconciled.

3. The "emergency" is at the scene and after the vehicle is removed and the traffic flows again, the mess on the back of the hook is the wrecker's business. State laws and regulations, grudgingly, allow overweight, overlength and overheight loads to be moved to the next exit to clear the

interstate. But, what is the WS going to do with a smashed, non-driveable vehicle at the next exit. You can't put such a vehicle on private property where repair facilities are not readily available. Incident management has to have the foresight to "manage the total incident. The quick solution of "off the freeway" is only the beginning of another set of problems.

A good example is when a wrecker company was called to remove a wrecked piece of heavy equipment. To move it off the freeway, the service had to go through the scales before coming to the next exit or tow backwards on the interstate. At the scales, the wrecker was overweight on an axle and was fined $240 by the same agency that had demanded the service respond in the first place. Technology has given us exceedingly capable equipment, but the antiquated laws have failed to allow that vehicle to operate (legally) on tile roads.

Florida has solved this problem because they value their ability to have a wrecker with the capability of quickly and safely removing their "incidents." Florida has ex-empted wreckers operating for state agencies from such regulations.

4. There is a need to be create a new entity that will respond to incidents during "peak" periods similar to the SWAT, Rescue and EMT teams that were created to meet changing "emergency" situations in their respective fields. These "responders" will need to be given the encouragement to make it profitable to maintain sufficient and adequate equipment and skilled technicians to operate these vehicles over an area that is selected by numbers and kinds of incidents rather than political bound-aries. In addition, a Wrecker Board (Board) will need to be created to deal with these new problems.

   Information is available to locate "hot spots" and zones can be established (and changed as needed) to allow for companies who wish to participate in the expensive operation to be compensated. These "responders need support from a governmental or quasi-governmental organizations (ARC could be the geneses of such a group) in the form of a Board or Commission that could determine rates on a compensatory basis and adjudicate problems arising from their operation on an equitable basis.

Plainly stated, the State can't continue to make unreasonable, capricious demands upon its partners and expect them to offer a "demand service. The State has to recognize the situation and become a full partner in dealing with the problem including an agency relationship on behalf of the contract towers.

To help TRAG accomplish this new relationship. TRAG asks ARC to lend its support in making the following changes by:

1. Seeking State Legislation to create a derelict law that would allow disposal of abandoned vehicles of lets worth than it takes to dispose of them.

2. Promoting agreements in counties that require a WS to have a storage lot within its borders to have those counties zone land that allows the WS to build such facilities if not already available-

3. Assisting in changing, as Florida did, the existing weights and measurements laws of the state to allow a similar exemption to WS while acting for law enforcement agencies.

4. Encouraging counties to Create Contracted Incident Management Wrecker Services and an Area-wide Incident Management Wrecker Service Board.

Given the new environment, described above, some specific suggestions are offered to answer the questions of the ARC.

Time:

Once zones are established by an independent authority like a Board, based upon information gathered from ARC, DOT, etc., a new "quick-responder" contractor can be chosen on merit, equipment, trained personnel and commitment. Zones will be established to accord equal distribution of incidents and locations where likely traffic tie-ups can be identified. Where more than 10 minute run time is incurred, prepositioning can be encouraged.

The contracts need to be specific so as to create an average run time of 10 minutes or lets during rush hour periods.

It will not be necessary to talk of elapsed time before another WS can be called. In areas, where rotation of WS's who have the equipment, personnel and commitment necessary to serve as "quick-responders", then their dispatchers must give an ETA. If that ETA is more than 10 minutes, another service shall be called. ATA can be monitored; and if the WS consistently cannot adequately respond within the time limit, it will be replaced or removed after a hearing from the list.

It is unlikely that independent WS's would be called to the. scene of "incidents" during "peak" periods. Care should be taken to define what is meant by peak or "rush." Also, it would be inequitable to seek any legislation that would not allow non-contract WS's to drive upon the interstate during these periods as do some toll roads. The public roads are public. The private low services will be out of the response system and will not usually be involved. It would be an unnecessary invasion of rights not to allow the motorist to walk to an exit and have a tow service remove his car, if it can be done before the contract WS arrives.

Notification should be based upon actual need for the wrecker. It is unfair to have a WS "respond" and sit while police do paper work. Therefore, a system of Notification would con-TM rain levels of readiness - like the old RAF during WWII.

a. Advise - central or authority dispatchers would advise the "responder" that an incident has occurred, and give as much information as possible about the incident This allows the WS lead time to ready his equipment and crew.

b. Standby -- central or authority dispatchers would request that a WS go on Standby with the necessary equipment to assist or remove an incident (a specific description of the incident is necessary). Additional equipment can be prepared if needed, etc.

c. Call -- The clock is on. The WS has 10 mins. to respond.

d. Cancel -- The call can be canceled before the WS reaches the scene. Since the WS should not be dispatched to a scene without an officer standing-by for safety and traffic management, if the disabled vehicle is able to start or the motorist returns with a tow truck, the WS can be notified before arrival on the scene. If the call is canceled by the police-on-the-scene, no fee is incurred. If, however, the call is not canceled and the WS proceeds to the scene, the WS will be paid a usual and customary service fee which is determined by the compensatory disclosures of the contracting WS's costs to the Board. The cancellation fee would not include profit, etc. This fee would be paid by the contracting county.

Usual removal time should be 10 minutes for vehicles without air-brakes and 30 minutes for vehicles with air-brakes. Recovery, off-loading cargo, hazardous material, etc. would be defined as unusual circumstances that would require additional time. Further, the officer-at-the-scene or incident manager may determine if it is necessary to delay removal for certain circumstances. A fee shall be charged for waiting time that exceeds 20 mins for standard incidents, 30 minutes for air-brake vehicles or for unusual circumstances. Removal times shall be monitored and supplied to the Board for their consideration of future suggested items in county contracts.

Equipment may be defined as follows:

a. The basic performance rating of the recovery equipment is the weight the equipment can lift in a winching mode, when the boom is static at a 30 degree elevation with the load lines vertical and the lifting cables sharing the load equally, measured with a live load (weight or load cell).

The structural design of the recovery equipment must have a higher load capacity than the performance rating(s).

Winches shall conform to or exceed the specifications set forth by the Society of Automotive Engineers (SAE) Handbook, SAE J706.

All ratings for cable and chain assemblies are for the undamaged assembly condition.

All cable and chain assemblies should be the same type, construction and rating as specified by the original equipment manufacturer (OEM) for the equipment.

b. Safety chains shall be rated at no less than the rating specified by the OEM.

c. All controls shall be clearly marked to indicate proper operation as well as any special warnings or cautions.

Tow Truck Classifications and Equipment Specifications

1. Class A Tow Truck

- 10,000 - 19,500 pounds GVWR Chassis
- 4 ton recovery equipment rating
- Hydraulic or mechanical winch(es)
- 100 ft. 3/8" 6x19 cable or OEM specs.
- Tow chains, 5/16" alloy or OEM specs. J/T hook assembly
- Safety chains, 5/16" alloy or OEM specs.
- Tow sling ratting 3,000 lbs.
- Wheel lift safety straps
- Tow dolly
- One 3 ton snatch block
- Wheel lift rating - retracted .... 3,000 lbs.
  - extension .... 3,000 lbs.

2. Class A Car Carrier - One Car

- 10,000 - 16,000 pounds GVWR Chassis
- Hydraulic or mechanical winch
- 50 ft. 3/8" 6x19 cable or OEM specs.
- J/T hook loading bridle/chains
- Safety chains, 5/16" alloy or OEM specs.; two pairs of safety chains for the vehicle being transported.

3. Class B Tow Truck

- 19,501 - 33,000 pounds GVWR chassis
- Air brakes or hydraulic w/air hookup package
- 14 ton recovery equipment rating
- Hydraulic or mechanical winch(es)
- 150 ft. 7/16'6x19 cable or OEM specs.
- Tow chains, 1/2" alloy or OEM
- Safety chains, 1/2" alloy or OEM specs.
- Tow sling rating 7,000 lbs.
- Two 8 ton snatch blocks
- Wheel lift safety straps
- Wheel lift or Under lift rating - retracted ....10,000 lbs.
- 85" extension .. 8,000 lbs.

4. Class B Car Carrier

- 19,501 pounds or more GVWR chassis
- Hydraulic or mechanical winch
- 50 ft. 3/8" 6x19 cable or OEM specs.
- J/T hook loading bridle/chains
- Safety chains, 5116" alloy or OEM specs.; two pairs of safety chains for each vehicle being transported and two safety chains for the vehicle being towed.

5. Class C Tow Truck

- 33,000 - 50,000 (and Up) pounds GVWR chassis, 200" wheelbase
- 200" wheelbase with truck hitch
- 240" wheelbase with under-lift
- Air brakes w/air hookup package
- 25 ten recovery equipment rating
- Hydraulic ,or mechanical winch(es)
- 200 ft. 5/8 6x19 cable or OEM specs.
- Tow chains, 5/8' alloy or OEM specs.
- Safety chains, 5/8" alloy or OEM specs.
- Tow sling rating 12,000 lbs.
- Two 12 ton snatch blocks

- Under lift rating - retracted .. ... . 25,000 lbs.
  - 100" extension ..... 12,000 lbs.

Additional Equipment will include:

- Extension - Brake and tail lamps (tow lights specified by Federal Motor Carrier Safety Regulations, U.S. DOT). (not included for car carriers)
- Fire extinguisher(s)
- Broom
- Shovel
- Reflective triangles
- Flares
- Trash can(s) with absorbent
- One 3 ton rated snatch block
- Two 8-ton rated snatch blocks (B class tow truck only)
- Two 12-ton rated snatch blocks © class tow truck only)
- Shop to truck radio (C/B excluded)
- Motorcycle straps
- Air hoses and necessary fittings to provide air to the towed vehicle (class B & C only)
- Axle covers/caps
- Steering wheel clamp or tie-down

Any company serving as a "quick-responder" shall comply with all applicable Federal and Georgia safety and insurance codes and requirements. Also, it must comply with such laws as processing abandoned motor vehicles, etc. The language of the Gwinnett County Contract might serve:

Contractor will conform to all Federal, State, Local laws, rules, ordinances and regulations now in effect and any legal revisions that apply. Contractor assumes responsibility to insure that the contract wrecker service meets all legal applicable requirements.

Personnel to man the equipment needs to be professionally trained capable of operating safely the equipment they run. Air-brake vehicles may require two-man teams or a small wrecker and driver to assist in recovery. TRAG is willing to offer a certification program that will train and maintain proficiency of the wrecker's crews and recovery vehicles. Such programs should be divided into light-duty, heavy-duty service capabilities and special training in the use of recovery equipment and procedures like air-bags, etc. A mandatory certification program should be installed with a periodic educational up-date requirement. In addition, all dated Federal and Georgia laws dealing with drug testing, CDL's etc. should be mandated.

Incident Management Team approach is needed to adequately and safely conduct removal of wrecked, disabled and damaged vehicles from high use areas. The WS can provide the muscle through equipment and skilled operators, but it cannot manage traffic and make decisions to abandon cargo loads to further damage in the interest of time and convenience. Police and GSP are trained traffic management authorities and shall be with the wrecker during the recovery and hook-up to control traffic. No wrecker shall be required to respond to a call from a police authority without that authority maintaining control of the traffic conditions through the entire process.

Decisions to sacrifice loads, etc. come under the incident management team leader who be responsible to order the WS to conduct such recovery practices that are contrary to standard practices of recovery in the industry. The contract will clearly state the line of responsibility ,and seek to indemnify the WS against suits for carrying out the orders of the Incident Manager.

Dangerous or hazardous loads, pulls of wrecked equipment that exceed load limits and that are towed at precarious angles shall be accompanied by escort cars from the law enforcement authority to ensure safety.

Quick-responders will be licensed as a special class of a vehicle. This will require modification of State law. When these vehicles are going to and during recovery, they shall display an additional flashing strobe white light that sits atop of their light bar or cab. This light shall only be used when they are serving as emergency vehicles for the Incident Management team.

Owner's request for a private tower should be available for an incident that occurs during off-peak periods, if the incident is out of the flow of traffic and if the private tower can guarantee an ETA not exceed 30 minutes. Towers arriving after their 30 minute guarantee may be ticketed for delaying the flow of traffic.

Vehicles should be moved off the roadway and not just pushed to the shoulder, except in unusual circumstances.

In addition to the insurance requirements of the GPSC, the contract tower shall carry insurance as spelled out on pgs. 12 & 16 of the Gwinnett County Contract:

Contractor shall maintain for the duration of this contract, liability insurance in the form of a Comprehensive General and Automobile Liability policy or a garage keeper's liability insurance. Such policy shall protect him from claims for bodily injury, including death, to his employees and all others and from claims for property damage, all such may arise out of or result from the Contractor's operations under this contract. This insurance shall be in amounts as specified by the Georgia Public Service Commission. (Cobb County's requires one million dollars policy to indemnify the county against loss or damaged on the part of the wrecker service and that names the county as an additional insured). In addition, the Contractor shall carry $50,000 cargo insurance for tow trucks towing non-air-brake vehicles and $100,000 for vehicles towing air-braked vehicles.

Impound lots should be located within the area of the pull. This may be possible only if the County Commissioners work with the WS's to obtain land in that zone. The zoning authority needs to be responsible for selling aside land for such use within its zone. The county must also take responsibility for the removal and adequate storage of these vehicles. Especially, if many of the cars will become derelicts and stay on lots for months.

The lot needs to have the concept of a "security lot" not a junk car graveyard.

Security Facilities basic requirements should require operators to provide adequate security of vehicles and property at the place of storage. As a minimum, a fenced or enclosed area shall be provided. The operator is responsible for the reasonable care, custody and control of any property contained in towed or stored vehicles.

a. The lot must have a facility that will hold 300 vehicles.

b. It must have the entire lot adequately illuminated during the hours of darkness to discourage and detect attempts at theft or vandalism.

c. All fences must be of 6' chain link, barbed wire running at the top, with gates that can be securely locked. These gates shall be and remain locked during hours of dark-ness except when they are under an employee's control.

d. An attendant shall be n the property 24 hours per day, able to respond to a request for releasing of vehicles.

Georgia Code 40-11-1 provides more than enough notification of owners and lien holders in a timely fashion. Language in the contract should mandate compliance.

Contract lengths should be for four years.

The fee structure should be by compensatory means. This is a standard term familiar to most governmental bodies that deal with rate making. The WS's should yearly offer their costs of operation and a Board should determine a fair figure for compensation of their costs. Then the WS's negotiate for a profit. This way no party gets used. The WS's get their costs and a negotiated profit.

We feel that a basic pull relative value scale and fee schedule as recommended by the Board should be established for tows of various weights, complexity and vehicle size. Such factors as dollies, additional equipment can be worked out by the Board. The county could negotiate with its contractors, if the zones extend across lines, then a Commission like the MARTA could be established to work with WS's. It could set fees each year.

Waiting time should be charged and excessive recovery procedures should be charged out per hour.

Incident Management Wrecker Board would be assigned (under the existing county contract system):

a. To establish recommended "cost" figures for counties to use in negotiating their contracts and updates.

b. To hear complaints of counties or WS about contract violations.

c. To arbitrate complaints from services who are going to be removed for cause.

d. To hear citizens complaints where they feel a WS did not treat them fairly, over-charged them, damaged their vehicle during tow, etc.

e. Make recommendations of zones and zone "hot spots."

f. Ensure the training program arc adequate and valid for the needs of the area.

g. Define standard times and categories for incident management and recovery

h. Ensure that quality of service is being rendered within the area.

A fund from the contract S could be used to pay the costs of this Board. It is a TRAG policy. oppose contracts that require WS's to pay for the right to tow for a municipality or county. This is double taxation. It is, however, fair to have the WS's pay for the benefits afforded by a Board that will be as much to their benefit as the county's or area's.

If a county continues to demand WS's to offer them money as an inducement to obtain a county contract then that county only should be required to pay its share of the cost of the Board.

This nine-Person Board should be composed of political officers from the area municipalities. law enforcement officers. DOT reps, WS contractors and interested parties representing the towing industry, but not a contracted WA, and members of the general public, Approximately representative ratio could be one-third governmental officials, one-third law enforcement and one-third towing industry reps.

<u>Other Suggestions to Make the System Flow:</u>

There appears to be a need for Centralized Dispatching on incidents.

At one time, there were fund,, available to place Emergency Call-Boxes on Atlanta Interstates. That may need to be re-considered, especially in areas where it would be excessively long to places of help, or dangerous to walk on the interstate.

More patrols of police would be helpful in being notified of wrecks, stalls, breakdowns, etc.

Police transport the wrecked car's passengers to a safe place instead of the wrecker service needing to wait to remove the vehicle until the paperwork is finished.

Quick-responders be given authority to monitor police bands to aid in organization of their more rapid response.

TRAG would make presentations available to police academies on how to assess a wreck scene to determine the needed equipment for removal, etc.

Thank you again for your allowing us to participate in the planning of this important program.

Module 7
Site Management

The goal of Module 7 is to describe the site management phase of the incident management process, describe specific challenges to effective site management, describe potential tools or strategies for improving site management efforts and provide the opportunity to examine local site management needs and potential tools/strategies for improvement.

MODULE 7

SITE MANAGEMENT

DEFINITION

Coordination and management of resources and activities at or near the incident scene.

Relies heavily on one-on-one agency/company cooperation and communication.

OBJECTIVES

- Coordinate multidisciplinary activities
- Improve communications
- Maximize use of resources
- Improve motorist and responder safety through traffic management

BENEFITS

Incident durations reduced by half because of improved relationships between Maryland transportation and police agencies

- Kassoff

ISSUES AND BARRIERS

Who's "in charge"?

Incident Command System (ICS)

- Who is "in charge of what"?
- Single contact makes final decision based on others' input

ISSUES AND BARRIERS

Who can close the roadway?

- Interagency agreements
- Supporting legislation

ISSUES AND BARRIERS

Lack of interdisciplinary awareness

- Major incident response teams
- Interdisciplinary training

ISSUES AND BARRIERS

Who performs traffic control?

- Clearly define role for transportation agency in incident management
- Interagency agreements

ISSUES AND BARRIERS

Access and maneuverability at the scene is difficult

- Quick implementation of traffic control and alternate route plans
- Response vehicle parking plans and equipment staging areas

ISSUES AND BARRIERS

Inability to communicate via radio

- Alternative communication devices
- Cross-installation of conventional radios
- Single-frequency radio systems
- ICS and command post

NON-TECHNICAL TOOLS/ STRATEGIES

- Incident Command System
- Major incident response team
- Personnel identification or uniforms
- Equipment staging area

Incident Command System

DEFINITION

ICS is a formalized system that:

- lends consistency to actions in an incident
- eliminates the need to re-invent the wheel for each new incident

Incident Command System

OBJECTIVES

- Clearly define command
- Improve interdisciplinary communication
- More fully utilize resources

Incident Command System

COMPONENTS

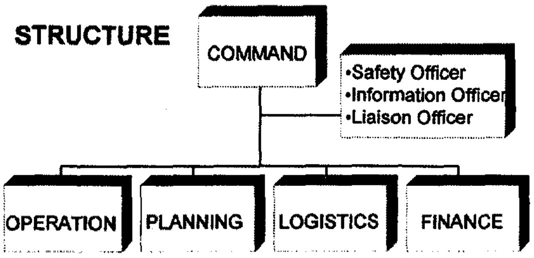
- Common terminology
- Modular organization
- Integrated communications
- Unified command structure

Incident Command System

COMPONENTS

- Consolidated action plans
- Manageable span of control
- Designated incident facilities
- Comprehensive resource management

Incident Command System



Incident Command System

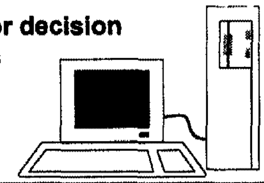
- ICS designates will change
- ICS structure will not

TECHNOLOGY-BASED TOOLS/ STRATEGIES

- Alternative communication devices
- Cross-installation of conventional radios
- Single-frequency emergency radio systems
- Trunked 800 Mhz radio system

EMERGING TECHNOLOGIES

- Portable laser warning system
- Inter-operable radio systems
- Expert systems or decision support systems



NATIONAL EXAMPLES

Interdisciplinary Training in Oregon

- *Traffic Control for Emergency Responders*
- Intended for fire, police, tow truck operators, utility company personnel, and other responders

NATIONAL EXAMPLES

- Traffic Control in Pennsylvania
- Minimizes danger of stopped traffic
- Slows traffic to 15 - 30 mph
- Allows 1 - 15 minutes work time

Table of Contents

Module 7
Site Management

Definition

Site management is defined as the coordination and management of resources and activities at or near the incident scene, including personnel, equipment, and communication links.

The site management phase of incident management occurs after responding agencies have arrived at the scene. Injured persons are immediately attended to, the incident scene is protected, and plans are formulated for scene documentation and clearing wreckage or debris.

Successful site management relies heavily on agency and company cooperation and traffic management strategies. Inferior incident management tools or strategies that are well managed may be more effective than superior tools or strategies that are poorly managed. For minor incidents, site management is relatively simple, usually involving just a single agency (e.g., a transportation agency) or a single agency and a company (e.g., a police agency and a wrecker company). Site management becomes much more complicated as the severity of the incident increases. The number of responding agencies and companies and the number and complexity of individual tasks consequently increase.

Objectives/Benefits

The objectives of improved site management are as follows:

- to effectively coordinate the activities of multiple agencies
- to improve inter- and intra-agency communications

- to maximize the use of personnel and resources.

- to improve the safety of motorists and responders through traffic management

Because much of site management deals with agency and company personnel coordination, measured benefits of improved site management efforts are seldom available. However, the Maryland State Highway Administration reports that incident durations have been reduced by half as a result of its improved relationship with the Maryland State Police (Kassoff 1992).

Issues or Specific Barriers

A number of issues can arise when site management is improved. Because effective site management relies so heavily on agency/company cooperation and communication, the barriers are perhaps more challenging to deal with. Unlike other incident management phases, in which technological advances or additional resources can largely improve efforts, improvements in site management require more one-on-one interaction between agency/company personnel. Issues that often are raised in improving site management efforts are discussed below. When possible, specific examples of how other areas have dealt with these issues are provided.

Who is "in charge" at the scene?

Response personnel at the scene of an incident are often required to make quick decisions that may have serious or even life-threatening implications. Disagreement among response personnel regarding the proper actions to take can lead to additional stress at the incident scene and can have a lasting, damaging effect on long-term inter-agency relationships. The question of who is "in charge" often arises when disagreement exists. When multiple agencies are required to work together, such as is required at the scene of an incident, the phrase "in charge" can sometimes initiate feelings of resentment. Police personnel are not "in charge" of transportation personnel, nor are fire personnel "in charge" of police personnel. Certainly however, a structure is required by which decisions can be made. A more appropriate approach to agency coordination at the scene is to consider who is "in charge of what" and to assign a single contact to whom all information is reported. That single contact will make the final decision, but on the basis of input from everyone else at the incident scene. The Incident Command System (ICS), discussed in detail later in this module, provides this structure. Under the ICS, the single point of contact is referred to as the Incident Commander (IC).

Interdisciplinary training, particularly in ICS, can help to alleviate the issue of who is "in charge." Incident Command System training is offered as a two-day course; interested personnel should check with fire or police agencies to learn about training opportunities. In some instances, supporting legislation may be required. In Washington state, the following supporting legislation exists for response to hazardous material incidents.

> 70.136.030 Incident Command Agencies — Designation by Political Subdivisions. The governing body of each applicable political subdivision of this state shall designate a hazardous materials incident command agency within its respective boundaries, and file this designation with the director of community development. In designating the incident command agency, the political subdivision shall consider the training, manpower, expertise, and equipment of various available agencies as well as the Uniform Fire Code and other existing codes and regulations. Along state and interstate highway corridors, the Washington State Patrol shall be the designated incident command agency unless by mutual agreement the role has been assumed by another designated incident command agency. If a political subdivision has not designated an incident command agency within six months after July 26, 1987, the Washington State Patrol shall then assume the role of incident command agency by action of the chief until a designation has been made.
>
> 70.136.035 Incident Command Agencies - Assistance from State Patrol. In political subdivisions where an incident command agency has been designated, the Washington State Patrol shall continue to respond with a supervisor to provide assistance to the incident command agency.

Who makes the decision and has the authority to close the roadway?

As just described, often disagreement exists over important decisions to be made at the scene of an incident. One of the more common disagreements involves when to close a roadway to traffic. The disagreement over this issue stems from differing agency priorities. Transportation personnel traditionally have pressed to keep the roadway open to alleviate traffic congestion and prevent secondary incidents. Police and fire agencies have traditionally encouraged road closure to protect response personnel from passing traffic and to maintain the integrity of evidence at the scene. Given such clearly differing perspectives, it is important to develop a process through which the decision can be made quickly and efficiently (without extensive deliberation among agency personnel) while the perspectives and concerns of other agencies are considered. Again, ways to ensure quick and efficient decision-making related to road closures are to develop supporting legislation or to form interagency agreements.

> 47.48.031 Emergency Closures by State Patrol. (1) Whenever the Chief or another officer of the State Patrol determines on the basis of a traffic investigation that an emergency exists or less than safe road conditions exist due to human-caused or natural disasters or extreme weather conditions upon any state highway, or any part thereof, State Patrol officers may determine and declare closures and temporarily reroute traffic from any such affected highway. (2) Any alteration of vehicular traffic on any state highway due to closure in emergency conditions is effective until such alteration has been approved or altered by the Secretary of Transportation or other Department of Transportation authorities in their local respective jurisdictions. (3) All state highway closures by officers of the State Patrol shall be immediately reported to the Secretary of Transportation and to other authorities in their local jurisdictions.

Lack of awareness regarding other agency/company roles and requirements at an incident scene.

We can all cite examples of lost information, flared tempers, and extreme actions resulting from poor response personnel interaction:

- transportation or fire personnel unknowingly disturb evidence needed by police personnel to determine the causing party

- police personnel instruct towers to hook up the fire truck because fire personnel refuse to move it out of the travel lane

- transportation personnel are left in a dangerous situation because police or fire personnel would not remain at the incident scene with their vehicle's lights flashing until transportation personnel had a chance to set up traffic control.

Many other examples demonstrate how a lack of understanding and awareness among agency and company personnel has led to negative and combative feelings.

The task of increasing understanding and awareness among agency and company personnel can be daunting when you consider the number of agencies and companies that are involved in incident management.

Numerous public agencies are involved in incident management in various capacities. From transportation disciplines, these agencies likely include state or federal departments of transportation and county and city public works. Police agencies are likely to include state police or patrol, county sheriff, and city police agencies. County and city fire agencies often provide both fire response personnel and emergency medical personnel. State environmental agencies and the Federal Environmental Protection Agency typically become involved when hazardous substances are present. Other public agencies may include emergency management agencies, health departments, utilities and transportation commissions, and even the U.S. Coast Guard.

Highway maintenance/department of public works agencies are mainly concerned with infrastructure damage and traffic control. Highway traffic agencies want to maximize traffic flow, often with diversionary routes. Police agencies are concerned with public safety, property rights, investigation, and injured persons. Fire and EMS agencies are concerned with controlling fire or hazardous materials and taking care of injured persons. Environmental protection agencies seek to protect the environment. Each of these agencies has a different set of priorities at the incident scene. In spite of differing priorities, the best asset offered by each of these agencies is its personnel and their caliber of training.

To add to the coordination complexity at an incident scene, public agency personnel must frequently work with private company personnel to adequately manage the incident. Private companies likely involved in incident management include towing companies, heavy equipment operators, equipment rental agencies, ambulance services, hazardous materials cleanup agencies, and the media (i.e., traffic reporters). Private sector companies are not responding to incidents out of a public service commitment but instead to make a living.

Because each of these agencies and companies must work together at the scene of the incident, it is important to understand (1) where incident management ranks in each agency's or company's organization, (2) what motivates each agency's or company's actions, and (3) what capabilities and resources exist within an agency or company. Mutual understanding and awareness will greatly improve personnel cooperation at the scene.

This workshop and related materials provide you with some general information pertaining to agency and company priorities, capabilities, and resources. However, to improve working relationships in your locale, specific information from each agency and company will need to be collected, compiled, and distributed. A good way to gather and disseminate this information is through the development of an incident response manual. This manual can be cooperatively developed and shared among all incident responders and can include specific information pertaining to the needs of the various responders. A good example of such a document is the "Northern Virginia Freeway Management Team Operating Manual." This document describes various agency roles and includes any interagency agreements developed to facilitate efficient incident management operations.

When collecting local information, consider questions related to (1) the agency's or company's priorities and where incident management ranks, (2) response personnel capabilities and training, and (3) resources (i.e., equipment, supplies) and availability. Some basic questions to consider when learning about other agency/company operations include

- Who will show up at the scene of the incident?
- What equipment will they have?
- Where will they be coming from?
- How long will it typically take them to arrive?
- Why should I call them, what can they do for me?
- How do I call and request them?

Other means of improving agency/company awareness and understanding are through the formation of incident response teams or through interdisciplinary training. Incident response teams typically comprise a small number of personnel from several agencies whose main function is to respond to incidents. Because the group is small and involves the same individuals on a fairly consistent basis, response personnel have the opportunity to become familiar with the needs of response personnel from other disciplines.

Interdisciplinary training also serves to increase the awareness among agency and company personnel. Ideally, personnel from one agency should take advantage of training opportunities offered through another discipline. However, time and resource constraints typically limit the amount of training that personnel can take advantage of. An alternative is to integrate some aspect of agency awareness into a variety of training programs. For example, in the Seattle area, the Washington State Department of Transportation (WSDOT) sends a speaker to the Washington State Patrol Academy to talk to new recruits about the role of WSDOT at the scene of an incident, WSDOT personnel capabilities, and WSDOT resources. So far, this approach has been very successful in ensuring a good working relationship between WSDOT and the Washington State Patrol.

Who is responsible for and/or usually performs traffic control?

Transportation agency personnel across the country have varied levels of involvement in incident management. Some transportation agencies and personnel are very active and assume non-traditional duties or tasks in addition to traffic control and clean-up duties in an effort to improve overall incident management efforts. Other transportation agencies and personnel choose a less active role in incident management; traffic control is often provided by other agency personnel such as police or fire personnel. The level of current involvement from transportation personnel cannot always be assumed to be the desired level of involvement for the future; some will want more responsibility and some will want less. It is important to identify early on what role the transportation agency will have in incident management.

Guidelines describing circumstances under which traffic control will be provided and by whom can be developed and formalized through interagency agreement or can be included in an incident response manual shared by all agencies. For example, transportation agencies with more extensive traffic control resources (i.e., signs, cones) may be requested only when an incident blocks one or more lanes for one or more hours. More limited traffic control can be provided by other response agencies for shorter duration incidents.

Access to and maneuverability at the incident scene is difficult.

Roadway design and traffic congestion are the primary factors that limit access to the scene for incident responders. Many actions can be taken at the scene of the incident to improve accessibility. Implementing traffic control and alternative route plans as quickly as possible substantially improves access to the incident scene. Motorcycle patrols, which can more easily maneuver through traffic, can be useful in initiating early traffic routing around the scene of the incident; additional traffic control resources are quickly needed, however. Accessibility to and maneuverability at the incident scene can be further complicated by the incident response or emergency vehicles already at the scene. Traditionally, response vehicles have been parked where convenient without thought to access or roadway blockage. When a response vehicle must be moved, often the driver of the vehicle is not nearby. This style of operation results in unnecessary time delays at the scene. Response vehicle parking plans and equipment staging areas help to alleviate some of the response vehicle "congestion" that can slow operations.

Inability to communicate via radio with other agency personnel in the field.

Either en-route to the incident or at the scene of the incident, quickness and convenience could often be improved if response personnel from other agencies were able to communicate more directly with one another. For example, police personnel already at the scene of an incident may want to inform the dispatched wrecker to take a different, more time-efficient route. Instead, the wrecker may lose 15 minutes or more weaving through the traffic backup. In addition, police personnel may want to inform transportation personnel of the need to close a lane temporarily to remove the wreckage from the scene. The transportation personnel may be a half-mile or more upstream of the incident performing traffic control.

Ideally, incident response personnel should have compatible radio systems to facilitate communication. However, radio systems require a large capital investment, and it is unlikely that agencies will opt to change systems. Many agencies, typically initiated at the field level, have been very creative in dealing with the field communications problems. The use of alternative communication devices such as cellular telephones or alpha-numeric pagers has proven somewhat promising. Cross-installation of radios among response personnel vehicles is another approach (i.e., a transportation radio is installed in a police vehicle in addition to the police radio, and vice versa). Cross-installation of radios is limited by physical space in the vehicle and requires the identification of the most critical communication links. The Pennsylvania Turnpike Commission provides Turnpike radios free of charge to contracted fire services, EMS providers, and contracted towing services. When an incident occurs, all state police, Commission personnel, and emergency services are capable of communicating with one another. Hand held portable radios are used at the scene with repeaters in the state police and Commission units. Emergency radio systems that allow everyone at the incident scene to communicate for the duration of the incident may also be useful. For more severe, longer duration incidents, the Incident Command System and use of a command post can facilitate communications with existing radio systems. Personnel from each responding agency with their respective radios are staged at a command post. Information and directions are disseminated from the command post to each agencies' respective personnel.

Tools/Strategies for Improving Site Management

A number of existing tools or strategies can be used, and are currently being used around the country, to improve various aspects of site management. Many of these are summarized below.

Non-technical Tools/Strategies

- Incident Command System and Use of a Command Post
- Major Incident Response Teams
- Personnel Identification or Uniforms
- Response Vehicle Parking Plans
- Equipment Staging Area
- Emergency or Flashing Lights Policies
- Physical Incident Screens
- Traffic Control at the Scene

Technology-based Tools/Strategies

- Alternative Communication Devices
- Cross-Installation of Conventional Radios
- Single-Frequency Emergency Radio Systems
- Trunked 800 MHZ Radio Systems

Emerging Technologies

- Portable Laser Warning System
- Inter-operable Radio Systems
- Expert Systems or Decision Support Systems

Each of these are described more fully below.

Non-technical Tools/Strategies

Incident Command System and Use of a Command Post

The easiest way to understand the purpose of the ICS and your role in it is to consider the following set of questions.

- Have you ever been asked by your supervisor to perform a specific task?
- Did you perform that task?
- Did you report the completion of the task to you supervisor?

If you answered "yes" to all the questions listed above, you have essentially performed the necessary requirements for the Incident Command System; in the ICS, the "supervisor" is referred to as the Incident Commander.

Definition

The Incident Command System (ICS) is a formalized system that lends consistency to the way team members and agencies function in an emergency. It fosters efficiency by eliminating the need to re-invent the wheel for each new emergency. The Incident Command System provides a planned and organized approach to the management of emergencies.

Unlike this workshop's terminology, in which "incident" usually refers to a traffic-related emergency, the ICS "incident" refers to a broader range of emergencies (i.e., tornadoes, hurricanes, earthquakes, wind storms, water main break, traffic accidents).

Because ICS can be used at virtually any type of incident of any size, it is important to provide ICS awareness training to all emergency responders. Emergency responders must understand their role in the ICS.

The ICS should be viewed as a set of guidelines. It does not provide detailed procedural or contact information but rather provides a general set of procedures to follow.

As incident responders you also have guidelines for response. The purpose behind introducing the ICS is not to replace your existing response procedures - it is merely to provide you with a better understanding of other agencies' response operations.

Objectives

The ICS developed as a result of the wild land fires in Southern California in the 1970s. The response of multiple agencies was required - management problems resulted, command was not clearly defined, communication problems were monumental, and resources were not fully utilized.

Originally called FIRECOPE, the ICS has gradually developed to apply to all emergency and all agency situations. The ICS has now been adopted by the National Fire Academy, endorsed by the Commission on Accreditation for Law Enforcement Agencies Incorporated, and endorsed by the American Public Works Association. In addition, the use of ICS by agencies responsible for handling hazardous materials is required (by OSHA in OSHA states and by the EPA in non-OSHA states).

The objectives of the ICS are to

- clearly define command
- improve inter-agency communication
- more fully utilize resources.

Components

Eight components lead to the success of the Incident Command System.

(1) Common Terminology

(2) Modular Organization
(3) Integrated Communications
(4) Unified Command Structure
(5) Consolidated Action Plans
(6) Manageable Span of Control
(7) Designated Incident Facilities
(8) Comprehensive Resource Management

Common Terminology

Common names for personnel, equipment, and facilities in the area (i.e., common definitions, lingo) are essential to effective communication.

Modular Organization

The number of people and amount of equipment vary by the size and type of incident. A simple incident requires maybe only the involvement of a single agency. As the incident becomes more complicated, the ICS organization expands as needed. This provides a more efficient use of resources.

Integrated Communications

Effective two-way communications is essential. Messages must be received, understood, and acknowledged.

Unified Command Structure

The ICS organization framework can be expanded to include multiple agencies and levels. Command varies on the basis of the complexity of an incident.

Single Command. A single individual has overall management responsibility for the incident (i.e., an incident occurs within a single jurisdiction's boundaries and requires the personnel and resources of only a single agency).

Unified Command. Management responsibility is shared for the incident (i.e., either the incident impacts multiple jurisdictions or the personnel and resources of more than one agency are required to clear the incident). All agencies that have a responsibility at an incident cooperatively determine the overall incident objectives, strategies to employ, planning efforts, integrated activities or actions to take place, and maximum use of resources.

Consolidated Action Plans

Action plans should identify goals and objectives (e.g., clear the incident rapidly), other agency roles and resources, and procedures from the beginning to the end of the incident. Written action plans are recommended when a commitment of multi-agency resources is necessary, when more than one jurisdiction responds to the incident, or when the incident is of a longer duration than a single shift (personnel/equipment need to be rotated).

Strategy. The strategy is the overall plan broadly defined.

Tactics. The tactics are the specific actions through which the broadly defined strategy will be accomplished.

Manageable Span Of Control

The number of elements or resources under the direction of one individual. The desirable range is three to seven, with the optimum number being five. This management may span across several agencies or jurisdictions.

Designated Incident Facilities

Designated incident facilities, including command posts and staging areas, help to speed response and improve inter-agency communication and cooperation.

Command Post. A central, stationary location, usually identified by a flag, lights, or other markings, to assist in the incident command and control (i.e., a field office for managing the collection , analysis, and dissemination of information).

A command post is crucial for major incidents. This location becomes the center of all communication among and coordination for the responding agencies. The command post can be any location near the incident and may be as simple as the hood of a patrol car. A flag or other visible symbol should be used to indicate the command post for easier identification. The Incident Commander should provide this symbol. The location should be made clear to all responding agencies through communication channels. This way, everyone knows exactly where to report.

Staging Area. A staging area is defined as an area where resources can report and wait for assignment without creating a blockage at the incident scene and without causing a delay in response time.

For some major incidents, large amounts of equipment may be needed to clear the area. These pieces of equipment arrive at the scene intermittently. To avoid confusion, a staging area must be created to organize the equipment and designate its use. Transportation agencies will probably be the primary user of the staging area

Normally the staging area is at least ½ mile away from the incident area and near a shoulder so that it is not a further hindrance. Furthermore, agencies using this staging area should not have to weave through traffic to access it.

Comprehensive Resource Management

Respondents should be aware of existing resources, their status (i.e., whether the equipment is assigned or in use, available, or out of service), and any changes in resource location.

Single Resources. Single resources are the primary resources needed to control the incident. Single resources include both the equipment and the personnel to operate it.

Task Forces. Task forces are temporary combinations of single resources assembled for a particular need. The task force must have a leader, common communication, and a reasonable span of control. Task forces consist of different types of resources.

Strike Teams. Strike teams have a set number of like resources with an established minimum of personnel, common communications, and a leader.

Command

The command staff can be made up of an Incident Commander (IC), an Information Officer (IO), a Liaison Officer (LO), and a Safety Officer (SO).

Incident Commander (IC)

The Incident Commander is responsible for directing and coordinating all aspects of an incident. For a single jurisdiction incident, a single individual is in charge. For a multi-jurisdictional incident, the IC may be made up of several individuals.

Safety Officer (SO)

The Safety Officer monitors operations, assesses possible hazards, ensures personnel safety, and reports to the IC.

Information Officer (IO)

The Information Officer obtains information on the situation, disseminates the information to the media, and arranges interviews.

Liaison Officer (LO)

The Liaison Officer serves as the point of contact for agency representatives, and monitors incident operations to identify any interagency problems.

Functions

Operations

The Operations Branch performs all response activities at the incident.

Planning

The Planning Branch is responsible for the collection, evaluation, and dissemination of incident-related information to the incident personnel.

Logistics

The Logistics Branch supports activities at the scene. Duties include ordering all personnel, materials, resources, and supplies for the incident; distributing, storing, and recording all materials and supplies; providing facilities for the rest and feeding of personnel; and maintaining equipment. This branch must also provide fuel, repairs, personnel transportation, medical services, and communications.

Finance

The Finance Branch is established when needed for such services. Duties include keeping daily personnel time records and equipment time, monitoring vendor contracts, monitoring compensation/claims (i.e., for injury), and conducting cost analyses.

Summary

Under the ICS, the responsible individuals or agencies may change depending on the specific characteristics of the incident. The basic ICS components and process for incident or emergency response do not change. The focus is on the structure and the process more than on the specific individuals or agencies assigned to each component.

- ICS designates will change.
- ICS structure will not.

Major Incident Response Teams

The number of different personnel interacting at the scene of an incident could be minimized through the formation of a major incident response team. As described in Module 6, there are many variations in the composition of the incident response team. An incident response team typically consists of individuals from a variety of disciplines (e.g., police, fire, transportation) who train for and respond to major incidents together. The level of familiarity among the various team members is high. For a full description of incident response teams as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included in the back of this notebook.

Personnel Identification or Uniforms

Personnel identification or uniforms allows quick identification of responding personnel. Oftentimes, transportation, towing and recovery, media, and other responders are difficult to distinguish from one another; fire and police personnel typically dress in uniform. Full uniforms do not need to be purchased; hats, patches, or identification arm bands are less expensive alternatives that provide the necessary identification information. For a full description of personnel identification or uniforms (listed as "identification arm bands") as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included in the back of this notebook.

Response Vehicle Parking Plans

Maintaining traffic flow is an important part of dealing with an incident. With the exception of vehicles parked to secure the incident scene, the vehicles should be parked on the shoulder to keep from blocking any additional lanes of traffic. Sometimes response vehicles are used to screen off the incident from the motoring public to prevent "rubbernecking," although physical screens are available on the market. All responding vehicles should be parked on the same side of the roadway on which the incident occurred. Fire personnel are usually directed to park their vehicles directly behind or in front of the cars involved in the emergency, to minimize the disruption of traffic and also to reduce the exposure of men and apparatus to danger. The main goal is to keep as many lanes of traffic open as possible.

Should excess blockage be observed, police responders may request the removal of the response vehicle to a more appropriate location to minimize traffic disruption.

While it is not possible to develop parking plans to fit all incident scenarios, it is possible to develop guidelines or policies about how and where response vehicles should be parked so that traffic flow can be maintained past the incident and so that lanes can be opened when they are no longer needed by responders. On-scene staging of equipment should be considered when discussing parking at the scene. Tow trucks, sand trucks, and other vehicles should be parked where they can be accessed and moved while not blocking lane-opening activities.

For a full description of response vehicle parking plans as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included in the back of this notebook.

<u>Equipment Staging Area</u>

For some major incidents, large amounts of equipment may be needed to clear the area. These pieces of equipment arrive at the scene intermittently. To avoid confusion, a staging area must be created to organize the equipment and designate its use. All appropriate responders should be notified of the location of the equipment staging area. The staging area should be near the incident scene and easily accessible (i.e., agencies using this staging area should not have to weave through traffic to access it).

A full description of an equipment staging area as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, is included in the "Framework for Developing Incident Management Systems" located at the back of this notebook.

<u>Emergency or Flashing Lights Policies</u>

The use of emergency flashing lights to alert oncoming motorists that an incident has occurred can be positive or negative. Flashing lights are important when response vehicles are traveling on the shoulder or are next to traffic traveling at high speeds, especially at night. Flashing lights are also important aids in getting to the scene. However, flashing lights can distract motorists if they are used unnecessarily. The distraction increases congestion at the scene of the incident. Where possible, without reducing safety, flashing lights should be turned off or flashed in one direction only. During daylight hours, if response vehicles are sufficiently off the roadway and congestion prevents passing vehicles from traveling too quickly, flashing lights may be unnecessary.

Emergency or flashing lights policies are further discussed in the "Framework for Developing Incident Management Systems" included in the back of this notebook.

<u>Physical Incident Screens</u>

Physical screens to block the view of passing motorists and to consequently reduce traffic back-ups resulting from "rubbernecking" are available from a number of manufacturers. To be effective, physical incident screens must be compactly stored, portable, lightweight, quick to set up and take down, and able to withstand wind gusts. One danger with using physical screens is that just as the motorists cannot view actions taking place at the incident scene, incident respondents cannot be as watchful of traffic. If a vehicle should penetrate the screen, the respondents would have little or no notice.

Traffic Control at the Scene

The purposes of traffic control at the scene of an incident are to protect responders and involved parties, reduce secondary incidents, and reduce motorist delay by maintaining traffic flow past the incident.

Good traffic control at the scene of an incident requires signs, cones, flares, and other devices. These are not often readily available, particularly to non-highway agencies. A number of manufactures make roll-up signs that can be carried in many response vehicles. These signs come with messages (text or symbols) that can be attached to the sign face with Velcro or snaps to quickly fabricate signs in the field. Some areas also store signs and cones in strategic locations so that they can be quickly accessed and taken to an incident scene. These traffic control trailers are reserved for incidents only and are not used for normal maintenance operations.

Standard traffic control schemes may not be possible to set up in every emergency situation. Every effort should be made to conform to accepted standards. However, any available resources should be used initially, and if the situation is prolonged, standard procedures and devices should be implemented as resources become available. Flares may be used to initiate traffic control at incidents (does not apply at incidents where ignitable substances such as diesel have been spilled) or for short-term traffic control, but they should be replaced by more permanent devices as soon as practical. Procedures for ramp closures and the "wrong way" escorting of response vehicles should be addressed. Also, access to fire hydrants and access across median barriers should be addressed.

Traffic control for special events should always follow the standard procedures because they can be anticipated and planned for. (MUTCD 1988)

In situations where additional personnel are available to assist with traffic control, every effort should be made to inform motorists as early as possible of the upcoming incident. Arrow boards placed far enough ahead of the queue will warn motorists of the incident and give them an opportunity to exit the freeway. Where available and applicable, the HAR and VMS systems should also be used to provide motorists with warning about incidents and restricted traffic conditions.

Reference Documents

Manual on Uniform Traffic Control Devices (MUTCD), 1988 Edition, USDA and FHA.

ACES Guide for Work Area Traffic Control (American Traffic Safety Services Association), 1984, 2nd Edition, Russell M. Luis, Ph.D., P.E.

For a full description of improved traffic control strategies as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included in the back of this notebook.

Technology-based Tools/Strategies

Alternative Communication Devices

As described in Module 6, the use of alternative communication devices such as cellular telephones or alphanumeric pagers has proven somewhat promising in mitigating interagency communications problems. These alternative devices are relatively inexpensive to purchase, operate, and maintain. In some instances, strict guidelines describing when to use such devices and for what purposes may be required. To be most effective, a list of cellular telephone numbers or pager numbers should be compiled and distributed to affected response personnel. If the contact list is not maintained and updated, alternative communications devices will quickly lose their effectiveness.

Cross-Installation of Conventional Radios

Cross-installation of conventional radios among response personnel vehicles is another approach (i.e., a transportation radio is installed in a police vehicle in addition to the police radio and vice versa) to improve site management, as well as response to the scene. Resources can usually be found or made available to allow for the installation of one agency's radio in another agency's vehicle. Both agencies benefit if the swap of radios is equal. The cross-installation of radios is only effective at improving communication between a small number of agencies; cross-installation of radios is limited by physical space in the vehicle and the ability to simultaneously monitor and operate several different radio systems. Hence, cross-installation of radios requires the identification of the most critical communication links to be most effective.

Single-Frequency Emergency Radio Systems

One example of a single-frequency emergency radio system is the On-Scene Command and Communication Radio Network (OSCCR). OSCCR is a dedicated, on-site emergency frequency for use by dissimilar agencies at the scene of an incident (no base stations are allowed). OSCCR is a valuable asset to incident response because it provides a universal radio frequency for all agencies to share. Although the program was established in 1986-87 by APCO, it has only recently been used extensively.

OSCCR allows communication transmission and reception among agencies over a range of 1 to 5 miles (portables, 1 mile; mobiles, 5 miles). OSCCR can be a powerful tool for quickly communicating incident details to all responding agencies.

Other agencies are allowed to use the OSCCR network if they obtain a permit for its operation from the Department of Emergency Management. Any agency is granted permission, as long as it has a valid need for access to OSCCR. Agreements expire at the end of the licensed term. If an agency abuses its privileges, then the permit will be revoked and not renewed. Therefore, never use OSCCR for non-emergency communication—use the dispatch or another frequency.

Remember to use OSCCR only for emergency purposes. The OSCCR network causes interference to other channels. Most agencies accept this interference as a part of the OSCCR privilege.

No official or formal training is required to use the OSCCR network. Each agency provides its own type of communication training for its employees. Only the head commanders of dissimilar agencies are allowed to use OSCCR at the incident scene. Rules include speaking in a clear voice and using plain English (no agency jargon or lingo).

The decision makers of other agencies who need to use the OSCCR frequency during an on-scene, multi-agency emergency may use it as long as they abide by all of the OSCCR regulations. If these people need to be informed of details, they may be given a radio with the OSCCR frequency at the incident scene.

Other agencies that may be given access to the OSCCR frequency include the following:

- fire departments
- police departments
- ambulances
- public utilities
- Department of Ecology
- hospitals
- municipalities.

Trunked 800 MHZ Radio Systems

Trunked 800 MHZ radio systems were described in detail in the previous module, Module 6 - Response.

Similar to their response benefits, trunked 800 MHZ radio systems improves on-scene communications by using a pool of frequencies rather than a single dedicated frequency and facilitating interdisciplinary communication through "talk groups."

Emerging Technologies

Portable Laser Warning System

The National Cooperative Highway Research Program, as part of its IDEA program, has developed a portable laser warning system to improve the safety for anyone working on the roadway. The system includes a battery powered master laser transmitter, one or more repeater transmitters, and a worker notification system. The master laser and the repeater lasers are placed to follow traffic coning. A pulsed laser beam is sent from the master to the repeaters creating a kind of "laser fence" around the workers. If at any time this "laser fence" is crossed by an errant vehicle, an alarm system is activated, notifying the workers to take evasive action. For longer duration incidents, this system could greatly improve the safety of the respondents at the scene. The system was recently successfully field-tested.

Inter-operable Radio Systems

Rome Laboratory, in conjunction with the U.S. Army, Navy, and the Advanced Research Projects Agency (ARPA), is developing the next generation of field radio. Known as "Speakeasy," the radio offers new capabilities, including inter-operability in different frequency bands. The radio includes software reprogrammability that allows modifications to the radio in the field through software downloads. Speakeasy means that people will not only be able to "reach out and touch someone...they will be able to reach out and touch everyone." Speakeasy is being designed so that any manufacturer will be able to produce modular upgrades, improvements, and enhancements to the system to prevent obsolescence. For incident management, an inter-operable field radio could greatly enhance operations at the scene of an incident.

Expert Systems or Decision Support Systems

Many of the decisions made and the resulting actions taken at the scene of an incident are based on the good judgment of well trained response personnel. Sometimes, inconsistent decisions result for similar situations simply because different responders are present. Some responders have expressed a desire for more written material to support their judgment-based decisions. Expert systems or decision support systems aim to minimize the personal judgment that goes into the decision making process.

Under development at Virginia Polytechnic Institute and State University is the "Wide-Area Incident Management Software System" (WAIMSS). The goal of this system is to assist incident management personnel in finding the appropriate strategies to manage incidents and in executing the steps required for their implementation. WAIMSS supports both the individual and agency-level interactions. WAIMSS provides benefits through (1) its comprehensive examination of the problem and (2) the facilitation of group interaction. When examining the problem, WAIMSS estimates incident duration, predicts delay, and evaluates clearance and diversion strategies. WAIMSS improves the dynamic group decision process by enhancing participation and information exchange among the different groups working to manage the incident. The final prototype of the system is nearing completion.

National Examples

Below, some examples of successful incident management efforts are described. Successful incident management programs are developed through a series of smaller efforts; certainly the importance and success of these individual efforts should not be overlooked. Consequently, examples focusing on individual efforts to improve site management are highlighted below.

Interdisciplinary Training in Oregon

The Oregon Department of Transportation provides basic traffic control training for other non-transportation agencies. Entitled, "Traffic Control for Emergency Responders," this course is designed for fire, police, tow truck operators, utility company personnel, and other emergency and support responders that must perform duties in the roadway and interact with traffic. The overall goal of the course is to "increase the safety and professionalism of everyone responding to incidents and accidents on and adjacent to the highway." The training materials include a list of definitions; procedures for signing, flagging, and setting flares; use of the roadway shoulder; and a description of various agency responsibilities, priorities and roles. Response to this course has been very good, in particular from more rural emergency responders (i.e., volunteer fire personnel). A copy of the training course materials is included in the Further Reading section at the end of this Module.

Pennsylvania's PACE Traffic Control Procedure

The Pennsylvania Turnpike Commission has found a novel alternative to abrupt road closures and traffic stoppages. In an effort to the minimize danger of stopping traffic on high speed, high volume roadways, the Commission has developed a program that virtually eliminates the hazard of stopped traffic. Pace cars are used to adjust traffic flow; anywhere from 1 to 15 minutes of work time can be achieved through the use of pace cars. If the task takes longer, the pace cars can further reduce their speed or stop until the project is completed. The pace cars typically slow traffic from 55 mph to 15 to 30 mph, creating a gap between the pace cars and the downstream traffic. A check vehicle at the incident scene ensures that any vehicles that may have been stopped on the shoulder between the two traffic control points do not pass the incident scene. An additional vehicle is present at the rear of the pace cars to warn traffic of a possible slow down ahead. This method not only reduces the danger of a more abrupt traffic stoppage but also reduces the amount of time required for the traffic queue to dissipate after the incident has been cleared.

Further Reading

Lamb, Dave. "Traffic control for emergency responders." Oregon Department of Transportation.

SOURCE: Oregon Department of Transportation

Dave Lamb

TRAFFIC CONTROL FOR EMERGENCY RESPONDERS

Highway accidents and incidents affect all of us. Secondary accidents and congestion due to traffic backups at incidents are costing Our nation lives and money. Studies from around the country have found that as much as 20 percent of all freeway accidents are caused by previous accidents. The cost of delays from freeway traffic congestion is estimated at over 16 billion dollars per year for urban areas over 50,000 population and over 30 billion dollars nationwide. Over 60 percent of this freeway congestion and delay is caused by incidents.

One of the most promising potentials for improving safety, reducing emissions and diminishing congestion on our freeways and arterial highways, short of taking cars away from people, is improving our ability to respond and clear incidents quickly. Like profitable businesses in today's rapidly changing society, the most successful Incident Management programs are continuously improving by taking advantage of new technologies, exploring new problem-solving approaches and establishing new partnerships.

With this in mind we at ODOT would like to form a partnership with all emergency responders to increase the safety and professionalism of everyone responding to incidents and accidents on and adjacent to the highway.

MISSION

The traffic control mission at emergency situations is to provide for emergency responders safety, workzone safety, public safety, and to facilitate traffic flow.

Scope:

This program provides a quick reference for controlling traffic in and around emergency situations and incidents. Content is based on Section VI of the Federal Highway Administration "Manual on Uniform Traffic Control Devices"

Emergency incidents include response to fires, accidents, stalled vehicles, fallen power lines, etc.

Application:

This program is designed for use by fire and police agencies, tow truck operators, utility companies, and other emergency responders.

Definitions:

Authority: ORS 810,010 and 810,830 provides ODOT the authority to close state highways. No other agencies or persons may close a state highway or a portion of a state highway without the permission of ODOT. During an emergency a state highway or portion thereof may need to be closed, briefly, for the protection of those involved in the emergency. (EXCEPTION: A state highway that has been designated as a crime scene by an authorized police officer may be closed by that officer.)

Buffer Space: The open space on each end of the emergency work area that provides an extra margin of safety between traffic and the emergency responders.

Flagger: A person who has completed a training course in the principles of safe traffic control; wears a bright orange or strong yellow/green reflectorized vest; and who uses a minimum 18" "STOP/SLOW" sign/paddle to assist in traffic control.

MUTCD: The Manual on Uniform Traffic Control Devices as published by the Federal Highway Administration.

ODOT: The Oregon Department of Transportation.

Roadway: That portion of the road that is improved, designed or ordinarily used for vehicular travel, exclusive of the shoulder.

Shoulder: That portion of a roadway that is contiguous and outside of the normal travel way.

Sight Distance: The length of roadway visible to the driver.

Traffic Control Device: Any device used to warn, direct, or control traffic, i.e.: signs, cones, barrels, barricades, etc.

Work Area: The area set aside for the emergency responders and their vehicles to conduct operations. This area may be on or off the roadway.

EMERGENCY TRAFFIC CONTROL ZONE COMPONENTS

The emergency traffic control zone as shown below has five parts and includes the entire section of roadway between the first advance warning sign through the last traffic control device where traffic may return to it's normal path and conditions.

1. Advance Warning Area

An advance warning area is used in traffic control zones to warn and alert drivers that their normal driving pattern will need to be altered to provide safety for workers and equipment in or adjacent to the roadway.

The advance warning area may consist of a sign i.e. "Wreck Ahead", "Fire", or "Emergency" etc.; a series of signs providing more detailed information; a flare or series of flares.

Advance warning devices should be placed far enough in advance of the work area to allow motorists time to react to the changing conditions:

- **Urban** **100-200 ft.** (speed less than 45 mph)
- **Standard** **500 ft.** (speed 45 mph or higher)
- **Freeway** **500-1000** **800-1600** **1300-2600**

These sign spacings are devised for a minimum of three signs. If fewer signs are used then the distance needs to be increased. If traffic is going to back up beyond the signs then the distance needs to be increased.

As traffic builds up to the original sign placement it will be necessary to move the signs further back to allow approaching motorists time to react.

Signing the area is advisable even when all of the activities and vehicles are completely off of the shoulder. This helps to protect the responder who inadvertently steps into the roadway, and any motorists that slow down to look at the incident.

2. Transition Area

Traffic uses the transition zone to alter its' normal mode of operation. This may involve changing lanes, slowing for congestion, stopping for a flagger, or even having to detour.

3. Buffer Space

The buffer space is a short section of clear roadway between the transition area and the emergency work area which provides an added safety margin for both the workers and traffic.

4. Emergency Work Area

This is the immediate area where emergency responders and equipment are operating. It. should be large enough for all of the emergency responders and equipment to operate without interfering with, or being placed at risk by traffic. Provisions need to be made for late arriving equipment and personnel to enter the work area. The work area may expand or contract depending on changing conditions and/or specific actions being performed.

5. Termination Area

This area advises motorists they can resume normal driving patterns and speeds.

NOTE: Evaluate the situation on arrival and plan your actions and traffic control to minimize disruption of traffic. In emergency situations you should try to use all of these traffic control zones to enhance your safety and the safety of motorists. Make the best use of available materials, equipment, and personnel to do the best you can.

Signs

Signs are recommended for advance warning as they can provide motorists with the most specific information. Signs should be orange with black lettering, however, yellow signs with black lettering may be used if orange/black signs are not available.

Placement

Visibility and motorist reaction are critical elements to keep in mind when placing advance warning devices. Conditions that affect the placement of devices include:

- hills and curves;
- weather conditions;
- smoke;
- dust, and other driving hazards.

Try not to rely solely on emergency flashing/strobe lights to provide your protection. The few minutes it takes to set out warning devices is time well spent. Your safety and the safety of the motoring public is at stake.

Flagging

Flaggers, when used, should provide clear and positive guidance for traffic through the area.

Flaggers may be used to slow traffic, direct traffic around the area, stop traffic, or detour traffic.

For your safety and the safety of motorist flaggers must be trained and approved in the principles of safe traffic control.

MINIMUM STANDARDS FOR FLAGGERS

- Training
- Average intelligence.
- Sense of responsibility for self, coworkers, and the public. Mental alertness.
- Good physical condition, including sight and hearing. Courteous but firm manner.
- Neat appearance.
- Reflectorized vest, shirt or coat

PROPER FLAGGING TECHNIQUES

1. Establish a proper flagging location, 200-300 feet from the work area. The flagger should be visible to traffic approaching from a distance of at least 500 feet.

2. A flagger should stand alone and not allow people to congregate around the flagging station making visibility difficult. Maintain a clear area of at least 100 feet around the flagging station.

3. To stop traffic the flagger should stand on the shoulder of the road; hold the stop sign away from the body and facing traffic; raise the free hand to shoulder level with the palm up and facing traffic.

4. Try to stop the first vehicle near the shoulder so that you can move near the centerline and have clear visibility to stop subsequent traffic.

5. **Never stand** directly in **front of a stopped** vehicle.

6. To release traffic return to the shoulder of the road, turn the slow side of the sign to traffic, and with the free hand motion which lane *for* traffic to proceed in.

7. To slow traffic, hold the slow side of the sign facing traffic. If traffic doesn't slow enough move the free hand in an up and down motion with the palm facing down.

8. **Flaggers must plan an escape route in the event of errant or out of control vehicles.**

FLARES

Emergency road flares, or fusees, may be the only available warning device. Flares are not recognized as traffic control devices and should be used in conjunction with signs, cones, etc.

When using flares to close a lane or divert traffic they need to produce a long even taper. This can be done by setting the flares out at the designated speed limit in feet, i.e. 50 mph=50 feet spacing for flares, 35 mph=35 feet spacing for flares, etc.

Each flare is placed on a one foot offset. This means that it takes 13 flares to close a 12 foot wide lane.

Flares shall not be used at the scene of chemical or fuel spills, during windy conditions in dry brushy areas, or at other times when the flares may create problems.

SHOULDERS

When the traffic lanes are clear but the incident or equipment/responders are using the shoulder it should be closed off in the same manner as a lane closure.

When the emergency situation requires lengthy closure of the highway or a portion of it contact the Oregon Department of Transportation.

REMEMBER: For your safety, motorists need adequate warning time, and adequate reaction time.

In situations where the first responder to arrive is on the "wrong side of the road":

- Park together
- Minimize adverse effects on traffic
- Provide traffic control
- Depart as soon as possible

You should develop a traffic control plan for each incident you respond to.

The traffic control plan may be simple or complex depending on several factors:

- Traffic Volume
- Designated Speed
- Time of Day
- Location of Incident
- Location of Equipment and Responders
- Visibility
- Type of Incident
- Available Resources
- Length of Time of Incident
- Weather
- Surface Conditions

Traffic control plans can be worked out ahead of time by utilizing your experiences from incidents you have responded to in the past. Draw a simple diagram and indicate where and what type of traffic control devices would have been appropriate for each incident.

Start now on a program of critiquing each situation you respond to for what worked well and where improvements could be made in your traffic control.

Once you start practicing safe traffic control you will be able to accomplish it at each and every scene. This will enhance your safety and that of the traveling public.

INCIDENT RESPONSIBILITIES, PRIORITIES, ROLES

AGENCY	RESPONSIBILITIES	ROLE
ODOT	#1 Responder Safety #2 Public Safety #3 Traffic Operations #4 Clearance and Clean-up #5 Damage assessment and repair	Traffic Control/ICS
POLICE	#1 Responder #2 Safety Public #3 Safety Traffic #4 Operations Investigation #5 Clearance	Enforcement/ICS
FIRE	#1 Responder Safety #2 Public Safety (medical, fire, hazmat) #3 Traffic Operations	
AMBULANCE	#1 Responder Safety #2 Public Safety #3 Medical	
TOW	#1 Responder Safety #2 Public Safety #3 Vehicle Removal #4 Clean-up	

EMERGENCY TRAFFIC CONTROL TEST

1. Flares should not be used near hazardous materials incidents.

   T **F**

2. Flaggers should stand on the shoulder to stop the first vehicle.

   T **F**

3. Flaggers need to stay alert at all times.

   T **F**

4. How many parts are there to an Emergency Traffic Control Zone?

   1 2 3 4 5 6 7 8 9 10

5. The buffer space is where you park excess equipment and responders cars.

   T **F**

6. Advance warning devices work well on hills and curves.

   T **F**

7. Flaggers should not stand in front of stopped vehicles.

   T **F**

8. It doesn't matter where you park your vehicle as long as it is close to the emergency work area.

   T **F**

9. A traffic control plan should be developed for each incident you respond to.

   T **F**

10. Safe traffic control is a matter of luck and not planning.

    T **F**

11. Secondary accidents and congestion due to traffic backups at emergency incidents are costly.

    T **F**

12. Emergency traffic control should use the same principals that govern all traffic control situations.

T **F**

13. Which provides motorists with the most information?

CONES **FLARES** **SIGNS** **FLASHING LIGHTS**

14. How far should the flagger stand from the work area.

100'-200' **200'-300'** **400'-500'** **600'-700'**

15. Flares can create problems greater than the existing emergency.

T **F**

16. Flaggers must wear a reflectorized vest, shirt, or coat.

T **F**

17. Flaggers should allow motorists plenty of reaction time.

T **F**

18. When diverting traffic you should use devices to produce long even tapers.

T **F**

19. What should a traffic control plan consider?

TRAFFIC VOLUME **DESIGNATED SPEED** **VISIBILITY**

TYPE OF INCIDENT **LOCATION OF INCIDENT** **WEATHER**

SURFACE CONDITIONS **ALL OF THE ABOVE**

20. Since emergency responders have vehicles with flashing warning lights traffic poses no threat to their safety.

T **F**

Module 8
Clearance

The goal of Module 8 is to describe the clearance phase of the incident management process, describe specific challenges to effective clearance, describe potential tools or strategies for improving clearance efforts and provide the opportunity to examine local clearance needs and potential tools/strategies for improvement.

MODULE 8

CLEARANCE

DEFINITION

Safely and quickly remove vehicle, debris, or spilled material and restore the roadway's full capacity.

OBJECTIVES

- **Efficiently use resources**
- **Restore capacity quickly and safely**
- **Enhance responder and motorist safety**
- **Minimize motorist delay, frustration**

BENEFITS

Seattle, WA reduced truck-involved incident clearance from 5 to 7 hours to 1-1/2 hours after formation of WSDOT's major incident response team.

- California PATH Program

BENEFITS

Chicago, IL reports the following:

Lanes Blocked	Clearance Time (minutes)
None	9
One	12
Two	24
Three	40
Exit Ramp	10
Entrance Ramp	12

ISSUES AND BARRIERS

Liability concerns over clearance actions

- Damage costs are most often covered by insurers
- Damage-related costs are negligible compared to cost of fatality or serious injury

ISSUES AND BARRIERS

Abandoned vehicles

- Encourage motorist to stay with their vehicles
- Motorist assistance services are free or charge nominal fee but only if motorist is at vehicle

ISSUES AND BARRIERS

Formal declaration of death

Allow certified EMS unit to certify death

- Relay vital signs telemetrically
- Permit the removal of fatalities to a better, safer refuge

ISSUES AND BARRIERS

Condemning a spilled load - who makes the call?

- Revisit traditions, policies, laws to determine if involvement of Department of Agriculture or Health is really required

ISSUES AND BARRIERS

Quick accident investigation but slow response to the scene

- Use spray paint to mark evidence
- Use conventional investigation methods until equipment arrives
- Define acceptable response times

ISSUES AND BARRIERS

What entails clean-up, who performs it?

- Interagency agreements naming responsible party
- Incorporate into towing contracts

ISSUES AND BARRIERS

Reluctance to assume possession of debris, especially HAZMAT

- Inhibited by limited storage area, disposal costs, and safety concerns
- Interagency agreements
- Single agency policies

ISSUES AND BARRIERS

The forgotten detail - documentation

- Advanced accident investigation equipment
- Temporarily marking evidence
- Electronic data entry in the field

NON-TECHNICAL TOOLS/ STRATEGIES

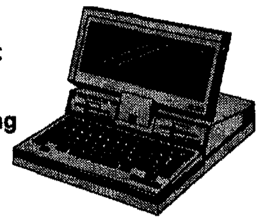
- Dedicated roving patrols
- Major incident response teams
- Push bumpers
- Accident investigation sites

NON-TECHNICAL TOOLS/ STRATEGIES

- Abandoned vehicle policies
- "Hold harmless" policies
- Alternate means of marking evidence
- Public education
- Alternative routes

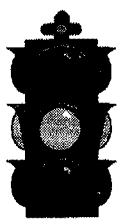
TECHNOLOGY-BASED TOOLS/ STRATEGIES

- Automated debris recovery system
- Incident management database
- Total station surveying equipment



EMERGING TECHNOLOGIES

- Perspective grid accident investigation systems
- Advanced traffic signal control



NATIONAL EXAMPLES

Perspective Grid Accident Investigation Systems in Oregon

- Measures evidence from 35mm photographs
- Costs $6,300 per unit
- Reduces investigation time from 5 to 6 hours to potentially 1 hour

NATIONAL EXAMPLES

NYDOT's Jumbo Anti-Waste System (JAWS)

- **Picks up debris ranging from tin cans to car tires**
- **Travels at speeds up to 30mph**

NATIONAL EXAMPLES

Advanced Law Enforcement Response Technology (ALERT)

- **Developed at Texas Transportation Institute**
- **Lights, siren, communications controlled with touch-screen computer**

NATIONAL EXAMPLES

Total Station Surveying Equipment in Kentucky

- **More measurements, less time**
- **Reduced personnel requirements**
- **Improved liability defense**
- **High initial cost, but recoverable**

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Module 8
Clearance

Definition

Clearance is the final step in the incident management process. Clearance refers to the safe and timely removal of any wreckage, debris, or spilled material from the roadway and the restoration of the roadway to its full capacity. It is important to emphasize, particularly in providing information to the motoring public, that an incident should not be considered "cleared" until the traffic backup has fully cleared. Motorists are only interested in their chances of encountering delay. If an incident has been reported cleared because the blockage has been removed, but motorists encounter significant delay in the traffic backup, your agency may lose credibility and the public's trust and respect. Effective incident clearance relies on effective equipment utilization (i.e., appropriate towing and recovery vehicles, push bumpers) and an awareness of legal authority to speed clearance.

Objectives/Benefits

The objectives of improved incident clearance are as follows:

- to make the most efficient use of resources, including equipment and personnel
- to restore full roadway capacity as quickly and safely as possible
- to enhance the safety of responders and motorists
- to minimize delay and ease frustration for motorists.

Seattle, Washington's (1990 population 516,259) Major Incident Response

Team reports reducing freeway clearance times for incidents that involve large trucks from 5 to 7 hours before the formation of the team to 1-1/2 hours after the formation of the team (California PATH Program 1997).

While no before and after data were available, dedicated roving patrols, coined "Minutemen," in Chicago, Illinois (1990 population 2,783,726), report the following "on-scene times" from 1995.

Lanes Blocked	Clearance Time
none	9 minutes
one	12 minutes
two	24 minutes
three	40 minutes
exit ramp	10 minutes
entrance ramp	12 minutes

Issues or Specific Barriers

Improving incident clearance can raise a number of issues. Improvements in incident clearance are often limited by equipment constraints and a lack of awareness regarding legal authority to clear the roadway. This uncertainty in legal authority limits the sense of urgency to clear the scene quickly. Issues that often arise when incident clearance is improved are discussed below. When possible, specific examples of how other areas have dealt with these issues are provided.

Liability Concerns over Clearance Actions Taken

Perhaps the most common issue that arises when attempts are made to improve incident clearance is the fear of liability resulting from additional damage to a vehicle or its cargo as a result of clearance actions taken. Important points to realize, however, are that (1) the vehicle and cargo are already damaged as a result of the incident and are already, in many instances, unusable; (2) damage costs are most often covered by insurers, not the party involved; and

(3) liability costs attributable to extra damage are negligible in comparison to the liability costs associated with an unnecessary fatality or serious injury.

"Hold harmless" policies have been enacted in many states to permit responders to rapidly open the roadway by quickly removing vehicles. The motivation is improved public safety. In Texas, state law relieves responders from liability for additional damage to the vehicle or the cargo from clearance actions, as long as the actions were not taken in a negligent manner. In Maryland and North Carolina, respective state Attorneys General ruled that such clearance measures were in keeping with normal emergency authorization to clear the roads, such as that granted during snow emergencies.

Abandoned Vehicles

When a vehicle becomes disabled because of a mechanical failure, gasoline depletion, flat tire, or some other reason, motorists seldom stay in their vehicle and wait for help. Many walk along the roadway shoulder or are transported by another passing vehicle to reach services. When responders stop to offer assistance and a motorist is not with a vehicle, the only action they can take is to "tag" the vehicle as abandoned (if the responder has that authority). Once a vehicle has been tagged as abandoned, motorists are allowed to leave a vehicle in its location for up to weeks, in some cases.

Currently, there is no formal policy that requires motorists to stay with their vehicles after a breakdown. Public education efforts can encourage motorists to stay with their vehicles. An incentive for motorists is that by staying with their vehicles and receiving help from either publicly sponsored or privately sponsored programs, they may save money. Many motorist assistance services are free or require a nominal charge.

Formal Declaration of Death

In many cases, local policy requires that the moving or removal of a fatality from the incident location is not permitted until the death has been certified by the coroner. The result may be significant delays to traffic while the arrival of a coroner is awaited. A wait may be required because the coroner is not facing a life or death situation and therefore may not feel an urgent need to respond. In addition, the number of coroners available is limited in comparison to their geographic area of coverage.

Alternative policies include allowing a certified EMS unit to certify death, allowing the vital signs of fatalities to be telemetrically relayed to an off-site coroner for verification, and permitting the removal of fatalities to a better, safer refuge in the interest of public safety (I-95 Northeast Consultants 1996). All of these options greatly reduce incident clearance times.

Under Pennsylvania state law, when an incident involves a fatality, the body may be moved before the arrival of the coroner when it poses a safety hazard. To expedite clearing the roadway and to prevent additional incidents, the Pennsylvania State Police mark the locations and remove the bodies immediately, without waiting for the arrival of the coroner.

Condemning a Spilled Load — Who Makes the Call and How?

Large truck incidents can add a unique challenge to the clearance process. Often, cargo transported by the truck is spilled across the roadway. The clearing and clean-up process is complicated by the fact that instead of one vehicle to right and clear, there are many pieces of cargo to clear. Additionally, certain types of cargo may require certification from governmental agencies to confirm that the load was damaged and is unusable. This additional determination is required when agriculture or livestock, or certain other perishable products such as food is involved. In this case, response from the Department of Agriculture and the Health Department may be necessary. It may be necessary to revisit your local traditions, policies and laws to determine if involvement by these agencies is formally required.

Quick Accident Investigation but Slow Response to the Scene

The benefits resulting from quick accident investigation efforts are often diminished by slow response times to the scene. Because of the cost of some accident investigation equipment, such as total station surveying equipment, fewer units may be available for a geographic area. As a result, much time can be wasted waiting for this equipment to arrive at the scene. If response is delayed too frequently, responders will stop requesting the equipment altogether and will return to conventional accident investigation procedures. Little can be done about the need to traverse long distances to reach an incident scene other than strategically locating the equipment on the basis of incident frequency or severity. However, several things can be done to reduce the frustration of the responders and to improve the efficiency of operations at the scene until the equipment arrives. Alternative methods for marking evidence, such as spray paint, can be used to allow the removal of vehicles and the opening of a portion or all of the roadway. Conventional accident investigation methods can be used until the equipment arrives at the scene. Guidelines can be established that define certain response times from accident investigation personnel. If, for a particular incident, these response times cannot be met, the personnel will not be requested, and other investigative methods will be used.

What Entails Clean-Up, Who Performs It?

Non-hazardous clean-up can be performed by a variety of incident management personnel. Sweeping glass and picking up small debris are likely the least glamorous part of the incident management process and are often overlooked when personnel roles and responsibilities are defined. These actions have to be performed, however, before the roadway can be opened to traffic. In some cases, clean-up responsibilities are incorporated into towing contracts and are performed by towing personnel. In other areas, non-hazardous clean-up is provided by transportation agency personnel or other responders.

Hazardous clean-up can only be performed by adequately trained individuals from public agencies or private companies.

Any uncertainty in knowing who is responsible for clean-up can lead to delays in clearing the incident and opening the roadway. Interagency agreements should consider clean-up as a separate task and should identify one or more responsible parties.

Reluctance to Assume Possession of Debris, Especially HazMat

Once a responder has assumed possession of debris at the scene of an incident, the debris is theirs to transport, store, or further dispose of. Limited storage area and disposal costs are inhibiting many agencies from taking responsibility for the debris. Additional safety concerns are introduced when the "debris" is a hazardous material. If responsibility for cleaning up the debris is not carefully defined among the various agencies, delays in clearance can result. It is important to define documentation and training on what can be done.

One way to define clearance and clean-up responsibilities is through interagency agreements or single agency policies. As an example, below is a recent Washington State Department of Transportation (WSDOT) policy that outlines the responsibilities of transportation personnel and, in particular, those of WSDOT's incident response (IR) team personnel for assuming possession of hazardous materials.

Hazardous Materials & Vehicle Accidents

Introduction

The Incident Response (IR) Program was developed to provide for traffic management needed for significant vehicle accidents. Routinely, vehicle accidents result in spillage of incidental amounts of vehicle fluids (antifreeze, fuel, lubricants) which must be removed from the roadway surface to return it to a safe condition. Occasionally, vehicle accidents result in more significant amounts of fuel spillage (saddle tanks, tanker cargo) or spillage of other hazardous material cargoes which present hazards to the responders, the public and/or the environment. WAC 296-62-300 applies to workers who respond to hazardous materials incidents and requires certain levels of training to assure worker safety.

Policy Statement

It is the goal of the Washington State Department of Transportation to provide for a safe work environment in all department activities. This guidance regarding hazardous materials is intended to meet the Department's safety obligations as well as allow for protection of the environment when the safety of the worker will not be compromised.

First Priority — Safety

It is the Department's obligation and responsibility to provide a safe work environment.

All Incident Responders and other WSDOT maintenance personnel who may participate in accident scene management will be trained at the "awareness" level at a minimum.

Responders to accident scenes that involve hazardous materials as cargoes will not be involved, in any way, with the accident scene except for traffic management at a safe distance from the accident scene. Only after the hazardous material cargo accident scene has been determined safe by the "Incident Commander" will WSDOT personnel enter the area to perform their maintenance functions.

At routine vehicle accident scenes where incidental amounts of fluids have spilled onto the road surface, IR personnel or other WSDOT personnel in areas without dedicated IR staff can remove this material from the roadway, after traffic management functions are no longer needed.

Incidental amounts of gasoline spilled onto the roadway resultant of vehicle accidents will only be managed by IR personnel after fire personnel have indicated it safe to manage.

Second Priority — Environment

Response to vehicle accidents involving more than incidental amounts of diesel spillage may necessitate the containment/control of the fuel to minimize damage to the roadway, or prevent or minimize the effects on WSDOT features (landscape, detention ponds etc.), or to minimize or prevent environmental damage.

It is generally not the policy of IR personnel to control or contain large amounts of diesel spillage. This task is the responsibility of the hauler's environmental contractor or the Department of Ecology. However, if practical, simple and safe measures can be taken to contain or control the spillage, to prevent damage to WSDOT features or imminent damage to water resources, IR personnel can act, only with the concurrence of the incident commander. In no case will IR personnel be involved in plugging holes in ruptured bulk diesel tankers.

Lowest Priority

Spillage of large amounts of diesel (saddle tanks, cargoes), where the spillage will not damage WSDOT features or cause imminent damage to water resources will not be managed by IR personnel.

The Forgotten Detail — Documentation

Some incident management agencies are more keenly aware of the importance of documentation than others. Police agencies are particularly aware of the importance of documentation because the nature of their job often requires personnel to confirm conditions at the scene and defend actions taken. Other incident management agencies are becoming more aware of the importance of good documentation. Unfortunately, this awareness is motivated by the need to defend one's actions against negligence claims. Other benefits that result from improved documentation include an ability to identify weak areas in operation and to win upper management support for incident management efforts. Drawbacks to good documentation are that it is often time consuming and typically inhibits quick clearance of the incident scene. Advances in accident investigation equipment (e.g., total station surveying equipment), use of alternative methods for temporarily marking evidence (e.g., spray paint), and devices to allow electronic data entry in the field (e.g., laptop computers) all help to speed the clearance process without compromising the integrity of documentation.

Tools/Strategies for Improving Clearance

A number of existing tools or strategies can be used, and are currently being used around the country, to improve various aspects of incident clearance. Many of these are summarized below.

Non-technical Tools/Strategies

- Dedicated Roving Patrols
- Major Incident Response Teams
- Push Bumpers
- Accident Investigation Sites
- Abandoned Vehicle Policies
- "Hold Harmless" Policies
- Alternative Means of Marking Evidence
- Public Education
- Alternative Routes

Technology-based Tools/Strategies

- Automated Debris Recovery System
- Incident Management Database
- Total Station Surveying Equipment

Emerging Technologies

- Perspective Grid Accident Investigation Systems
- Advanced Traffic Signal Control Systems

Each of these is described more fully below.

Non-technical Tools/Strategies

Dedicated Roving Patrols

Dedicated roving patrols are described more fully in a previous module, Module 4 - Detection and Verification, in the Further Reading section of Module 4 - Detection and Verification, and in the "Framework for Developing Incident Management Systems" included at the back of this notebook.

With respect to incident clearance, dedicated roving patrols are equipped with or carry many resources that can, without assistance from other responding agencies, clear minor incidents. Many incidents result when a vehicle runs out of gas or experiences minor mechanical failure. Roving patrol personnel typically carry gasoline and are trained in mechanical repair so the vehicle disablement can be immediately attended to. Some roving patrol vehicles are equipped with push bumpers and are capable of moving vehicles off the roadway to a safer location. Clearance benefits that result from dedicated roving patrols vary greatly on the basis of the equipment used; motorcycle patrols cannot provide as much benefit as a pickup or larger, heavy-duty vehicle.

Major Incident Response Teams

Major incident response teams are described more fully in a previous module, Module 6 - Response, and in the "Framework for Developing Incident Management Systems" included at the back of this notebook.

A major incident response team typically consists of individuals from a variety of disciplines (e.g., police, fire, transportation) who train for and respond to major incidents together. Because the level of familiarity among the various team members is high, respective clearance procedures, requirements, and resources are well understood. Therefore, the clearance process as a whole is accomplished more efficiently.

Push Bumpers

Push bumpers, mounted on response vehicles, are used to quickly and safely remove disabled vehicles from the shoulder or travel lanes. This reduces the likelihood of secondary accidents and improves the safety of both the field personnel and motorists. The Washington State Department of Transportation's "Incident Response Guide" (1994) recommends the following procedures for pushing disabled vehicles.

1. Always obtain driver permission before pushing the vehicle off to the shoulder.

2. Make sure the driver knows where the vehicle will be pushed. He/she must understand the direction to steer. Also, remind the driver to turn the key in the ignition to unlock steering or that the power steering or power brakes may not be functioning.

3. Guide the driver by giving instructions through the loudspeaker.

4. Push to the nearest shoulder. Do not cross traffic to clear a vehicle unless it is absolutely necessary.

5. Ensure that the bumper connection is well fit.

6. Do not push the vehicle too quickly.

7. Do not pull vehicles out of the ditch.

8. Do not push vehicles down hills.

9. Gather as much information about the accident scene with pictures, or paint marks on the road where the vehicle's tires are, before removing the vehicle.

Push vehicles when:

- the vehicle is stalled or disabled, but its wheels are free to roll
- the incident response vehicle has compatible bumpers or push bumpers
- the vehicle is no larger than the incident response vehicle
- the driver is capable of steering the vehicle to the side of the roadway
- there is an area to push to within a reasonable distance.

Do not push vehicles when:

- the vehicle is too large to move
- the wheels are locked (push only in a severe emergency)
- the driver is not capable of steering the vehicle to the shoulder
- there are injuries
- the driver is suspected of being impaired by a substance such as alcohol.

The Atlanta Regional Commission, with participation of regional law enforcement agencies near Atlanta, Georgia (1990 population 394,017), conducted an evaluation of push bumpers used by area police agencies (1994). The study revealed that push bumpers reduce damage incurred by police vehicles and have the potential to reduce back and leg injuries incurred by officers who physically push vehicles from the roadway.

No legal issues related to the use of push bumpers arose during this evaluation.

Most motorists generally were not hesitant about being assisted out of the roadway via a push bumper; those who did hesitate cited concern over damage to their vehicle.

Officer-described drawbacks to push bumpers included increased wind noise, reduced top vehicle speed because of a loss in aerodynamics, and scraped bumpers on steep inclines.

In spite of the reported, albeit minor, drawbacks, the use of push bumpers was recommended by the majority of the officers because of their quick clearance capabilities.

For a full description of push bumpers as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included in the back of this notebook.

Accident Investigation Sites

Accident investigation sites provide a safe haven off of the main roadway where further investigation or documentation can take place. Removing the vehicle(s) from the main roadway improves the safety of the responders, the motorists involved in the incident, and other motorists coming upon the incident. In addition, it reduces delay experienced by other motorists. Accident investigation sites typically have very low construction costs and are flexible in design and location. Accident investigation sites should be

- easily accessible from the main roadway, yet sufficiently out of sight to prevent motorist delay caused by rubbernecking

- adequately signed

- located near high accident areas

- at least 1,000 square feet of space to provide for large truck or multiple vehicle occupancy

- sufficiently lit

- linked to a telephone.

For a full description of accident investigation sites as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included in the back of this notebook.

<u>Abandoned Vehicle Policies</u>

While the level of hazard is still disputed by some, vehicles on the shoulder of a roadway are a hazard. Recall from Module 2 that 4.4 percent of all fatality crashes occur on the shoulder of the roadway. Laws defining the length of time that motorists have to remove their vehicles from the shoulder vary widely around the country, ranging from as little as 4 hours to as long as 7 days. In most areas, responders can legally remove any vehicle that is parked in a location considered to be "hazardous." The perception of a "hazard" varies widely among officers.

Pennsylvania recently amended its state law regarding allowable time for vehicles on the shoulder of a roadway. Whereas vehicles used to sit for up to several weeks on the roadway shoulder, now they are moved within 24 hours. The primary motivation for instituting this change in the law was a desire to improve public safety.

In many areas, police are the only personnel able to tag and request removal of vehicles on the shoulder of the roadway. Sometimes vehicles remain on the shoulder of the roadway longer than the allowable time either because (1) they were not detected and reported immediately by police personnel, or (2) police personnel did not specifically check for the vehicle at the end of the allowable time period (i.e., police personnel may not have passed that segment of roadway until a day later). Accurately enforcing the "time clock" requires vehicles to be tagged at the time of detection and shoulders to be actively patrolled to assure that vehicles are not left long beyond the time allowed. To improve the enforcement of the "time clock," the Maryland State Highway Administration's (MDSHA) incident management personnel can notify the Maryland State Police of a vehicle. When the Maryland State Police receives notification from MDSHA, the "time clock" is started.

"Hold Harmless" Policies

With concerns over liability becoming more important, more agencies are taking proactive measures to protect themselves. Often, liability concerns are raised by responding agency personnel when they clear an incident because of additional damage the vehicle or cargo may incur during clearance procedures. Recent sensitivity to liability has resulted in hesitation regarding clearance actions, even though the resulting additional vehicle damage is often minimal and covered by the causing party's insurer.

In Texas, state law relieves responders from liability for additional damage to the vehicle or the cargo from clearance actions, as long as the actions were not taken in a negligent manner. In Maryland and North Carolina, respective state Attorneys General ruled that such clearance measures were in keeping with normal emergency authorization to clear the roads, such as that granted during snow emergencies.

It is best to contact the Attorney General in your state to determine what clearance actions are deemed appropriate to ensure public safety.

Alternative Means of Marking Evidence

Traditional methods of gathering evidence for an accident investigation required that nothing be moved from its resting place until officers could record its type and location. The base tape method has been traditionally used to record evidence location information. In this method, a "baseline" tape is laid through the incident scene. The perpendicular distance from the baseline tape represents the location of the evidentiary item. This investigative process is very time consuming and prevents concurrent incident management activities from taking place. To speed the investigative process, many areas are now using paint to mark the evidence, including vehicle positions and locations, and a camera to photograph the incident scene. Once it has been marked and recorded, the incident scene can be cleared. Police personnel can later return to the incident scene at a time when traffic volumes are low, close the necessary portion of the roadway, and collect the information required as part of the accident investigation. In Pennsylvania, all state police patrol cars now carry surveyor's paint to mark the position of accident vehicles and Polaroid cameras to photograph the scene. The state police may then direct the removal of the vehicles immediately.

Public Education

The cooperation of the public is vital in promptly clearing vehicles involved in "property damage only" accidents.

Many states have laws that require motorists to move vehicles involved in minor accidents if the vehicles are moveable and there are no injuries. These laws are seldom enforced and, therefore, are seldom adhered to. Few motorists intentionally resist the law; many are simply not aware of the requirement to move their vehicles. The lack of enforcement has been demonstrated in surveys of response personnel about the laws; many responders are unaware that such laws exist. Texas adopted a "Move-It" public education program to increase awareness and to encourage motorists involved in minor accidents to move their vehicles off the roadway before exchanging information or calling police. Georgia has a similar program called "Steer It - Clear It."

Louisiana recently initiated a similar program and has additionally been working with vehicle insurers to help increase motorist awareness. Motorists' reluctance to move their vehicles typically originates from the fear that insurers will not cover the damages if the vehicle is moved from the incident scene. Because motorists' decision to move their vehicles relates to insurance compensation, they will not feel confident moving their vehicles unless they hear from their insurers that such action is appropriate. Other response personnel (i.e., transportation personnel, police personnel) are not as effective at convincing motorists that it is acceptable to move their vehicles.

Cooperative partnerships between incident management agencies and private insurers may produce the most effective and direct public education efforts.

<u>Alternative Routes</u>

Alternative routes serve two purposes:

- allow incident respondents to more quickly and easily access the scene without working through the traffic back-up on the affected route

- reduce frustration for the motoring public by reducing their delay, improving their safety, and keeping them moving.

Alternative routes that accomplish the second purpose, allowing motorists to avoid the incident, are more difficult to identify and use. Routing general traffic onto alternative routes, especially arterials and secondary roads, has a tremendous impact on the operations within another jurisdiction. When county or city roadways are utilized as alternative routes, the other jurisdictions should be notified immediately so that they may adjust to accommodate the additional traffic flow.

Alternative Route Considerations

For routing traffic to another state, county, or city route, several considerations are necessary:

Existing Traffic Volumes. If the route is already saturated, routing additional traffic could cause a real problem.

Motorist Familiarity with the Area. Enough signing and direction are required to allow motorists unfamiliar with the area to reach the alternative route safely. Limited guidance may put motorists in danger or may result in additional incidents.

Duration of Incident. If the incident is not expected to last long, it may not be best to reroute the traffic.

Availability of TCDs. Sufficient traffic control devices (TCDs) and signing are required to adequately convey direction.

Availability of Personnel. Sufficient personnel are required to establish traffic control in a timely manner.

Design Constraints. The ability for the alternative route to accommodate all types of traffic, including large trucks, should be considered. Weight limits on bridges, sharp turning radii, low overpasses, and rail crossings may limit truck traffic from using these routes. Lack of awareness of these design constraints could result in unnecessary infrastructure damage and injury.

As noted in an evaluation of the INFORM program on Long Island, New York, several ramps ahead of an incident have to absorb 3 to 4 percent of the approaching traffic volume; this higher volume may represent an increase in ramp usage of 40 to 70 percent. Consider ramp capacity when rerouting traffic.

Utility Work/Construction. Work in progress that may prevent the alternative roadway from operating at its normal capacity should be identified.

Unfortunately, information related to the above conditions is not always easy to access, compile, coordinate, or distribute to the right people. Personnel familiarity with the area can serve as a good starting point for developing alternative routes; routes then need to be reviewed and evaluated. The designation of alternative routes, because they typically involve multiple jurisdictions (city, county and state), can be political and should not be done by a single agency but instead should be agreed to cooperatively. Because of the inherent safety and operations problems in using alternate routes, the use of alternate routes during a freeway incident should never be regarded as a reason for less urgent response to and clearance of an incident.

For a full description of alternative route plans as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included in the back of this notebook.

Technology-Based Tools/Strategies

Automated Debris Recovery System

Debris in the roadway can lead to a more severe incident if it is not cleared quickly. Debris in the roadway typically affects only a small number of lanes and does not slow traffic as much as a vehicle-involved incident (motorists are not as likely to rubberneck for debris, and debris usually blocks a smaller portion of a lane than a vehicle, so traffic in adjacent lanes tends to slow less). Because debris-related incidents do not typically "regulate" or slow traffic flow past the scene, clearing the debris can be a particularly dangerous task and may require more extensive traffic control to ensure the safety of responders.

An automated debris recovery system (ADRS) can help to alleviate the danger involved in clearing debris. A self-propelled vehicle picks up and stores debris from the roadway to later dispose of it at a suitable location. An automated debris recovery system can pick up small to large debris, including tire treads, hubcaps, road kill, blankets, and other items. The automated debris recovery system successfully recovers debris at speeds between 5 and 30 miles per hour; slow speed warnings are required for motorists approaching the ADRS from behind. The automated debris recovery systems allows response personnel to remain safely within the vehicle.

For a full description of automated debris recovery systems as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included in the back of this notebook.

Incident Management Database

An incident management database allows incident-related information to be entered and stored electronically at the scene of an incident, thus eliminating problems with illegible field notes and lengthy data entry times at the office. The time savings resulting from direct data entry in the field means that more timely information related to motorists and vehicles involved in incidents, as well as incident management operating statistics, is available. Most databases allow incident-related information to be summarized in several ways. Incidents can be summarized daily, for a range of dates, and for a particular location. To be most effective, incident management databases require that all field personnel have operable data entry devices (i.e., portable laptop computers). This may be a somewhat costly initial expense. Future ITS programs will focus heavily on integration of systems. Therefore, direct data entry will be useful to other parties such as police, fire, etc.

For a full description of an incident management database as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included in the back of this notebook.

<u>Total Station Surveying Equipment (TSSE)</u>

Traditional methods of collecting physical evidence at an accident scene (i.e., the base-tape method or coordinate method, triangulation method) can be time consuming and personnel intensive. Total station surveying equipment (TSSE) uses an infrared electronic distance meter combined with a rod-mounted prism to automatically measure horizontal distance to an object; a theodolite, or electronic transit, to measure the horizontal angle to an object; and an internal level to measure vertical rise to an object simultaneously. Once data have been collected, they can be downloaded into a computer-aided drafting and design (CADD) system for accident re-creation. This technology greatly reduces the time required by police agencies for data collection in accident investigation. Implementation of this option consequently reduces the need for road and lane closures.

For a full description of total station surveying equipment as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included in the back of this notebook. In addition, several articles related to TSSE are included in the Further Reading section of this module.

Emerging Technology

Perspective Grid Accident Investigation Systems

Perspective grid systems have the ability to measure roadway evidence from 35 mm still photographs. Photographs are taken at the scene from several different angles and incorporate a small placard of known size for reference. Vehicles are cleared and the roadway is opened to traffic. The photographs are developed and digitized so that they may be entered into a computer. Specially designed computer software then measures evidence directly off the photograph. Time at the incident scene is greatly reduced. Further investigation involving the vehicles can take place off the roadway.

Advanced Traffic Signal Control Systems

Advanced traffic signal control systems would greatly benefit traffic flow that has been rerouted because of an incident. Currently, if an incident occurs on the freeway, traffic reroutes onto arterials or city streets. This additional and unexpected increase in traffic volume quickly results in gridlock. Advanced traffic signal control systems include both adaptive traffic signals and coordinated traffic signals. Adaptive signal controls "sense" the traffic demand or traffic volumes at an intersection or an on-ramp and automatically adjust the signal timings (red and green times). Traffic demand can be measured using a variety of technologies, including electronic loops, video imaging, and microwave sensors. Coordinated traffic signal systems share traffic demand data across jurisdictional boundaries (i.e., data related to traffic conditions on the freeway are sent to arterial and local traffic signal systems so that they may adjust accordingly). Two operational tests currently under way include the FAST-TRAC project in Oakland County, Michigan, that is testing adaptive traffic signal systems and the North Seattle ATMS project that is testing coordinated traffic signal systems.

For a full description of advanced traffic signal control systems as an incident management strategy, including a discussion of advantages, disadvantages, and relative costs, refer to the "Framework for Developing Incident Management Systems" included at the back of this notebook (see responsive Traffic

Systems).

National Examples

Perspective Grid Accident Investigation Systems in Oregon

The Oregon State Police has been working with the Oregon Department of Transportation for several years to find accident investigation methods that would allow quicker data collection and quicker incident clearance. Several alternative methods have been employed or tested, including laser-based measuring devices (i.e., total station surveying equipment) and video imaging systems using videotapes of the incident scene. The latter proved too inaccurate for further consideration. However, a new system that employs methods of photogrammetry or perspective grid measurement is showing promise. Perspective grid systems have the ability to measure roadway evidence from 35 mm still photographs. Photographs are taken at the scene from several angles and incorporate a small placard of known size for reference. Vehicles are cleared and the roadway is opened to traffic. The photographs are developed and digitized so that they may be entered into a computer. Specially designed computer software then measures evidence directly off the photograph. This perspective grid system is currently being tested as a cooperative pilot project of the Oregon Department of Transportation (ODOT) and the Oregon State Police. ODOT is providing the required equipment at a cost of roughly $6,300 per unit. The state police are providing the reconstruction expertise, training, and operation of the system. Anticipated benefits from this system include a reduction in accident investigation time from 5 to 6 hours to potentially 1 hour.

JAWS in New York?

Clearing debris can be a particularly dangerous task and may require more extensive traffic control to ensure the safety of responders. New York is utilizing an automated debris recovery system (ADRS) to help to alleviate the danger involved in clearing debris. The New York Department of Transportation's Jumbo Anti-Waste System (JAWS) vehicle is self-propelled and can successfully pick up debris ranging from tin cans to car tires on city streets and highways when traveling at speeds of less than 30 miles per hour. JAWS is available for quick cleanups after traffic accidents where spills of loads or debris can close lanes for a considerable period.

Advanced Law Enforcement Response Technology (ALERT) Vehicle

The "next generation" of law enforcement vehicle is currently under development at the Texas Transportation Institute. The entire vehicle and all its technologies, including overhead lights and siren, are controlled by a single touch-screen computer in the vehicle's cockpit. The Advanced Law Enforcement Response Technology (ALERT) vehicle is equipped with advanced communications systems that will provide access to multiple sources of traffic enforcement and investigation information. Using a combination of off-the-shelf and advanced technologies, the ALERT idea can be adapted to other incident management vehicles, other enforcement vehicles (i.e., commercial vehicle enforcement), and any other emergency vehicle used to relieve traffic congestion and enhance traffic safety. The ALERT vehicle and its technologies improve responder safety through improved tracking and monitoring capabilities; improve safety for both responders and motorists during high-speed chases by automatically performing some of the communication tasks, leaving the driver to concentrate on the task of driving; and reduce scene documentation times by allowing electronic data entry.

Total Station Surveying Equipment in Kentucky

The benefits of using total station surveying equipment in comparison to conventional accident investigation methods quantified by Kentucky accident investigation agencies are described below (1994).

In Kentucky, estimates of data collection time by both the coordinate and total station procedures were documented for a large sample of accidents to determine the extent to which total station procedures would prove advantageous. Accident investigation work logs provided general accident information, as well as information specific to the study's needs (i.e., data collection time, number of measurements, number of officers required to collect the data, personnel-hours required to collect the data, and accident diagram preparation time).

The change in the collection of physical evidence can be expressed in two ways. First, a greater number of measurements can be collected by using total station surveying equipment, providing a more comprehensive picture of the accident. Second, the measurements can be collected at a much faster rate.

The number of measurements investigators were able to collect at the incident scene more than doubled (43.5 measurements increased to 88 measurements). Simultaneously, investigation time was nearly halved from 198 minutes to 115 minutes.

Plotting the accident after the field data have been collected is a time consuming part of the accident investigation process. In Kentucky, time savings for accident recreation was estimated to be 50 percent (no specific time estimates were given).

Kentucky researchers noted that although the initial equipment costs for TSSE are high, these costs are recoverable, often after only a single major incident if vehicle delay costs are considered. In addition, researchers identified many hidden savings resulting from TSSE use that are difficult to quantify. These savings include reduced personnel requirements and improved tort liability defense.

Further Reading

Nee, J., J.L. Koehne, and B.B. Legg. "The Use of Total Station Surveying Equipment for Accident Investigation: A National Perspective." Washington State Transportation Center, College of Civil Engineering, University of Washington

"Strategies to reduce incident duration"

"Interagency agreement MD/SHA-MSP; removal of vehicles from roadway."

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Quick Clearance Policy: Maryland

Quick Clearance Policy: Texas

SOURCE: Washington State Transportation Center
College of Civil Engineering
University of Washington

THE USE OF TOTAL STATION SURVEYING EQUIPMENT FOR ACCIDENT INVESTIGATION: A NATIONAL PERSPECTIVE

ABSTRACT

This report examines

1. how the use of total station surveying equipment (TSSE) for accident investigation has expanded to other parts of the nation after first being demonstrated to be effective in Washington,

2. the factors that encourage and discourage the use of the new technology, and

3. how the quantified and perceived benefits vary.

This information will be useful for future technology transfer applications. The researchers documented how the use of TSSE has extended to other parts of the country by

1. developing a contact list,

2. conducting a telephone survey,

3. conducting a mail-out survey, and

4. collecting quantified benefit information.

The results indicate that for states where TSSE is currently being implemented, efforts should focus on

1. developing a set of well defined guidelines for TSSE use,

2. having well trained personnel available at the scene for investigation,

3. having a convenient TSSE storage site,

4. quantifying and evaluating TSSE benefits, and

5. encouraging non-users to implement TSSE if its use has proved successful.

For potential TSSE users, information about TSSE and its benefits should be distributed to a wider audience through accident reconstruction workshops and informational brochures. In addition, more information about financial alternatives, such as state or federal government grants, should be provided to accident investigation agencies. Because special effort was made through this project to encourage the transfer of TSSE technology, future evaluation is recommended to investigate how this effort affects TSSE use.

Key Words

Technology Transfer, Accident Investigation, Total Station Surveying Equipment

INTRODUCTION

The use of total station surveying equipment (TSSE) by the Washington State Patrol in the greater Seattle area has proved successful at reducing accident investigation time and speeding incident clearance. The Washington State Department of Transportation (WSDOT) took a national leadership role in the investigation and implementation of this technology. After WSDOT documented the success of this application, interest in using TSSE for accident investigation developed across the country. To date, no one has investigated the success of the technology's transfer to other parts of the country by documenting

1. the use of TSSE for accident investigation across the country

2 the perceived benefits resulting from its use

3 the quantifiable benefits resulting from its use

4 reasons for its selection as an incident management strategy

5 reasons for its use in particular situations such as perceived benefits or administrative policies.

BACKGROUND

Police agencies are typically responsible for accident investigation. Their main role is twofold: (1) to identify any suspicious or illegal activity (e.g., illegal use of alcohol or other drugs, felony involvement) and (2) to diminish the potential for a liability dispute (i.e., subject to court action). Police troopers document all pertinent physical evidence and details at the accident scene. Such documentation may include (1) a description of the roadway and surrounding environment (e.g., locations of intersections, beginnings and ends of curves, warning signs), (2) a description of each vehicle's movement (e.g., direction of travel, speed, unusual movements, changes in direction), and (3) a description of other pertinent details such as the beginning and end of skid marks, debris patterns, gouges, and scratches. The time required to document this information varies greatly, depending on the magnitude and severity of the accident.

Traditional methods of collecting physical evidence at an accident scene require a stationary reference and a means for measuring distance between an object and the reference. The two most common methods, aside from TSSE, for collecting physical evidence include the triangulation method and the coordinate method (see FIGURE 1 Methods For Collecting Evidence At The Accident Scene).

The triangulation method relies on two stationary reference points, points A and B in Figure 1A. For each object to be documented, two measurements are required: the distance from the object to reference point A (Ai) and the distance from the object to reference point B (Bi). Either a measuring tape or a measuring wheel is used to collect the measurements. The two identifiers for each object measured (Ai, Bi) are recorded by hand in a field book. Because the triangulation method uses reference points rather than a reference line, it is more convenient for accidents that extend over a large area.

The coordinate method, also referred to as the base tape method, relies on a base or reference tape, which is laid through or adjacent to the accident scene, and a reference point along this tape. Each object considered to be pertinent physical evidence is then documented by three identifiers: (1) the distance along the base tape measured from the reference point (xi), (2) the distance perpendicularly from the base tape (yi), and (3) the direction (see Figure 1B). Either a second measuring tape or a measuring wheel is used to collect the perpendicular measurements. The three identifiers for each object measured are recorded by hand in a field book. Photographs or videotape may also be used to further document the scene. In the office, the accident is recreated, again by hand, relying on the field notes and measurements.

To speed the documentation process, some accident investigation agencies are initiating the use of total station surveying equipment. TSSE uses an infrared electronic distance meter combined with a rod-mounted prism to automatically measure horizontal distance to an object; a theodolite, or electronic transit, to measure the horizontal angle to an object; and an internal level to measure vertical rise to an object (see Figure 1C). These three measurements are obtained simultaneously. Rather than being entered into a field book, the data are recorded automatically. In the office, the stored data can be either downloaded to a plotter for a quick but crude plot or manipulated in a microcomputer database or drafting program to produce a more detailed view. With the appropriate software, the accident can even be recreated in animation.(1)

of-way in exchange for some form of fiber optic service, or alternatively for monetary compensation. Many issues remain to be resolved in forging such relationships (e.g., which telecommunications company should it be, how should this be decided, etc.), but this may be an area in which cooperation could be mutually beneficial.

National Examples

In addition to the national examples of TOCs offered in this section, at the end of the module the reader will find summaries of services offered by TOCs nationwide, prepared by the National Incident Management Coalition. These summaries give the reader a good idea of the range of functions being performed in TOCs nationwide, as well as which metropolitan areas already have TOCs, which areas are planning them, and in which areas they do not yet exist.

Atlanta, Georgia

The federal government and the State of Georgia took advantage of Atlanta's (1990 population 394,017) high profile as the host of the 1996 Summer Olympic Games by providing the state with the funding impetus it needed to build the largest integrated ITS program in the country. In fact, Atlanta's TOC served as a Showcase, meaning that it presented its ITS programs and its TOC to the public extensively throughout a four month period in the summer of 1996. Atlanta's core TOC is linked by fiber optic cable to seven TOCs located in the five metropolitan area counties, the City of Atlanta and the Metro Area Rapid Transit Authority. All of these center have similar capabilities and access to each other's surveillance cameras and other information.

While the Showcase period was intended as a means of demonstrating to the public and the press the feasibility of ITS functions such as automated incident detection and traffic control, as well as their value in maximizing existing system capacity, the FHWA has asked the Showcase partners to continue operations, and in effect, to create a lasting legacy.

The integrated ITS system demonstrated during the summer of 1996 covered over 60 miles of freeway and included over 300 cameras, more than 100 miles of fiber optic cabling, variable message signs, automatic radio transmitters, and

RESEARCH APPROACH

Information was gathered by developing a comprehensive contact list of all states with the potential for using TSSE, conducting a telephone survey to determine which states were using it, and conducting a mail-out survey to identify more detailed issues relating to its use. Each consecutive task was intended to act as a screening process. As the project progressed, fewer people were contacted and the questions became more detailed (see FIGURE 2 Project/Survey Participation).

Development Of A Contact List

The first task in this project was to identify people within each state who could describe their state's current method of accident investigation. Inquiry records maintained by WSDOT and the WSP personnel each time they were contacted by accident investigation personnel in other areas of the country provided several of the contacts needed. In other states, additional people were identified by directly contacting police jurisdictions or other accident investigation entities.

Telephone Survey

Once a comprehensive list of contacts had been developed, a carefully designed telephone survey was administered to selected people in all states. The design of this telephone survey was thorough enough to prevent multiple call-backs, yet brief enough to encourage continued participation. All participants were asked to describe the techniques they were using to collect physical measurements at an incident scene (e.g., measuring wheel, baseline tape/coordinate method, total station surveying equipment, photographs, or others.) They were also asked to list the new data collection technologies, if any, the agency was considering for implementation. If TSSE was not mentioned in response to these two questions, the respondent was asked whether he or she was aware of TSSE as a means to speed the data collection and accident recreation process.

At the conclusion of each telephone survey, people who had indicated that their agency was using total station survey equipment for accident investigation were asked to take part in a mail-out survey. People who had indicated that their agency was not using total station surveying equipment but were aware of it were also asked to take part in a mail-out survey. However, people who had indicated that total station surveying equipment was not in use for accident investigation because they were not aware of the technology were not contacted for the survey but were sent information about TSSE.

Mail-Out Survey

On the basis of information gained through the initial telephone survey, the mail-out survey was designed to address four potential audience types:

1. administrative-level personnel responsible for overseeing TSSE use for accident investigation

2. field-level personnel responsible for using TSSE for accident investigation

3. administrative-level personnel responsible for rejecting TSSE as an accident investigation tool

4. field-level personnel who were aware of TSSE as an accident investigation tool but were unable to use it.

Discovered through the telephone survey, many states were in the process of purchasing TSSE. Survey respondents in these states were asked to complete the mail-out survey as best they could, speculating as to the benefits of TSSE. A separate category was created for state agencies planning to use TSSE in the survey analysis.

The mail-out surveys were designed to provide information regarding the likelihood of purchasing TSSE and the likelihood of using TSSE once it had been purchased. For each of the informational categories described below, the questions were directed and phrased to best address the areas of knowledge for both field-level and administrative-level personnel.

Information about local conditions such as agency involvement, agency priorities, available resources, and communication between administrative and field response personnel was collected through a series of questions. General safety information-number of fatality accidents-provided the researchers with an indication of the importance of quick accident investigation for a particular area. This information was not collected through the survey but was based on existing state-specific safety statistics.

Information about current administrative procedures was collected from administration-level personnel from both agencies that used and that did not use TSSE. Such information included the medium by which they first became aware of TSSE, the motivation behind purchasing or not purchasing the equipment, the availability of funds, changes in staff requirements, additional training requirements, and the approximate date when TSSE was implemented or decided against.

Field-level respondents were asked a series of questions regarding accident investigation procedures including time commitment, current methods used and their personnel requirements, the medium by which they became aware of TSSE, the availability of the TSSE equipment, reasons why TSSE might not be used even when it is available, and TSSE accessibility and use.

Information regarding both the perceived and quantified benefits resulting from the use of TSSE was sought, though most questions were devoted to understanding perceived benefit. Perceived and quantifiable benefits include both the time savings realized in the field and the administrative savings resulting from a reduction in paperwork (e.g., report preparation, documentation, record keeping). The perceived benefits of TSSE realized by both the field-level personnel investigating accidents and the administrative-level personnel setting procedural policy may have a substantial impact on its use.

Survey participants who were planning to use TSSE were asked to speculate regarding the benefits resulting from TSSE use. Survey participants who were not currently using total station surveying equipment were asked to respond to questions regarding the impact they thought TSSE would have on their accident investigation procedures (e.g., time, budget, staffing requirements, training requirements).

Questions related to both perceived and quantified benefits were included for survey participants who had indicated that total station surveying equipment was in use or planning to be used for accident investigation. If effort had been made to quantify the benefits resulting from the use of TSSE, questions were focused on the method and results of this effort. If no effort had been made to quantify the benefits resulting from TSSE use, questions were asked that were similar to those asked of survey respondents who were not using TSSE (i.e., the impact they thought TSSE had on their accident investigation procedures, including time, budget, staffing requirements, and training requirements).

Collection Of Quantified Benefit Information

The level of effort undertaken during this task was highly dependent on the information obtained during the previous two tasks. Primary variables included the number of areas using total station surveying equipment for accident investigation and the proportion of these areas that had already conducted some type of quantified benefit analysis.

If local quantifiable benefits existed (as discovered in the mail-out survey), the researchers made use of these data. Care was taken to ensure that the method used to quantify the benefits was acceptable. In addition, the magnitude of each benefit was carefully observed to determine its likelihood.

Where local benefits had not yet been measured, the original intent of the researchers was to request cooperation from local accident investigation agencies in obtaining this information. Local accident investigation personnel were to be asked to collect incident data for a small number of specific incidents using two methods: total station surveying equipment and their previous method for accident investigation (the incident could be real or staged as part of a training exercise). Accident investigation personnel were to be asked to record the time requirements for and data collected by each method. Using this information, the researchers could have estimated the time savings that is realized in the field in each participating area.

Because of the large number of states found to be using or planning to use TSSE and the small number of states (i.e., Washington and Kentucky) that had conducted a quantified benefits investigation, time and resource constraints limited the collection of quantified benefit information to that available at the time of this study.

SURVEY RESULTS

The series of surveys was intended to gather information, but information collected from each of the six groups (originally four) (i.e., administrators who were using, planning to use, and not using TSSE and field respondents who were using, planning to use, and not using TSSE) was not intended to be statistically valid because of the small sample sizes. In addition, the survey may not have been comprehensive. A number of small, local jurisdictions may be using TSSE. When they were readily locatable, people from these agencies were contacted. However, both time and budget constraints prevented a comprehensive survey of local agencies. Instead, the surveys focused on state agencies.

Telephone Survey

The telephone survey and the mail-out survey were intended to collect very different types of information. The telephone survey was intended to act as a screening step to determine how many of the 50 states' accident investigation agencies were using total station surveying equipment. The telephone survey was also intended to group the states' accident investigation agencies into three categories: (1) those that were using TSSE, (2) those that were not using TSSE because they were not aware of it, and (3) those that were not using TSSE for reasons other than awareness. Responses from the telephone survey indicated a need for a fourth group: states' accident investigation agencies planning to use (i.e., in the process of getting) TSSE.

The telephone survey showed that

- 10 states are using TSSE
- 13 states are at the planning stage
- 12 states are not using it but were aware of it
- 15 states are not using because they were not aware of it (see FIGURE 3 TSSE Use Nationwide).

Depending on the information learned from the telephone survey, mail-out surveys were distributed, or information about total station technology was sent to states unfamiliar with TSSE.

Mail-Out Survey

The mail-out survey was designed to address four potential audience types:

1. administrative-level personnel responsible for overseeing total station surveying equipment use for accident investigation
2. field-level personnel responsible for using total station surveying equipment for accident investigation
3. administrative-level personnel responsible for rejecting total station surveying equipment as an accident investigation tool
4. field-level personnel aware of total station surveying equipment as an accident investigation tool but unable to use it.

After the respondents had been grouped into these categories, mail-out surveys specially designed for each respective group were administered. The purpose of the mail-out survey was to determine, in more detail, the factors most likely to affect an accident investigation agency's decision to purchase or not purchase a TSSE system and the factors likely to affect its use once it had been purchased.

Technology Transfer

A pattern in the transfer of TSSE technology throughout U.S. emerged from the information gathered by the mail-out survey (see FIGURE 3 TSSE Use Nationwide). The Washington State Patrol was the first agency to use TSSE for accident investigation in 1989. By 1992, TSSE not only was being implemented along the West Coast in Oregon, California, and Texas, but the use of TSSE was also expanding east to Delaware. In 1993, the use of TSSE had spread farther, to Colorado, Alaska, and Kentucky. The process of the technology transfer continued along the East Coast from Maryland in 1994 to New York in 1995.

It is not surprising to see that the TSSE technology spread from coast to coast while skipping the Midwest. The map shows that most of the Midwest and Southeast states are unaware of TSSE, whereas more states on the East Coast are planning to implement the use of TSSE than the rest of the country. One hypothesis is that the coastal states sought this high-tech information sooner than the inland states because the coastal states generally have higher population densities and more traffic, resulting in a greater need to speed accident investigation.

Also note that many of the states that are not using TSSE are surrounded by states that are using or are aware of TSSE. This could be the result of not enough state to state contacts (e.g., conferences to exchange information about incident management) or little need to acquire new technology because of no need for improvements in accident investigation (i.e., few major accidents, low population density).

Agency Responsible For Accident Investigation

The survey results showed that police agencies are the primary agency responsible for traffic accident investigation in most states, with the exception of two states not using TSSE. In Oklahoma and Virginia, the responsibility of accident investigation is shared by the police and highway department.

Accident Investigation Priority Ranking

Within most of the investigating agencies, accident investigation was ranked as a high priority by a majority of the administrative and field-level personnel. None of the states ranked accident investigation "low." The choice between "high" and "medium" was more balanced in the states using TSSE than in the states planning to use or not using TSSE. Of the administrators, 70 percent from the states using TSSE, 90 percent from those planning to use TSSE, and 83 percent from those not using TSSE viewed accident investigation as a high priority. A similar pattern was also found in the field personnel's' reply: 75 percent of the states using TSSE, 78 percent of those planning to use TSSE, and 90 percent of those not using TSSE viewed accident investigation as a high priority. These consistent findings suggest that whether accident Investigation is viewed as a priority does not have an impact on TSSE purchase (i.e., states not using TSSE still view accident investigation as a high priority).

Accident Fatality Rate

The survey results showed that the state's fatality rate also does not appear to have an impact on the use of TSSE. This finding suggests that a high accident fatality rate does not promote the use of TSSE. Mississippi, which does not use TSSE, recorded 49.15 fatalities per 100,000 drivers in 1993 - the highest rate among the 50 states. Rhode Island, currently planning to use TSSE, recorded 10.63 fatalities per 100,000 drivers - the lowest fatality rate among the 50 states. Figure 8 shows that the average accident fatality rate in states not using TSSE is higher than that in states planning to use TSSE (3).

Ranking By Time Commitment

For most of the states in all usage categories, measuring physical evidence ranked as one of the biggest time commitments during the investigation process.

Technologies and Tools Currently Used

Among the states using TSSE, the coordinate method, photo/video, and the measuring wheel, along with TSSE are the most common techniques and tools for collecting physical evidence. In the states planning to use TSSE, the most popular techniques and tools are the coordinate method, photo/video, and the triangulation method. For those not using TSSE, agencies use the coordinate method and photo/video, while the measuring wheel and the triangulation method are also popular.

Number of People Required

The survey indicated that the number of people required for TSSE is not always less than that required for a previous investigative method or tool. Among the investigative methods, the measuring wheel and photo/video only require one person to operate, whereas two people are needed for the coordinate method, TSSE, and the triangulation method. Michigan is currently using a surveying transit, which requires two people to operate.

Source of TSSE Information

Most administrators first became aware of TSSE through information from outside of their agency and by reading material. Many agencies also obtained information regarding TSSE from within the agency, through vendor demonstration, working with the Department of Transportation, watching a video tape, or attending a special meeting.

Reading material seemed to be the primary information source for many field respondents from states planning to use and not using TSSE. In most of the states using TSSE, field personnel listed "within the agency" as the main source. Besides "outside the agency" and "reading material," they also got information by watching a video tape on TSSE. A special seminar on accident reconstruction by the Institution of Police Technology and Management also contributed in spreading information about TSSE.

Administrator/Field Respondent Discussion

In terms of administrator/field respondent discussion, communication seems to occur more frequently in the states that use TSSE than in the states planning to use or not using TSSE. In more than half of the states using TSSE, accident investigation discussion between administrators and field respondents occurs after every major accident. Only in 35 percent of the states planning to use TSSE are discussions held after every major accident. In the states not using TSSE, most discussions occur during training sessions and as needed.

Factors Encouraging The Purchase of TSSE

The states that are either using or planning to use TSSE were mostly motivated to purchase it by the availability of resources, high perceived benefits, and the desire to improve public service. Kentucky and Washington also added "road closure time reduction" and "more detailed investigation," respectively, as other benefits from implementing TSSE. Only one state using TSSE (Maryland) and one state planning to use it (Minnesota) listed "minimal training requirements" as a purchase motivation. One state planning to use TSSE (Arizona) listed "someone suggested it" as one of its motivations. Thus, "minimal training requirements" and "someone suggesting it" seem to have less impact on the decision to purchase TSSE.

The factors of available funding and high perceived benefits motivated more states using TSSE than those planning to use it. Nearly 90 percent of those planning to use TSSE were motivated by a desire to improve public service.

Internal agency pressure existed to improve efficiency by implementing TSSE in most of the states using and planning to use TSSE and existed in only 10 percent of those not using TSSE. However, this variable does not seem to have an impact on TSSE purchase. This motivation factor was only mentioned by only about 10 percent of the states planning to use TSSE and none of states using it. The variable is also not a preventative factor because the lack of funding was the primary factor preventing states from using TSSE.

Factors Discouraging The Use of TSSE

As many as 67 percent of the states not using TSSE have considered it. However, 90 percent of those not using it are not planning to implement TSSE. As stated previously, a lack of resources is the strongest factor preventing states from pursuing TSSE for accident investigation. Ninety one percent of the respondents listed "lack of funding" as the only preventing factor. The state of Wisconsin also mentioned "all troopers are AI (accident investigation) trained, would take 400 (man-hour) units."

This finding may be explained by an unavailability of funds. More respondents from both the administrative and field levels indicated "not enough" than indicated "adequate" funds. Not a single respondent indicated that too much of the agency's funds were dedicated to accident investigation.

It also appears that not only are funds limited, but the source of funds is often not dedicated. Funds for purchasing equipment and program operation may come from federal or state grants rather than dedicated sources. Nearly 75 percent of the states planning to use TSSE will get financial support from government grants to purchase it.

Factors Affecting TSSE Use

Availability of personnel contrasts with availability of funds. More participants responded "adequate" than "not enough" personnel, while one administrator, from Florida, responded that he had "too many" personnel.

Required staff time does not seem to be less or perceived to be less because of the implementation of TSSE. Of the administrators, 70 percent from the states using TSSE, 78 percent from those planning to use it, and 70 percent from those not using it stated that "no change" in staff requirements had been or would be required after TSSE had been implemented. The need for additional staff or to reallocate superfluous staff time to other duties was fairly low among all the participating states.

Most field personnel in states using TSSE felt that the demand for the TSSE never exceeds the availability. Only 33 percent of the states using TSSE and 20 percent of those planning to use it responded that the demand for the TSSE would "often" exceed its availability.

TSSE may not always be used, even when it is available. From the states using TSSE, 78 percent of the personnel indicated that it had ever been available and not used. Only 40 percent of the states planning to use TSSE predicted that it would ever be available and not be used. None of the field personnel responded that the reason for not using the TSSE was that other investigation methods were more reliable or other investigation methods were more accurate. Instead, the most common reason respondents gave for not using TSSE when it is available was that an incident was minor and didn't require detailed investigation. Other important factors were that "TSSE is slow to arrive at the scene" and "TSSE trained personnel are not available at the scene."

Also affecting the use of TSSE are factors such as "the procedure for requesting TSSE is unfamiliar," and "other investigation methods are quicker." Another reason for Alabama was that "over-time is not authorized for TSSE operators." The following analysis may offer some explanation of these factors.

The reason that TSSE is slow to arrive at the scene may be explained by the fact that often the TSSE is stored at the office rather in a mobile response vehicle (police car, etc.) Fifty five percent of the field personnel from the states using TSSE store the equipment at the office. In states planning to use it, almost half of the field personnel will store the equipment at the office, and half of them will store it in the vehicle. In Illinois, the equipment has to be borrowed from the Department of Transportation.

One possible reason that the procedure for requesting TSSE is unfamiliar may be that no formal policies or guidelines exist for the use of TSSE. Of the field respondents, 67 percent from the states using TSSE and 83 percent from those planning to use it indicated that no formal policies or guidelines exist for its use or call out.

If TSSE trained personnel are not available at the scene, the reason may be that only a limited number of personnel are trained to use TSSE. A special crew, such as Major Accident Investigation Team (M.A.I.T.) or an accident reconstruction unit, is usually trained to use the equipment. The survey also showed that the person who is responsible for requesting the TSSE to the accident scene is also from the same agency responsible for investigating the scene, such as the field/scene supervisor.

Perceived or Quantifiable Benefits

In states using TSSE, data accuracy and completeness were indicated by every administrator as one of the resulting improvements. More than half of the administrators listed improvements in "documentation," "public image," and "time required for accident recreation." An improvement in the "amount of paperwork" was only experienced by 10 percent of the administrators.

Every administrator in states planning to use and not using TSSE predicted an improvement in the "time required for accident recreation." Better "accuracy or completeness" was also perceived to be one of the benefits. Improvements in "documentation," "public image," and "amount of paper work" were less frequently mentioned by states planning to use and not using TSSE.

Over 60 percent of field respondents noted or predicted improvements in every area listed in the survey. Improvements in data accuracy and completeness were noted not only by the administrators but by many of the field respondents, as well. Note that every field-level respondent from the states not using TSSE predicted improvements in areas such as "convenience of accident investigation in the field," "field respondent safety," "motorist safety," and "traffic flow."

Measured Benefits

Most of the administrative and field personnel from states planning to use and not using TSSE had not formally measured potential TSSE benefits. Such benefits had been measured mostly by the states using TSSE. However, respondents sent no documentation regarding measured benefits.

QUANTIFIED BENEFITS INFORMATION

While a number of states are using total station surveying equipment, only two, Washington and Kentucky, have made the effort to quantitatively compare the benefits of using this method with those of conventional methods. Table 3 summarizes comparable results from each state's estimate of benefits. The results from the two states are relatively consistent, especially given that the states used several different methodologies to arrive at the results. Below, each state's methodology and results are described in more detail.

Participating States

The use of total station surveying equipment for accident investigation was first considered in Washington prior to 1989. WSDOT believed that to introduce the new technology with any success, quantified benefits would be required rather than just speculated savings. A complete description of WSDOT's evaluation can be found in "Incident Management Using Total Stations "(4).

The paper "Evaluation of Advanced Surveying Technology for Accident Investigation" (5) documents the quantified benefits discovered by Kentucky accident investigation agencies in 1994.

Methodology

The basic methodology in Washington was threefold:

1. Investigation times were compared for three accident scenes at which both the coordinate method and the total station surveying equipment were used.

2. Incident clearance times were compared for urban freeway accidents in the Seattle area that required formal investigation; accidents from 1989,

before total stations had been used, were compared to those from 1991, when total stations were used exclusively.

3. Researchers estimated the benefit-cost relationship of using total station surveying equipment as an incident management tool.

In Kentucky, estimates of data collection time by both the coordinate and total station procedures were documented for a much larger sample of accidents to determine the extent to which total station procedures would prove advantageous. Accident investigation work logs provided general accident information, as well as information specific to the study's needs (i.e., data collection time, number of measurements, number of officers required to collect the data, personnel-hours required to collect the data, and accident diagram preparation time).

Collection of Physical Evidence

The change in the collection of physical evidence can be expressed in two ways. First, a greater number of measurements can be collected by using total station surveying equipment, providing a more comprehensive picture of the accident. Second, the measurements can be collected at a much faster rate.

In Washington, the number of measurements investigators were able to collect at the incident scene nearly doubled. The average number of measurements per hour increased from 28.8 measurements per hour to 49.8 measurements per hour. Concurrently, the time required to collect these measurements decreased by more than half. The average investigation time decreased from 130 minutes to 60 minutes.

Similar results were noted in Kentucky. The number of measurements investigators were able to collect at the incident scene more than doubled (43.5 measurements increased to 88 measurements). Investigation time was nearly halved from 198 minutes to 115 minutes.

Accident Clearance Time

Using a log of traffic investigations and computer-aided dispatch files, Washington researchers were able to determine the time of notification and the time of clearance for a number of freeway accidents. Similar types of freeway accidents investigated by different methods were compared. The comparison showed that the use of total stations for accident investigation can reduce the overall clearance time of the accident by nearly 72 percent.

In Kentucky, as in Washington, researchers considered accident clearance times for a variety of accident types and severities. However, this information was not directly related to the use of differing technologies for accident investigation. Hence, no comparison could be made.

Accident Recreation Time

Plotting the accident after the field data has been collected is a time consuming part of the accident investigation process. In Washington, investigators estimated that they could save approximately 6 hours as a result of the downloadable feature of TSSE (8 hours with traditional plotting methods reduced to 2 hours with the downloadable field data and drafting program), an improvement of 75 percent. In Kentucky, time savings for accident recreation was more conservatively estimated to be 50 percent (no specific time estimates were given).

Cost Recovery

Both Washington and Kentucky researchers noted that although the initial equipment costs for TSSE are high, these costs are recoverable, often after only a single major incident if vehicle delay costs are considered. In addition, researchers from both states identified many hidden savings resulting from TSSE use that are difficult to quantify. These savings include reduced personnel requirements and improved tort liability defense.

Recommendations

On the basis of the information gathered through this project, a number of recommendations can be made for current and future potential TSSE users.

For states where TSSE is currently being implemented, efforts should focus on the following:

1. developing a set of well defined guidelines for the use of TSSE
2. having enough well trained personnel available at the scene for accident investigation
3. having a convenient storage site for TSSE (e.g., mobile response vehicle)
4. quantifying and evaluating the benefits of using TSSE
5. encouraging non-users to implement TSSE if its use has proved successful.

For potential TSSE users, effort should be made to accomplish the following:

1. Information about TSSE and its benefits should be distributed to a wider audience through accident reconstruction workshops or seminars and informational brochures that discuss TSSE.
2. More information about financial alternatives, such as state or federal government grants, should be provided to accident investigation agencies .

Future evaluation of the process of transferring the TSSE technology is recommended. Because special effort was made through this project to encourage the transfer of TSSE technology and information, it would be interesting to investigate how this effort affects TSSE use.

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SOURCE: Arland T. (Ted) Smith
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Illinois Department of Transportation - District 1
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STRATEGIES TO REDUCE INCIDENT DURATION

Expand every possible means of early detection. (cellular phones etc.)

Train dispatchers to obtain accurate information on location and magnitude of the incident. questions.

Ask

- Is it an accident or a stall?
- Is it blocking traffic?
- Injuries?
- Type and number of vehicles'?
- Spilled fuel?
- Can vehicles be driven out of traffic?
- If it is a truck, inquire further: jack-knifed, rolled over, carrying hazardous cargo, is the load' spilled?

Notify proper response agencies, don't wait for followup verification, (this avoids compound response times).

Each agency should deploy only necessary equipment. (avoid overkill).

Make sure the wrecker equipment is adequate to handle the incident and only fully trained certified personnel are used.

First responder should direct all driveable accident vehicles to a sate location out of traffic.

First responder must now direct other response vehicles to park out of traffic and if possible on the right shoulder, especially ambulances. Open as many lanes as possible.

Diesel fuel and motor oil don't mix with water. Have a 24 hours source of sand to use in lieu of water at truck accident scenes.

Require wrecker crews to carry sand bags and brooms to sweep up all accident debris.

Aggressively motivate wrecker crews to clear travel lanes first. Drive, push or winch wrecks out of traffic before elaborate rigging begins. (non-hazardous loads only)

Monitor the progress of the wrecker crews to assure substantial progress is being made.

Do not allow off loading, involved cargo securement or major repairs while travel lanes are blocked, relocate to the shoulder first.

You may further want to restrict this type of activity during peak traffic periods.

Minimize the use of flashing or mars lights. Require unidirectional controls.

Require all response personnel to be uniformed with reflectorization at night. Vest, jumpsuits etc. (this includes wrecker crews)

Keep a police vehicle on the scene to monitor progress and assist with traffic protection until the incident is completely resolved.

Each agency should co-ordinate activities with the incident managers and maintain a co-operative professional attitude keeping traffic impact as a top priority.

Integrate congestion reduction and incident management into the training of police, fire. public works and wrecker personnel.

INTERAGENCY AGREEMENT
MDSHA-MSP
REMOVAL OF VEHICLES FROM ROADWAY

This agreement made this 26th day of October, 1990, by and between the Maryland State Highway Administration (SHA) and the Maryland State Police (MSP) is to provide guidance for State Police, and State Highway personnel in removing vehicles from roadways in certain situations to maintain a safe and orderly flow of traffic.

WITNESSETH: Whereas, the SHA is proposing to remove certain vehicles from the roadway on an urgent basis following collisions or where vehicles are abandoned and are causing a hazardous situation to exist.

I. General:

Whenever a road or lane is closed or partially blocked by an accident and traffic delays or safety problems may occur, the Resident Maintenance Engineer or his Representative, in cooperation with the police officer in charge, should reopen the roadway as soon as possible ON AN URGENT BASIS. This recognizes that public safety is the highest priority and must be secured, especially if injuries or hazardous materials are involved. It is understood that damage to vehicles or cargo may occur as a result of clearing the road on an urgent basis. While reasonable attempts to avoid such damage should be made, the highest priority is public safety.

II. Procedure/Requirements - SHA

A. General

The Resident Maintenance Engineer or his representative is to assign the necessary equipment and manpower to reopen the road or lane as soon as possible.

If materials being transported are involved, the SHA will make every effort to relocate the materials in the shortest possible time, using whatever equipment is necessary. All such materials will be relocated as short a distance, as possible, but not be placed so as to present a traffic hazard.

The Resident Maintenance Engineer or his representative is to prepare a list of the personnel and equipment used and the work hours involved so that the owner of the vehicle and/or cargo can be billed for the work. Appropriate warning devices (barricades, signs, arrowboards, etc.) are to be placed on the scene should either the damaged vehicle(s) or cargo remain adjacent to a lane or on the shoulder.

B. Hazardous/Flammable/Exploding Materials

No attempt is to be made by State Highway Administration personnel/equipment to move any hazardous or flammable or explosive material for any reason. If SHA is first on the scene and cargo content is not readily identifiable, the Resident Maintenance Engineer or his representative will contact the proper authorities to ascertain if special measures should be taken.

As soon as the public safety has been secured then reopening of the roadway is to proceed as described under "GENERAL" in this agreement.

III. MSP Duties and Responsibilities

Members of the Maryland State Police who are the on-scene motor vehicle collision investigators will work in cooperation with other Emergency Service Personnel and members of the MD State Highway Administration who are at the scene.

Members of the State police will conduct their required investigation in as expedient a manner as possible, considering the severity of the collision and the quality of their investigation. Lengthy investigations will require investigators to work diligently in an attempt to minimize traffic delays. This may mean that certain "non-critical" portions of an investigation be conducted at a later time when traffic congestion is non-existent (i.e., non-peak periods).

It should be understood that as fire and rescue service personnel complete their required tasks of extrication, administration of medical assistance and removal of the injured, the Maryland State Police Officer in Charge may choose to release them unless a HAZMAT situation exists.

This will also hold true for allied police personnel, additional troopers and members of the State Highway Administration as each complete their required functions, returning the roadway to normal as soon as possible. Members of the Maryland State Police shall not unnecessarily cause a delay in the reopening of a roadway in allowing a company to dispatch (an) additional truck(s) for immediate off-loading where this action will result in additional back ups or hazardous circumstances during peak traffic periods.

IV. Liability Issues

Maryland State Highway Administration's policy for the immediate removal of certain vehicles from roadways on an URGENT BASIS, utilizing available resources, recognizes that public safety is of the highest priority. Furthermore SHA realizes that damage to vehicles or cargo contained therein may occur as the result of their clearing the roadway, and SHA assumes liability under these circumstances for said damage, should that become an issue. SHA's liability under these circumstances would be no greater than they might. expect from negligence etc. on the part of snow equipment operations. As outlined in the "Limits of Liability" portion of the MD Tort Claims Act, SHA is only responsible for the first $1,000.00 in damages and the. Maryland State Treasurer's office would cover any additional damages under the State's Self-Insurance Program. SHA would not automatically be liable for damages resulting from clearing the roadway unless there was clear evidence on the Administration's part. that negligence was used in said operation.

In Witness Whereof, each party hereto has caused this agreement to be executed in its name and on its behalf by its duly authorized officer or agent as of this day and year first above written

Bishop L. Robinson, Secretary
Public Safety and Correctional Services

Richard H. Trainor, Secretary
Maryland Department of Transportation

Col. Elmer Tippett, Superintendent
Maryland State Police

Hal Kassoff, Administrator
MD State Highway Administration

SOURCE: The Guardian, January/February 1995
Technical Sergeant Eric C. Adair

CRASH ON NEW YORK'S 1-287 IGNITES FIREBALL

At 12:30 am July 27, an eastbound tractor and cargo tank combination transporting 9200 gallons of liquefied petroleum gas collided with a bridge overpass on interstate 287 in the city of White Plains, New York. Two-thirds of the front head were tom from the MC-331 tank, igniting the LPG into a massive fireball. The tractor separated from the cargo tank and the force of the blast hurled the tank off of the highway up a 40-foot embankment, and over a stand of mature trees. The tank came to rest in a residence approximately one-quarter mile away from the impact site. The initial blast from the ignited LPG destroyed three residences. Four other homes were damaged from the fallout as the tank was propelled in flames by the blast. The driver of the truck was killed instantly and 27 people within a quarter mile of the crash were injured, three critically. Damage to the Grand Street overpass was so extensive that the roadway above the interstate was visibly sagging and had to be reinforced by vertical steel beams to prevent the bridge from collapsing.

New York State Troopers initially responded to the scene, followed by City of White Plains P.D. and Fire Department personnel. Immediately, the Incident Command System was implemented and command post operations began. The establishment of the command post commenced one of the most extensive multi-agency commercial vehicle accident investigations in recent New York State Police history,'. Troopers assigned to the MCSAP/ HAZMAT unit commenced an investigation into the cause of the accident with the assistance of State Police criminal investigators. As the investigation continued, assistance was provided by the Federal Highway Administration Office of Motor Carriers cargo tank TAG members, Research and Special Programs Administration, National Transportation Safety Board, New York State Thruway Authority, and New York State Department of Transportation.

Personnel from these agencies provided in-depth technical assistance during the investigation. Experts in the areas of carrier/driver records, cargo tanks and vehicles provided tremendous support for the field investigators at the crash site.

The resulting investigation demonstrated the effectiveness and efficiency of a concerted multi-agency investigation despite circumstances that placed tremendous stress upon those charged with the task of determining how an accident of such magnitude could occur. The New York State Police MCSAP/HAZMAT unit, U.S. Department of Transportation OMC, RSPA, and the National Transportation Safety Board continue to collaborate and combine their extensive expertise to determine the cause of this tragedy.

QUICK CLEARANCE POLICY: MARYLAND

MEMORANDUM

FILE NO:	03-89-065-10P
TO:	Lt. Charles D. Tyler, F.O.B.
FROM:	Mark H. Bowen, Legal Counsel Unit
SUBJECT:	Accident Vehicle Removal

We have discussed over the telephone the proposal of the State Highway Administration to remove vehicles from the roadway at an accident scene. This memorandum will confirm these discussions.

In January of 1988, the MSP and SHA entered into an agreement concerning SHA removal of vehicles from Snow Emergency Routes. The MSP delegated its authority to tow such vehicles off the roadway, under Transportation Article Section 21 - 1119(e), to the SHA subject to certain limitations.

There is no specific provision under the Transportation Article authorizing the removal of accident vehicles analogous to TR 21 - 111'9(e). Article 88B Section 3 does provide that:

The Department shall have the .general duty to safeguard the lives and safety of all persons within the State, to protect property... Specifically, this duty includes the responsibilities: ... to maintain the safe and orderly flow of traffic on public streets and highways

This provision would authorize the MSP to remove an accident vehicle. Further, this authority should be delegable to the same extent as our authority under TR 21 - 1119(e).

The Agency will of course want to limit any delegation of authority under Article 98B Section 3 in the same manner as the delegation under TR 21-1119(e) was limited. The SHA would not remove a vehicle without first obtaining approval from the MSP personnel investigating the accident. Also, the SHA would assume all responsibility for handling any damage claims resulting from their removal of an accident vehicle.

I have reviewed the draft Maintenance Memorandum. No. 71.01-05.1 dated November 15. 1989, prepared by the SHA. I don't have any concerns or problems with the draft policy.

Of course, the Agency will require a written agreement between the MSP and the SHA before any removal activity can begin.

If you have any further questions or comments, please give me a call.

MHB

April 23, 1990 SUBJECT:

SUBJECT: PROMPTLY REOPENING ROADWAY TO TRAFFIC

Road/Lane Blocked/Closed by Accident or Loads Falling from Trucks.

PURPOSE : Whenever a roadway or travel lane is closed or partially. blocked by an accident and traffic delays or safety problems my occur, the RME or his representative in cooperation with the police officer in charge should reopen the roadway as soon as possible ON AN URGENT BASIS. This policy recognizes that public safety is the highest priority and must be secured, especially if injuries or hazardous materials are involved. 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 should be taken. the highest priority is public safety.

PROCEDURE: Type of Occurrence

GENERAL

The RME or his representative is to assign the necessary. equipment and manpower to reopen the road or lane as soon as possible

If the incident involve any truck (other than a pick-up) or removal of debris (safe spilled cargo), a rubber-tired Front End Loader shall be dispatched to the scene as soon as possible in the event it could be needed to assist a tow truck in righting/relocating the vehicle(s) involved, or assisting in debris removal/relocation.

If commercial help does not arrive within a reasonable period of time, SHA form shall begin the removal of vehicle(s)/spilled safe cargo.

If the commercial help is unable to correct the situation, the SHA shall assist by using the Front End Loader as needed

If materials being transported are spilled, the SHA will make every. effort to relocate the materials in the shortest possible time, using whatever equipment is necessary. All such materials shall be relocated as short a distance as possible, but not be placed so as to present a traffic hazard.

The RME or his representative shall prepare a list of the personnel and equipment used and the work hours involved so that the owner of the vehicle and/or cargo can be billed for the cleanup. The SHA's towing response form shall also be completed for every incident involving the SHA.

Appropriate warning devices (signs, barricades, arrowboards, etc.) are to be placed on the scene should either the damaged vehicle(s) or cargo remain adjacent to a shoulder.

HAZARDOUS/FLAMMABLE/EXPLODING MATERIALS

No attempt is to be made by SHA personnel/equipment to remove any hazardous or flammable explosive material for any reason. If the SHA is first on the scene and the cargo content is not readily identifiable. the RME or his representative will contact the proper authorities to ascertain if special measures should be taken.

As soon as the public safety has been secured, then reopening the roadway is to proceed as described under "GENERAL" in this memorandum.

MEMORANDUM

TO: Hal Kassoff
Administrator

DATE: January 4, 1990

FROM: Edward S. Hams
Assistant Attorney General
Chief Counsel

SUBJECT: Removal of Vehicles from State Highways
By State Highway Administration Personnel
(LEG-49; LEG 51)

I have reviewed this issue and have discussed the matter with the Assistant Attorney General representing the Maryland State Police. Both MSP's counsel and I agree that SHA's liability for injuries or damage resulting from our removal of a vehicle from a State road is no greater and no less than our potential for liability in any other area. For example, if one of our snow removal equipment operators is negligent and causes injury to persons or property, the State is liable under the Maryland Tort Claims Act. Similarly, the Tort Claims Act would apply to the removal of vehicles from a State road.

The limits of liability under the Tort Claims Act are $50.000.00 per person and $100,000.00 per occurrence. SHA is responsible for the first $1.000.00 in damages and the Treasurer's Office would cover any additional damages under our self-insurance program.

Please keep in wand that just because a vehicle is damaged as a result of being removed from a State road. it does not mean that the State is responsible for that damage. The State will only be responsible if we acted negligently (i.e. we did not act reasonably under the circumstances). Under certain circumstances, I would envision that it would be reasonable to damage on a vehicle if the only other alternative is to permit an unsafe highway condition to remain uncorrected.

Please let me know if I can provide you with any other information.

QUICK CLEARANCE POLICY : TEXAS

AN ACT

relating to the removal of obstructions from roadways and road rights-of-way.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF TEXAS:

SECTION 1. Chapter 1, Title 116, Revised Statutes, is amended by adding Article 6673g to read as follows:

Art. 6673g. REMOVAL OF OBSTRUCTIONS. (a) The State Department of Highways and Public Transportation may, without the consent of the owner or carrier of spilled cargo or other personal property on the right-of-way or any portion of roadway of the state highway system. remove the, cargo or property from the right-of-way or portion of roadway of the state highway system in circumstances in which. as determined by the department. the cargo or property is blocking the roadway or may otherwise be endangering public safety

(b) The department may, pursuant to Section I a) of this article, remove cargo or personal property that the department has reason to believe is a hazardous material. as defined by the Hazardous Materials Transportation Act (49 U.S.C. Sec. 1801 or a hazardous substance. as defined by the Texas Hazardous Substances Spill Prevention and Control Act (Subchapter G. Chapter Water Code); provided that in doing so, the department must comply with applicable provisions of Section 411.018. Government Code. and the Texas Hazardous Substances Spill Prevention and Control Act.

(c) The department and its officers and employees are not liable for any damages or claims of damages to removed cargo or personal property that resulted from removal or disposal by the department unless the removal or disposal was carried out recklessly or in a grossly negligent manner.

(d) The department and its officers and employees are not liable for any damages or claims of damages that may result from the failure to exercise any authority granted under this article.

(e) The owner and, if any, the carrier of cargo or personal property removed under the authority of this article shall reimburse the department /'or the costs of the removal and subsequent disposition.

SECTION 2. The importance of this legislation and the crowded condition or' the calendars in both houses create an emergency and an imperative public necessity that the constitutional rule requiring bills to be read on three several days in each house be suspended. and this rule is hereby suspended. and that this Act take effect and be in force from and after its passage, and it is so enacted.

Module 9
Traffic Operations Centers

The goal of Module 9 is to describe the role of traffic operations centers in the incident management process and to provide the opportunity to examine local TOCs or opportunities for developing a TOC.

MODULE 9

TRAFFIC OPERATION CENTERS

DEFINITION

A communications and traffic control clearinghouse that seeks, receives, processes, and transmits incoming information.

OBJECTIVES

- Enhance mobility
- Maximize existing infrastructure
- Manage congestion, reduce delay
- Improve safety
- Improve freight industry efficiency
- Facilitate coordination

BENEFITS

- 15% reduction in injury incidents
- 20% reduction in response times
- 80% motorist information compliance

  \- San Antonio, TX

ROLE OF TOC

DETECTION/VERIFICATION

- Receives incident reports
  - in-person from motorists and field personnel
  - automatically from loops, AVI, etc.
- Verifies using CCTV

ROLE OF TOC

MOTORIST INFORMATION

- Promotes information dissemination
- Serves as liaison with media
- Updates traffic information sources
- Relays information to paging devices
- Controls VMS and HAR

ROLE OF TOC

RESPONSE

- Dispatches resources using CAD
- Maintains communications with responders

ROLE OF TOC

SITE MANAGEMENT

- Provides responders with information for decision making
- Assists in obtaining additional resources and coordinating communications among various responders

ROLE OF TOC

CLEARANCE

- Activates freeway control systems:
  - traffic signals
  - ramp metering
  - lane controls
  - variable speed limits

ROLE OF TOC

DATA COLLECTION

- To improve predictability of incidents and resource allocation
- To demonstrate benefits provided by incident management programs

THE FUTURE OF TOCs

- CAD and 911 expansion
- Decision support systems
- Expanded coverage
- Video imaging
- Public/private partnerships
- Use of government rights-of-way for optic cable installation and use

NATIONAL EXAMPLES

1996 Summer Olympics Showcase
Atlanta, Georgia

Integrated ITS system:

- CCTV
- VMS
- automatic radio transmitters
- informational kiosks

NATIONAL EXAMPLES

Fairfax County
Virginia

- Used existing resources
- Joint police/transportation operations
- Integrated with VDOT's 24-hour communications center

NATIONAL EXAMPLES

TransGuide
San Antonio, Texas

- Interdisciplinary cooperation
- Automated incident detection
- Direct dispatch
- Creative funding solutions

NATIONAL EXAMPLES

Traffic Systems Management Center
Seattle, Washington

- Operated by a single agency, WSDOT
- VMS, HAR, CCTV, ramp meters

NATIONAL EXAMPLES

TRANSCOM
New York-New Jersey-Connecticut

- Coordinate activities of 100+ agencies, companies, jurisdictions
- Extensive notification network
- Provide "seamless" travel to motorists

NATIONAL EXAMPLES

Westchester County
New York

- Operated by Metro Traffic Control, a private, nationwide, traffic reporting company

Table of Contents

Module 9
Traffic Operations Centers

Definition

Traffic Operations Centers (TOCs), known in some areas as Traffic Management Centers (TMCs) or Traffic Control Centers (TCCs), fulfill a growing role in incident management. This is particularly true in large metropolitan areas, where the sheer scope of freeway systems, as well as the jurisdictional and agency fragmentation described in Module 3, complicate coordination of incident management. TOCs can integrate multiple advanced technologies, as well as jurisdictions, agencies and companies, under a single roof. Staffed by a single party or as a joint effort of multiple parties, TOCs can coordinate the management of multiple incidents simultaneously.

Above all, TOCs serve as a focal point and information clearinghouse for a wide range of traffic information, which is received both through traditional means--such as police and fire radio and land-line and cellular phone calls--and through advanced technologies. In addition to receiving and transmitting information to and from the incident scene, TOCs act on that information in support of incident management efforts, as we shall see later in this module.

Although TOCs may take time to create, and may require significant organizational commitment and funding, once established, they are effective in sustaining and expanding support for incident management programs over the long term.

The technologies employed by TOCs vary, depending on local resources and needs, but usually include the following:

- computer aided dispatch (CAD)
- roadway sensors (e.g., inductive loops)
- video surveillance (e.g., closed-circuit television)

- ramp metering
- lane controls in the form of signals, signs, and/or gates
- broadcast ability via highway advisory radio (HAR)
- control over variable message signs (including variable speed limits)
- video imaging

Objectives/Benefits

Nationwide, the particular functions and missions of TOCs may also vary; nonetheless, they usually share some common objectives, including the following:

- enhancing local and regional mobility through advanced communications and control technologies

- maximizing the capacity of the existing transportation infrastructure without having to build costly new freeway lane miles

- proactively managing congestion

- improving traveler safety and travel times

- reducing operations costs for commercial vehicles

- enhancing coordination between multimodal transit operations and users

Quantified benefits from a before and after study of the TransGuide TOC in San Antonio, Texas, reports the following:

- 15 percent reduction in injury-related incidents

- 20 percent reduction in average response times

- 80 percent compliance, over a previous 33 percent compliance rate, with motorist information (Inside ITS, 1997).

How Do TOCs Aid In Incident Management?

Because TOCs function as communication and control stations that seek, receive, process, and act upon information related to traffic operations, they have a role in each of the stages of incident management referenced in these training materials.

Detection and Verification

Detection. TOCs serve as a focal point for incoming information regarding incidents, including details about their exact location, nature, and type. TOCs may receive notification that an incident has occurred from various sources, including the following:

In-person reports such as

- land-line and cellular calls from passing motorists
- radio communications from field personnel, such as state patrol officers, transportation department maintenance crews, and radio station traffic helicopters

Automated data and video sources such as

- electronic loops
- automatic vehicle identification (AVI)
- microwave radar detectors
- close circuit television (CCTV)

Some TOCs, including San Antonio, Texas' TransGuide (1990 population 935,933), detect incidents automatically, on the basis of algorithms applied to electronic loop sensor readings. Specialized software analyzes the incoming loop data, which provides readings on speed, volume, and occupancy. The software compares values supplied by the loops to average data thresholds by location and time of day. When a threshold is exceeded, in either direction, the system automatically generates an alarm on the TOC operator's work station and changes the color of the roadway in the map display, thus alerting the operator to the possibility that an incident has occurred at this location.

TRANSCOM, a TOC in the New York City metropolitan area (1990 population 7,322,564), uses vehicles equipped with AVI transponders (primarily intended for electronic toll collection) as probes to monitor traffic speeds. Transponder readers are installed along roadways at about 1.5-mile intervals to collect transponder ID readings. The system scrambles the IDs for privacy and attaches to each ID the time and date that it was read. As transponders are detected by successive readers, TRANSCOM compiles data on speeds, travel times, and the number of vehicles that are expected but have not yet been detected by the next reader downstream. By comparing this information with historical data, TRANSCOM can detect incidents.

In Hanover, Maryland, a Baltimore suburb near the geographical center of the state, the TOC is the hub for the Chesapeake Highway Advisories Routing Traffic (CHART) system. CHART, a statewide program, also has satellite offices located at Maryland State Police facilities in College Park (Washington DC suburbs) and Golden Ring (Baltimore suburb). Approximately 96 bi-directional, overhead, radar-based traffic detector signs monitor average speeds across a given section of highway and notify TOC operators when the average speed falls below a preset threshold. The detectors thus enhance the operator's ability to quickly detect incidents.

Many TOCs now have closed circuit television (CCTV), which allows them to view video images of what is happening at any given point along the roadway. TOCs are typically equipped with remote controls, which allow operators to verify the nature and severity of the incident by panning, tilting, and zooming the cameras. Typically, cameras are placed on 50-foot poles at 1- to 3-mile intervals. Video output from the cameras is transmitted to the TOC, where it is viewed on video monitors and used for incident verification.

<u>Motorist Information</u>

As a single focal point for the media, the TOC promotes dissemination of consistent and accurate information to motorists: both to those already on the road, and to those who have not yet left their home, work or other points of origin. As ever, the objective of motorist information is to give people information they can act upon to reduce their travel times and, at the same time, to not exacerbate congestion at the incident scene.

TOCs may play the lead in disseminating motorist information through all the media outlets discussed in Module 5. Specifically, TOCs may

- serve as liaison with AM and FM radio stations
- control variable message signs and highway advisory radio
- disseminate information to paging devices
- provide information for updating Internet pages and special telephone lines
- update traffic information provided through automated kiosks at shopping centers, office complexes, and transit centers.

<u>Response</u>

Among TOCs' most useful functions is that they are equipped to serve as an information clearinghouse, a central point at which information about the incident can be gathered and acted upon in coordinated fashion. Operators in TOCs may dispatch or assist in dispatching the correct personnel and equipment to the scene.

Many areas, including San Diego, California (1990 population 1,110,549) and San Antonio, Texas (1990 population 935,933), are learning the value of coordinating communications by maintaining close links or even sharing space with other incident management agencies. The San Diego TMC, for example, has taken an important step in coordinating CalTrans dispatch functions by locating the dispatch centers for Traffic Systems Dispatch, Maintenance Dispatch, and Construction Dispatch, which formerly had been located in separate facilities, into one central TOC. Likewise, San Antonio's TransGuide brings together dispatchers from the State Patrol, the Texas Department of Transportation, and the metropolitan transit agency under a single roof.

Most TOCs are equipped with Computer Aided Dispatch (CAD), which provides the dispatcher with many sources of information in addition to the voice messaging provided by telephone and radio. For instance, CAD may feature auto-dialing as part of an emergency notification system. When a major incident occurs, a single command calls a selected group, plays a recorded message, then asks the intended recipient to acknowledge receipt by pressing a digit on the phone pad. CAD automatically tracks which agencies or companies have been called, who has acknowledged the message, and prints a list of the results. For a given type of incident at a given location, the dispatcher might simply activate one of a predetermined set of phone lists.

CAD software may also include specialized geographical resources, geofiles, capable of supporting several maps upon which can be depicted the location of all incidents, color-coded to indicate urgency, and shape-coded to indicate incident type. CAD systems can even be configured to allow traffic reporters access to selected types of incidents, so that the media can get the information they need without distracting dispatchers with routine "beat check" calls. This practice is followed in Los Angeles, California (1990 population 3,485,398).

A significant issue for dispatchers, regardless of the sophistication of their CAD systems, is that they are being bombarded with information, which arrives via multiple systems, in the form of multiple computer displays, alarm panels, keyboards, console buttons, and lights. Efforts are underway to better integrate diverse sources of information and control so that dispatchers can make more efficient use of existing information.

Site Management

The TOC supports on-scene incident management by providing information responders need to make informed decisions to handle the incident. For example, because the TOC dispatcher can see the upstream queue, as well as secondary incidents, on CCTV, crucial information can relayed to traffic control personnel in the field, who must determine how best to reroute traffic or engineer a closure. TOCs also assist the incident commander in obtaining additional resources and in coordinating communications among responders. San Antonio's system reports the current status of all field equipment in the incident area and allows the progress and success of the response to be monitored.

Clearance

TOCs aid in incident clearance by activating freeway control systems, which may include the following elements:

- traffic signals
- ramp metering
- lane controls
- variable speed limits

Freeway and arterial traffic conditions are related. For example, a serious freeway incident may prompt motorists to avoid the freeway and instead take an arterial route, which may cause congestion on the arterial. Another example of the interrelation of freeways and arterials involves ramp metering. Metering traffic entering the freeway may create backups on adjacent arterials. Acknowledging this interrelationship, some urban areas are now looking investigating ways to integrate freeway and arterial systems as part of a single traffic control network, rather than viewing them as separate operations.

Ramp metering is an effective means of preventing freeway traffic congestion by restricting the flow of vehicles onto the freeway. Metering ramps may be desirable when an incident has occurred to prevent a rapid buildup of traffic congestion upstream of the incident. After an incident has occurred, metering rates may be desirable to prevent congestion from growing too rapidly upstream of the incident. Metering rates may be controlled from the TOC by either manual or automated methods.

Some freeway systems control lane usage by time of day to reserve lanes for high occupancy vehicles (HOVs) or to reverse the direction of flow. If an incident occurs, lane controls may be used upstream of the incident to indicate that motorists should stop using the lane or lanes from which the incident is being cleared. Traffic control is provided through signals, signs, or devices such as gates.

To prevent secondary incidents, it may be desirable to lower speed limits upstream of an incident in order to slow motorists before they reach the scene. Adverse weather may be another reason to change speed limits, either to better cope with an existing incident or to prevent one from occurring. Variable speed limits can be indicated on signs that can be controlled from the TOC.

<u>Data Collection</u>

Another function of TOCs is data collection, which is important for several reasons:

- to indicate patterns about the locations, types, and severity of incidents, which may have implications for incident management operations, as well as indicate locations in need of structural improvement

- to demonstrate to decision makers the valuable services provided by incident management programs, as well as areas that need additional funding for yet operations

TOCs can develop automated means of logging and monitoring many aspects of incident management. When the resulting data are organized into databases, the information can easily be assembled, sorted, and analyzed as needed.

What is the Future of TOCs?

<u>Intelligent Computer Aided Dispatch (CAD)</u>

Intelligent CAD will assist dispatchers in tracking the status of response vehicles and in assigning units to respond to an incident based on the urgency of the incident and response vehicles' proximity. CAD will be able to make such decisions based on software advances and on the integration of automatic vehicle location technology with CAD. CAD will be able to base its decision as to which field unit to assign by comparing each field unit's position with the location of the incident, and calculating the shortest route to the scene, even taking into account factors such as traffic congestion, one-way streets, and speed limits.

Automated links to local, state, and federal crime databases will provide police personnel with hand-held computers that allows them to transmit and receive information from these sources directly.

Expansion of 9-1-1 Availability.

The use of a single, three-digit emergency phone number which immediately connects the caller with the appropriate dispatch facility, regardless of the caller's location, or the nature of the emergency, has only been in existence in the U.S. since 1967. The rationale behind the use of 9-1-1 is to eliminate the caller's need to figure out which of many possible numbers to call, depending on jurisdiction and the type of aid required. There are two basic forms of 9-1-1 service:

- basic service, which connects the caller with a dispatcher, and allows callers to make free 9-1-1 phone calls from any pay phone.

- enhanced service, which also displays the caller's address on the dispatcher's screen. This feature has saved many lives, in cases in which callers don't know, can't remember, or lose consciousness before being able to report their address to the dispatcher.

While 95 percent of U.S. cities with a population of over 100,000 have some types of 9-1-1 system, smaller cities and rural areas do not have access to this time-saving service. In cities under 100,000 population, only 60 percent are reached by some form of 9-1-1, and in towns of under 10,000, it is available to only 45 percent of citizens.

Also, automated location of cell 911 is mandated by Federal law and is supposed to occur in the near future. Put simply, the nation's public safety associations are working to get 9-1-1 service to every town, city and county in the U.S. They are also working to improve its reliability and to add new features to speed emergency response.

Development Of Expert Systems Or Decision Support Systems

TOCs around the country are working to find ways to automate aspects of incident management. Engineers have already begun to generate sequences of discrete dispatch actions, based on vast libraries of past incident experience, to be activated once an incident of a given type is verified. The need for such technology results in part from the fact that Americans are logging more vehicle miles of travel every year, while funding and environmental constraints keep government from building new roadways to meet demand. To prevent and cope with the increasing risk of incidents posed by growing roadway use, transportation engineers must find ways to deal more quickly and more efficiently with incidents. Automating aspects of incident management within TOCs constitutes one such strategy.

In fact, research is underway to predict congestion based on sampling and historic traffic patterns. This form of traffic control aims at preventing incidents and congestion in the first place. It will be used in conjunction with ramp metering, variable speed limits, lane controls, etc. to maximize existing infrastructure capacity.

More Lane Miles Will Be Added To TOCs' Coverage Areas

In many metropolitan areas, expensive hardware for monitoring and controlling traffic, such as CCTV and variable message signs, is basically limited to the urban core. However, as jobs and residential areas continue to sprawl to the suburbs and beyond, TOCs will have to expand their geographic coverage to serve public needs.

Video Imaging Vs. Electronic Loops For Incident And Routine Traffic Detection

As video imaging evolves, the associated hardware and software will improve, and prices will drop, which will encourage TOCs to move to this technology as a better alternative to electronic loop detection, an older technology that is subject to mechanical breakdowns and requires the roadway surface to be cut for implementation.

Privatization of TOCs?

The coming years may see innovative means of funding and operating TOCs, including public/private partnerships in which a government agency, or consortium of government agencies contracts with a private firm to run the TOC. This would not involve selling TOCs off to the private sector, but simply contracting out the function of operating and maintaining them. The public sector would still maintain ownership and control. Advocates of such public/private partnerships feel that such a relationship has significant advantages in terms of both cost and quality of operations.

First, some feel that the elements of market competition are conducive to efficiency; that is, the existence of several firms vying for the contract to operate a TOC would improve the quality of service offered, as well as providing that service at the lowest price.

Second, these advocates point out that the public sector is often constrained by bureaucratic "red tape" in administrative areas such as personnel management and procurement.

For instance, private firms are not bound by civil service personnel regulations, which gives the private sector more latitude in hiring, training, and promoting highly competent personnel, while being able to weed out unproductive workers. Since TOCs are technical environments, it is critical that employees' skills be updated in order to make the best use of the existing technology. Government funding for training has become difficult to secure in this era of resistance to public expenditure. Finally, procurement is also less complex for private sectors firms, which may, as a result, be able to purchase materials and equipment more easily, at better rates.

Exchange Of Government Rights-Of-Way For Optic Cable Installation And Use

Another possible area of public/private partnership with regard to TOCs is in the area of telecommunications technology. Emerging communications technologies related to incident management are expected to become much more demanding of data and video transmission, which consume a great deal of standard telephone line capacity. Fiber-optic lines give transportation centers the highest capacity for the transmission of dense data and video images It is also most reliable, least susceptible to congestion, and highest in transmission quality. However, it is expensive for departments of transportation to install fiber optic cable, and it is also expensive for telecommunications companies to purchase the rights-of-way in which to install the cable for their own purposes.

Both parties could benefit if transportation agencies were to allow telecommunications companies to install fiber optic cable along freeway rights-of-way in exchange for some form of fiber optic service, or alternatively for monetary compensation. Many issues remain to be resolved in forging such relationships (e.g., which telecommunications company should it be, how should this be decided, etc.), but this may be an area in which cooperation could be mutually beneficial.

National Examples

In addition to the national examples of TOCs offered in this section, at the end of the module the reader will find summaries of services offered by TOCs nationwide, prepared by the National Incident Management Coalition. These summaries give the reader a good idea of the range of functions being performed in TOCs nationwide, as well as which metropolitan areas already have TOCs, which areas are planning them, and in which areas they do not yet exist.

Atlanta, Georgia

The federal government and the State of Georgia took advantage of Atlanta's (1990 population 394,017) high profile as the host of the 1996 Summer Olympic Games by providing the state with the funding impetus it needed to build the largest integrated ITS program in the country. In fact, Atlanta's TOC served as a Showcase, meaning that it presented its ITS programs and its TOC to the public extensively throughout a four month period in the summer of 1996. Atlanta's core TOC is linked by fiber optic cable to seven TOCs located in the five metropolitan area counties, the City of Atlanta and the Metro Area Rapid Transit Authority. All of these center have similar capabilities and access to each other's surveillance cameras and other information.

While the Showcase period was intended as a means of demonstrating to the public and the press the feasibility of ITS functions such as automated incident detection and traffic control, as well as their value in maximizing existing system capacity, the FHWA has asked the Showcase partners to continue operations, and in effect, to create a lasting legacy.

The integrated ITS system demonstrated during the summer of 1996 covered over 60 miles of freeway and included over 300 cameras, more than 100 miles of fiber optic cabling, variable message signs, automatic radio transmitters, and information kiosks.

One reason that the system is distinctive lies in its ultimate reliance on a fiber optic backbone that runs along the sides of the freeways and sends video images back along the backbone to hub buildings and then to the TOC. In places, the video image often crosses the freeway to reach the backbone via real time radio receivers.

Fiber optic technology makes it possible to transfer data and video from the many cameras to the hubs and the central TOC with high quality and efficiency. The hubs are small buildings that house four to ten video image processors and all the necessary communications hardware. Atlanta's video wide area video detection system relies on surveillance cameras at regular, closely spaced intervals along each side of the freeway. These cameras, along with their processing hardware and software, provide information on average speeds, volumes, occupancy and stopped vehicles. Every 20 seconds, a communications server polls each of the 57 Autoscope machine vision processors for data from nearly 5,000 detectors and relays this information to the TOC.

Fairfax County, Virginia

The Fairfax County, Virginia TOC, located in a suburban area of Washington, D.C. is distinctive in that it was able to establish a TOC by using existing resources, in the form of personnel and equipment. In fact, this single, local jurisdiction used a training room in the joint police/fire 9-1-1 center along with existing personnel and spare equipment to more closely monitor County Police, who responded to incidents, primarily on arterial streets (i.e., non-freeway incidents). Established in 1988, the TOC is now jointly operated by Fairfax County Police, Virginia State Police, and the Virginia DOT, and is integrated with VDOT's 24-hour communications center and TOC.

San Antonio, Texas

San Antonio, Texas (1990 population 935,933) is the ninth biggest city in the US, with an average of 100 vehicle accidents per day. TransGuide (short for Transportation Guidance System), representing a cooperative effort among the Texas Department of Transportation, the San Antonio Police, and the metropolitan transit authority, comprises a network of road sensors, high-tech signs, cameras and TOC operators. TransGuide's mission is to improve traffic flow, decrease delays and accidents, and provide immediate response to highway incidents.

One interesting aspect of TransGuide operations is the extent to which this TOC is using forms of artificial intelligence to respond to highway incidents. Incident detection is automated. Traffic stops and slowdowns are detected by loops, which automatically relay an alarm via fiber optic cable to the TransGuide TOC. There, an operator can pinpoint the problem with special map displays and investigate by turning on one of the high-resolution cameras installed at every mile. These powerful cameras are capable of zooming in on incidents closely enough to determine whether injuries are present. TransGuide provides automated incident detection within two minutes, and traffic control changes within 15 seconds of verification.

As soon as a TransGuide operator has verified the incident type, San Antonio Police Department personnel, who are on hand in the same control room, send out the type of emergency assistance needed (e.g., courtesy patrol, tow truck, police, fire, or paramedics). Dispatching assistance immediately, from the TOC, rather than even waiting until an officer is on the scene, saves valuable time.

While help is being dispatched, the TransGuide computer searches thousands of traffic scenarios in its database to find the one that most closely fits the situation and location. Based on this approximation, the computer gives the operator suggestions on how best to use the high-tech motorist information tools available for rerouting traffic--again, directly from the TOC, without having to have an officer on-scene to relay this information. Based on the computer's suggestions, the TOC operator may reprogram freeway message signs to tell approaching drivers there's an obstacle or slowdown ahead; change lane signals to keep traffic from backing up; and adjust traffic light signal timing along access roads. Thus, even if freeway traffic has to detour onto those roads, TransGuide can increase green light time to keep things moving. Once the emergency has been cleared, all lights, signals and signs automatically return to normal settings.

Note the name "TransGuide," which is intended to avoid identifying this TOC with any particular agency. Although the Texas Department of Transportation took the lead in initiating getting TransGuide built and running, this TOC is notable in that it is a cooperative venture with police and the San Antonio metropolitan transit authority, VIA. The name TransGuide is new, as is the TOC itself, thus reflecting the cooperative nature of the effort. At TransGuide, transportation and police personnel work side-by-side, which facilitates communications, and in turn, more effective incident response. The interdisciplinary and interjurisdictional cooperation underlying this TOC goes back decades; transportation, police, fire, metropolitan planning organization, and transit representatives have long met informally to discuss issues of mutual concern. According to a TransGuide spokesman, the mutual understanding that has evolved over these meetings was a major factor in carrying off this cooperative effort.

Creative funding solutions have been developed at TransGuide. For instance, while the Texas Department of Transportation worked closely with the federal government to secure major funding to build this state-of-the art building, police contribute not by paying rent, but by paying for security and janitorial services.

Seattle, Washington

In Seattle, Washington (1990 population 516,259), a fast-growing metropolitan area, demand for transportation facilities and services far outstrips supply: population and employment are both projected to increase about 50% by the year 2020. Adding to the pinch, economic, geographic, and environmental factors have restricted construction of new roads for over 20 years, making Seattle one of the nation's 10 most congested metropolitan areas.

Seattle's Traffic Systems Management Center (TSMC) is unique in that it is operated by a single public agency - the Washington State Department of Transportation. Key components of the TSMC include the following:

- radio and dispatch unit
- variable message signs
- highway advisory radio
- ramp meters
- closed circuit television cameras

- electronic loop detectors.

Hundreds of miles of fiber-optic cable and radio transmitters allow the various technologies to transmit and receive information.

New York/New Jersey/Connecticut Metropolitan Area

Established in 1986, TRANSCOM is a coalition of 14 transportation and public safety agencies in the New York-New Jersey-Connecticut metropolitan region. Together they provide a cooperative, coordinated approach to regional transportation management. Funded by member agencies and the FHWA, TRANSCOM is governed by the chief executives of its member agencies.

TRANSCOM is notable for the extent to which it has managed to coordinate the activities of over one hundred agencies, companies and jurisdictions in a large, diverse, and extremely populous metropolitan area. Its leaders share a common understanding that the traveling public is not interested in jurisdictional boundaries. Rather, the traveler simply wants a smooth, seamless trip, regardless of the number of agencies or jurisdictions involved.

TRANSCOM's TOC collects and disseminates real-time regional incident and construction information, 24 hours a day through an extensive notification network, which links TRANSCOM to over 100 member and affiliated agencies through an alphanumeric pager system, phone, and FAX. Each notification is distributed selectively to affected agencies and companies in the three-state area. Recipients include highway and transit agencies; state, county and local police departments; and media services.

Westchester County, New York

The Westchester County, NY (located in a northern suburb of NYC) TOC is distinctive in that it is operated not by the state or by some consortium of public agencies, but by a private firm on contract, in this case Metro Traffic Control, a nationwide traffic reporting company.

Module 10
Where Do We Go From Here?

The goal of Module 10 is to encourage the identification of specific action items that will initiate improvements to existing local incident management efforts.

Table of Contents

Module 10
Where Do We Go From Here?

In this module, you are given the opportunity to apply what you have learned over the past day or two days. Through the exercise performed in conjunction with this module you should be able to identify some areas for improvement and specify several initial "action items" that can make incident management efforts more efficient and effective. Included below is an inspirational description of how to get to where you want to be. Following this, in the Further Reading section of this module, are several description of early "action items" from other areas in the country to give you a sense of what can be accomplished.

"Ten Steps To Achievement Of Excellence" by Clark Staten

During each of our lives, we set within ourselves, patterns that help to determine the success or failure of our efforts. Psychologists tell us that we either consciously or subconsciously write "scripts" for our minds to follow. The content of these "thought processes" is believed to be self- determined and controllable.

Of course, outside influences or stimuli can have some measure of influence on the make-up of these thoughts and beliefs; ultimately the "scripts" themselves are composed of our preconceived and conditioned responses to our environment. Therefore, the individual reply to a negative experience or situation is controlled by each individual's personal ability to run the "right script" or "internal program" to allow that person to effectively cope with or manage the negative influence or circumstance. Conversely, positive influences and stimuli need to be translated into additional "input programming" to foster a sense of well being and confidence that will enable additional and greater achievement.

While this may seem a rather clinical and analytical approach to behavior understanding and modification, it is presented for the purpose of explaining that we CAN control our own destinies and the way that we respond to everyday conflicts and challenges. Additionally, it is the basis for setting productive patterns of achievement that will eventually result in excellence. In other words..... WE ARE WHAT WE THINK AND HOW WE PLAN!!

I. Decision Making and a Focus

The first step to planning a successful life and career is to analyze and decide what is really important to the individual who is making the plan. For some, this will involve making a great deal of money; for others it will entail the creation of a great work of art. The primary step must encompass the basic wants and needs of the person making the decisions, rather than the perceptions and wants of others. Far to many people have become failures because they aspired to fulfill the desires of others. Determining one's own fulfillment is the key to the future planning of one's life focus.

II. Goal Setting; the Path to our Focus

In order to understand or perceive any real progress or personal sense of achievement, an individual must ascertain certain goals. These goals must be determined by the individual concerned, as being significantly important to his/her overall best interest and part of a larger plan for accomplishment of their life's focus.

These goals may be large or small, seemingly significant to others or not; they must, however, exist with clarity in the mind of the person doing the planning. The goals should be written down and reviewed for thoroughness. Accomplishment deadlines should be set and honored. Establishment of a criteria list of acceptable outcomes should be undertaken. Otherwise, it becomes practically impossible to measure success or failure and thus provide positive or negative feedback to our personal sense of fulfillment.

III. Commitment is the Key

The key to completion of goals and subsequently to achievement of our life's focus is Commitment. Without it, little has ever been accomplished in the history of man. Success often starts with the mere existence of the Commitment to change and improve. By committing ourselves to accomplish the goals that we have determined, we take that first step to the achievement of excellence. Commitment is what transforms promises and hopes into reality. It is an internal adherence to personal integrity and accomplishment. Therefore, Commitment to our focus and completion of goals is paramount to excellence..

IV. Knowledge is Necessary

Achievement is based in knowledge.... of oneself, of the topic that we have chosen as our focus, of peripheral subjects that will help us to our goals. Learning is not always a formal process. Often, it is an aggregation of experiences that prepare us for further progress. While formal education is necessary and can provide us with the basic building blocks of knowledge, it is frequently not the prime contributing factor to excellence. The application of knowledge is far more important than the accumulation of it. However, the failure to be educationally prepared for any field of endeavor is a critical flaw in the overall plan for achievement. You must have the knowledge to recognize a true opportunity when it presents itself.

V. Failures will occur

Failure is inevitable for those that try to accomplish any given difficult task. It often is a method of learning about the things that don't or won't work. Thomas Edison was said to have failed hundreds of times during his invention of the light bulb. He, however, looked upon each failure as one more possible alternative on the path to ultimate success. This persistence of purpose is a hallmark of those that are extremely successful. Failures will occur in any circumstance; the winner is he/she who learns from these experiences and then renews his or her Commitment to excellence.

VI. The Cyclical Planning Process

Following failure or the achievement of a goal, the prudent achiever will stop to assess the results of that effort. This assessment should serve to facilitate the foundation for the a new round of goal-setting and modification of our focus..

Constant measurement of our success or failures affords us the opportunity to modify or delete goals that do not serve our ultimate purpose.

A frequently encountered problem is that upon completion of a goal, people tend to rest "on their laurels" or participate in destructive behavior that is contradictory to the achievement of it. For instance, the person that has lost weight, "rewards" him\herself with a large meal and enters back into the behavior that created the problem in the first place. A far more productive or meaningful approach, would involve rewarding oneself by buying some new clothes that would further enhance one's appearance and reinforce the loss of additional weight.

It is recommended that each accomplishment be used as a springboard or stepping stone to further achievement. Cyclical analysis can then become part of a larger planning process in an endless progression of successes.

VII. Progression of Achievement

Excellence is best achieved in small steps that encompass a greater whole. A productive and reinforcing method of goal- setting involves the breaking of any large task (or our overall focus) into manageable segments, with the easiest parts to be accomplished first. By actually achieving success after success, we begin to establish a repetitive pattern of achievement that leads to even greater accomplishment. Success, like failure, tends to be a trend. Continued successes encourage continued successes. Enough successes eventually comprise ultimate excellence.

VIII. Resource Utilization

One of the important steps on the road to excellence is the appropriate use of resources. Some of these resources are not tangible in nature. Maximum utilization of God-given gifts, friendships, relationships, and information is often necessary to extract the greatest possible good from any circumstance. Caution is urged, however, in the exploitation of others. The greatest secret of using the knowledge and ability of others is to insure that they ALWAYS benefit from the experience. To do otherwise will undoubtedly, eventually, result in the loss of the friendship, relationship, or information resource.

Other resources are material and obtained in finite quantities. In today's society, the use of technological and financial assets probably ranks among the highest priorities of entrepreneurs and those that strive for excellence. For some, the accumulation of wealth appears to be a "Yardstick" by which they can measure their degree of success or failure. Undoubtedly, the effective use of all available assets will, in large part, determine the ultimate success or failure of any worldly enterprise. The use of lesser technologies (when better ones are economically available) has frequently been the failing of various businesses. A failure to appropriately manage and allocate funding resources has been the cause of ruin for many otherwise worthy individuals.

In one's personal life it is a necessity, of course, to manage one's money in a responsible way. However, it should be noted that the accumulation of money is probably not a very good determining factor in gauging relative success. Financially "poor" people can be successful, if they have accomplished the goals that they have established and are attaining the substance of "their focus", whatever that might be. Achievement of one's stated personal objectives might be a better measurement of success than money. Amazingly, people that accomplish what they have thoughtfully planned to do, often find themselves to be financially secure.

Millionaires have gained financial wealth, but may not consider themselves successful until they become billionaires. A painter, on the other hand, may have little financial wealth during the creation of his work, but gains a great deal in the process of creation and may eventually profit financially from it. In other words, the pursuit and attainment of a goal, quickly, may become more valuable than the resulting accumulation of material resources. Happiness in one's endeavor and satisfaction with the outcome of that effort would appear to be a prime directive in this strategy for excellence.

IX. Persistence is the Answer

Regardless of any other principal that is presented here for your consideration, the practice of persistence will prevail when other strategies have failed. Once committed to a focus and goals; a continual, grinding, grudging, sweating, and diligent effort is necessary to accomplish the end outcome objective....excellence. Little has ever been gained by half-hearted or sporadic attempts at anything. Persistence is difficult, and it's easy to become discouraged and quit. Those that have prevailed in almost every field of endeavor, however, have shown a common trait...that of persistence.

X. The Courage for Attainment

One of the often forgotten facets in the pursuit of excellence is that of personal courage. Courage is a prerequisite to the effort of accomplishing the other suggestions in this strategy for success. It is the courage of self-conviction and self-denial. It is a courage of personal integrity and ethical behavior while in the pursuit of attainment. It is the capacity to forge ahead when you are afraid of the inevitable failure. It is the endowment of the human spirit to feats of mental and physical effort that are thought inhuman. It is the genius unleashed on a seemingly insurmountable problem. Courage is what will allow you to face the fear of fear itself and achieve greatly in the process. YOU must have the courage to succeed and in continued success, you will have accomplished excellence.

Excellence

To paraphrase a very smart man; excellence is ultimately.... persevering when others think the task is too difficult, risking more than others think is healthy, caring more than many think is prudent, and expecting more than others think is possible.

Further Reading

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MOBILIZING FOR INCIDENT MANAGEMENT IN THE DENVER REGION

On November 4, 1991, the Colorado Incident Management Coalition held its first meeting. This coalition, representing various interests throughout the Denver region who have a stake in incident response and incident management, was called together to foster the development of an incident management program in the Denver region. The coalition met monthly over the course of a year and developed a set of recommendations which are currently being implemented. This paper describes the formation of the management coalition, its operation, its recommendations, and future challenges.

Getting Started

Incident management has occurred, in one form or another, since the time that people began to be conveyed in vehicles. Until recently, the management of incidents was primarily the concern of emergency response agencies, who have performed that function very proficiently, albeit without a great deal of concern as to the impact of the incidents and the associated response activities on traffic movement. Recognizing that it is becoming more difficult, if not impossible, to provide necessary roadway capacity to meet traffic demands in major urban areas, the U.S. Federal Highway Administration (FHWA) has encouraged transportation planners and engineers to emphasize transportation system management techniques to improve the operating efficiency of urban freeways and other major urban roadways. Increased attention to removing capacity reductions resulting from non-recurring incidents is one way of preserving the built-in capacity of the roadway system.

In 1991, the National Incident Management Coalition was formed to encourage greater attention to incident management programs in the United States.

This coalition represents a broad spectrum of transportation interests, including the American Association of State Highway and Transportation Officials, the American Automobile Association, the American Trucking Association, the Institute of Transportation Engineers, the Federal Highway Administration, the Towing and Recovery Association, and others. It was this National Incident Management Coalition which instrumental in supporting an initiative by the Colorado Department of Transportation (CDOT) to establish an incident management coalition in the Denver region.

In September, 1991, the Colorado Department of Transportation invited a variety of organizations and interests who were involved or might be interested in incident management to a conference which was cosponsored by the American Association of Stall Highway and Transportation Officials (a representative of the National Incident Management Coalition) and CDOT. The Coalition provided speakers for the conference who commented on the need to give incident management greater attention and what various states were doing to improve the manner in which they handle incidents. This conference, attended by over 200 persons, unanimously urged CDOT to move forward with the establishment of an incident management coalition The first step in the formulation of an incident management coalition had been taken. Local officials and staffs were made aware of the usefulness of an incident management program, the benefits which might be accrued and, importantly, what other communities were doing to improve their incident management efforts to move traffic. Expert testimony regarding case studies supported the "doability" and benefits of incident management. Presentations from a representative of the Colorado Transportation Commission, the CDOT Executive Director, the chair of the Denver Regional Council of Governments, and local governments, provided encouragement for all units of government and interested organizations to become involved.

A tool in securing an indication of support for incident management in the Denver region was a survey distributed at the conference. The survey requested comments as to the need for incident management, the desirability of proceeding with such a program, and an indication of the degree to which those persons attending wanted to be involved in the process. The response to this survey and the conference was overwhelmingly supportive. As a result, the Colorado Department of Transportation agreed to take the necessary steps to form the coalition.

Coalition Building

Using the indication of interest as submitted on the survey forms distributed at the conference, and after considering the broad spectrum of organizations and interests which needed to be represented on the coalition, the Colorado Department of Transportation selected 15 persons to be members of the Colorado Incident Management Coalition Task Force. To assure, however, that all persons interested had an Opportunity to participate, those persons expressing an interest in the coalition through the survey forms were invited to attend coalition meetings and to participate in the discussions. A variety of interests were represented on the coalition: transportation planners and traffic engineers at the state and local level; emergency response agencies - police, fire, emergency medical teams; Colorado Department of Transportation traffic engineers and maintenance personnel; the news media regularly reporting on traffic conditions in the region; trucking interests; the American Automobile Association; local research agencies who could provide a link to IVHS and other related research activities.

Recognizing the broad-based nature of the organization and the need for substantial interjurisdictional coordination and cooperation, it was felt that the coalition should not be perceived to be driven by CDOT. Consequently, at the first meeting of the coalition task force, a representative of the Denver Regional Council of Governments was nominated by the state, and elected by the task force, to serve as the co-chair of the coalition. A member of CDOT was nominated and elected to serve as the other co-chair. This latter selection demonstrated the commitment of CDOT to the incident management coalition.

Key to the functioning of the coalition was the commitment of CDOT to the coalition as expressed by the CDOT Executive Director, Dr. A. Ray Chamberlain. Dr. Chamberlain championed the coalition, and publicly committed the support of CDOT staff to the operation and functioning of the coalition. This staffing commitment was critical to the operation of the task force as few of the other agencies involved had the ability to devote a substantial amount of staff time to the regular care and maintenance of the coalition. The support of the Colorado Transportation Commission, CDOT's policy body, was also an important factor in the successful operation of the coalition. A member of the Colorado Transportation Commission expressed support for the coalition and was in regular attendance at most of the coalition meetings.

The overall goals of the coalition were to support incident management activities, to further cooperation among incident management agencies, and to educate the public with respect to the benefits of incident management activities and how to respond to them. Its prime objective was to prepare a set of recommended actions to be taken to improve the Denver region's incident management activities. To focus the work of the coalition, the Executive Director of CDOT charged the committee to emphasize short-term recommendations and identify specific short-term implementation projects. It was felt that the concept of incident management could be best advanced through the implementation of specific activities in the short term.

Operation

The responsibility for the logistics of the task force was assumed by CDOT. It notified task force members and all other interested parties as to the time and dates of the coalition meetings and was responsible for the final preparation of the minutes and agendas. It should be noted that the Department utilized telephone facsimile as the primary method to notify members of meetings, although mailed announcements were also used as a follow-up. The Denver Regional Council of Governments' (DRCOG) representative, serving as the co-chair, met with the CDOT co-chair to establish the meeting agenda and refine issues for discussion at the meetings.

A key objective of the coalition was to actively involve as many persons as possible in the work of the coalition. It was felt that such wide participation would serve to prepare acceptable and credible recommendations and implementation projects. Importantly, this participation would also develop a broad base of support for the recommendations and projects once defined. As such, eight "action groups" were formed, primarily on the basis of interest and issues. Action groups were established for a number of topics (e.g., legal, towing, communications, incident command). Participation in the groups was open to all those interested, with CDOT staff members serving as the "leaders" of most of the action groups. CDOT provided meeting notification, documentation, etc. for the action groups. It was agreed that the action groups would meet independently, with the monthly meeting of the Colorado Incident Management Coalition serving as a coordinating and information exchange mechanism for all the action groups.

Given the charge to identify early action implementation projects and the make-up of the coalition, which included a number of persons who were not used to a protracted planning process, the first challenge of the coalition operation was to harness the group's energy sufficiently to define a set of goals, objectives, and products in a deliberative fashion while, at the same time, not impeding the enthusiasm and energy of those persons who had already identified activities to pursue. This was done by usually dividing the meeting agenda into two different parts. The first part dealt with setting the direction of the coalition, identifying end-products and a workable schedule. The second part involved the reporting of the activities of the action groups and the coordination of these efforts. At the beginning of each meeting, the objectives of that specific meeting were clearly identified. This tended to keep the meeting focused and productive. Establishing goals, objectives and products up front, and the continued reinforcement of these decisions, was extremely helpful to the chair in keeping the coalition focused on its objectives. In general, the "planning" aspect of the meetings dealt with the longer term issues, whereas the action group portion of the dealt with the easy action recommendations.

Early in the process, it became clear that a committee was necessary to design agendas and guide the work of the coalition chairman's committee, comprised of CDOT personnel and the Federal Highway Administration, was established by the DRCOG co-chair and met regularly to set the course of each of the meetings. This technique was extremely effective in coordinating the various activities of the groups and in setting the agenda for the coalition meetings.

Products

By June, 1992, a set of recommendations had been prepared and approved by the coalition. (A listing of these recommendations is provided at the end of this paper.) In addition to the recommendations, the costs were very broadly estimated and an implementation schedule was prepared. In developing recommendations, emphasis was placed upon the ability to get the recommendation accomplished in a timely manner, the public visibility of the recommendation, and the degree to which the recommendations could be supported at various levels, including CDOT, local governments, and the state legislature. These considerations were particularly important with respect to the early action implementation projects. Substantial emphasis was placed on the early implementation of a project which would engender significant public visibility and, hopefully, public support. The most visible early action recommendation was the initiation of courtesy patrols on the heavily traveled portions of the two freeways, 1-25 and 1-70, through the central part of the region. Fortunately, CDOT had funding available to enable the early implementation of this project.

Next Steps

Clearly, a substantial amount of progress has been made by the Coalition in the development of a set of recommendations and by the state and others in their implementation. However, a substantial amount of work yet remains.

A number of issues remain with respect to the implementation of an incident management program in the Denver region. These include continued responsibility for the program, interest retention, and implementation issues.

Responsibility for Incident Management

Clearly, the U.S. Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 intended to shift the focus of transportation activities from construction to Operations and maintenance. Yet, the acceptance of such a shift in direction is not easily accomplished on the part of organizations who have long been in the business of pouring concrete and laying asphalt. At the political level, the opening of new roadway or bridge is of much more political appeal than a set of Statistics documenting how well the roadway is being operated. Consequently, accepting and internalizing an organizational paradigm shift to operations including incident management - will take time. While, as noted earlier, CDOT has championed the first year of the Coalition's operation, it is not clear as yet whether CDOT wishes to continue this emphasis. As the Coalition noted, it is clear that the state must be the lead player on the freeway system. While some progress has been made to date, little in the way of significant organizational changes within CDOT or at the local government level to embrace incident management as an important operational effort has occurred. It would appear, however, that once a traffic operations center has been established (as recommended by the Coalition), other aspects of incident management will receive greater attention.

While it is pretty straight-forward to establish the responsibility for incident management of the freeway system at the state level, it is more difficult to identify the responsibility or lead at the local level. In many. cases, major arterial roadways pass through a number of different jurisdictions. While the coordination of such an incident management program for an arterial system could be accomplished by DRCOG, as the Metropolitan Planning Organization, it should be noted that DRCOG has no authority to make day-to-day management decisions regarding local roadway operations. Only through an intergovernmental agreement could DRCOG be given the authority to manage a major regional arterial, should it be the desirable agency to do so. Obviously, individual units of government could likewise become managers of a multi-jurisdictional arterial roadway corridor, provided other jurisdictions would agree.

Interest Retention

The objective of the first year of the Colorado Incident Management Coalition was clearly upon the development of specific recommendations for implementation. Now that those recommendations have been prepared, the challenge is to develop a program which will retain the interest of participating members of the Coalition. What should be the continuing mission of an incident management coalition? What mission is deemed worthy enough to maintain the continued interest and commitment of others? The second year objective of the coalition is to foster and pursue the implementation of the

Coalition's recommendations. Meetings have been and are being developed to pursue issues which were not completely resolved or not as thoroughly refined as necessary in the original recommendations. Emphasis is being placed on the recommended legislation with action groups meeting to refine proposals, discuss strategy, and assist in legislation currently being considered in the state legislature. Considerable emphasis is being placed on the implementation of a traffic operations center to respond to the issue of providing for acceptable mobility to the new Denver International Airport, two Corridor Management Teams have been established by DRCOG and are pursuing specific corridor actions. It is believed that interest in the coalition's activities will remain, based on the attractiveness of these issues. However, it appears that a change in the coalition's membership may be necessary to focus more specifically on the implementation issues. Once these issues are resolved, the coalition's agenda and its membership composition will, again, need to be assessed.

Implementation Issues

Although the Coalition was formed to represent a wide variety of interests, unfortunately, not all of the players attended regularly or participated in the development of the recommendations. Consequently, there are still a number of conflicts which will need to be addressed by the Coalition. Although developed in an open process by a fairly representative group, the recommendations have not been fully accepted by some special interests, e.g the tow truck operators, motor carriers, etc. The Coalition will have to expand its membership and initiate a dialogue with persons who previously, due to their own choosing or otherwise, did not participate in the process, and will have to continue the dialogue with members of the Coalition who may have not completely realized the manner in which the recommendations may affect their way of doing business. It would appear then that an ongoing effort must be the continued refinement and support of the recommendations and a continued outreach program.

Colorado Incident Management Coalition Recommendations

- Establish a traffic operations center.

- Establish and maintain a public information program.

- Provide incident management training.

- Secure interjurisdictional cooperation.

- Establish an organized cellular call-in system to promote the effective use of cellular phones to report incidents by the public.

- Establish a roadway reference marking system to allow for more precise location of incidents.

- Improve the existing/implement new incident verification methods.

- Clarify jurisdictional boundaries to assist responding agencies in establishing responsibility.

- Encourage each response agency to develop and follow an automatic aid agreement to reduce response time.

- Develop maps which clearly identify all jurisdictional boundaries.

- Revise annexation legislation requiring clearly identifiable boundaries to reduce confusion for response agencies and to reduce the chance of unnecessary agency response.

- Amend existing place of trial legislation to allow flexibility in response, investigation, and prosecution of incidents.

- Establish a common communication system to allow for direct communication between agencies.

- Initiate a courtesy patrol program to assist motorists, thereby reducing the extent of incident caused congestion.

- Establish corridor management teams to improve cooperation and coordination among agencies which respond to incidents along specific corridors in the region.

- Establish a Clear Roads policy to allow for the quick removal of hazards from public highways and rights-of-way.

- Enact legislation to expedite removal of abandoned vehicles.

- Investigate the use of accident investigation sites for motorists to exchange accident information rather than at the scene of the incident.

- Provide "total station" equipment to expedite accident investigation.

- Enact minor accident legislation to allow removal of a vehicle from the roadway to a more suitable location which does not impede traffic.

- Enact legislation to require all jurisdictions to use the incident Command System.

- Establish traffic diversion routes for use when a freeway must be blocked for an extended period of time.

- Provide necessary equipment resources to effectively manage incidents at the incident scene.

- Use highway advisory radio to inform motorists of incidents.

- Use variable message signs to inform motorists of incidents.

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BLUEPRINT FOR ACTION
EXECUTIVE SUMMARY

Traffic congestion frustrates millions of commuters, commercial drivers and business travelers daily on our nation's arterial. Studies have indicated that over 70 percent of the congestion is caused by incidents (accidents or breakdowns of vehicles). The estimated cost of congestion is in billions of vehicle hours of delay, in billions of gallons of wasted fuel and in billions of dollars in user costs every working day.

Simply building additional lanes for traffic is no longer feasible due to excessive cost and adverse environmental impacts. Evidently, some action needs to be taken before the problem gets worse.

In 1992, over 40 representatives of government and industry in metropolitan Detroit established the Metropolitan Detroit Incident Management Coordinating Committee (MDIMCC). The committee served as an inter-agency forum to discuss complex problems such as incident detection and response, incident removal, and motorist information systems.

The committee, ever since, has been holding monthly meetings at the Michigan Intelligent Transportation Systems Center (MITS-C), MDOT's laboratory of Intelligent Transportation Systems (ITS) activities. Members include representatives from FHWA, the road commissions of Macomb, Oakland, and Wayne counties, AAA of Michigan, Michigan Emergency Patrol (MEP), Michigan State Police, WJR radio, City of Detroit, MDOT Metro District and the Southeast Michigan Council of Governments (SEMCOG) among others, with MDOT acting as chair and providing staff support.

For preparing their future agenda, committee members desired to have in-depth reports on issues that affect incident management throughout Southeast Michigan. They sought active participation from users to study these issues and prepare recommendations.

In February 1993, the directors of MDOT, MSP, and SEMCOG jointly signed invitations to 55 volunteers to serve on eight task forces to study the issues in detail and submit recommendations to the committee for action. The task forces were: Detection and Verification, Response, Removal, Alternate Routes, Information to Motorists, Jurisdictional and Boundary, Legal, and Budget.

After several months of deliberations and meetings, 47 recommendations were made to the MDIMCC by these task forces. The committee, in its coordinating role, consolidated the recommendations, established priorities for action, estimated the budget for implementation, established time frame, and designated the lead agencies to take action on the final 17 recommendations. Documentation of this effort is published herein. The final draft was approved by the directors of MDOT, SEMCOG, and MSP in January 1994. Since the Blueprint For Action report is meant to be a guide to further continued incident management plans, the MDIMCC will use the report to ensure incident management progress and development.

Southeast Michigan is currently involved in some of the most significant action for development which will transform the area with phenomenal improvements. MDOT is completing the installation of an ITS-Advanced Traffic Management System/Advanced Traffic Information System project covering over 250 miles of area freeway and trunklines. Some other programs include Advantage I-75, automation of the International Border Crossings, FAST-TRAC in Oakland county, and DIRECT operational field test in Detroit. There is a great deal of momentum and an unprecedented spirit of cooperation among the area agencies exists.

The purpose of this document is to report on the accomplishments that are in motion or have been completed since the initial BLUEPRINT FOR ACTION recommendations were drafted in 1993. This is intended to be a dynamic process and subsequent reporting will occur.

Part 1 explains how the MDIMCC was established and utilized the task force organization framework leading to recommendations contained in the original Blueprint for Action published in 1993.

Part II reviews each of the original task force recommendations and discusses accomplishments that have been set in motion in response to the original Blueprint for Action.

PART I: BACKGROUND

Introduction

One of the major messages in the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) is to better manage the existing transportation system prior to investing in a large capital improvement The development of an Incident Management System is one important part of an overall strategy to decrease travel delay. No one agency in the Detroit metropolitan area currently has Incident Management as their first job priority. As a result, this activity does not get the attention it deserves and needs.

We encounter delay in our travel on a daily basis. This delay can be the result of too many vehicles trying to use the roadway at the same time (i.e. predicted congestion) or as a result of an incident (i.e. an accident, construction). Whatever the cause, the impacts of delay are serious. Delay results in the loss of time, loss of efficiency, needless pollution, and elevated frustration. It increases the potential for traffic crashes. Existing levels of delay are currently unacceptable and are projected to get worse as traffic volumes continue to escalate.

In the summer of 1991, state and local officials in metropolitan Detroit began planning for a National Incident Management Conference 10 call attention to the potential benefits of incident management for metropolitan Detroit. In the process of planning for this conference, officials responsible for maintaining the Detroit area freeways and surface streets began sharing information on procedures and outlining programs to improve the responses to traffic incidents.

The conference, held in November 1991 at the Engineering Society of Detroit, featured speakers from the Federal Highway Administration, the American Association of State Highway and Transportation Officials, the American Trucking Associations, the Highway Users Federation for Safety and Mobility, WJR radio, Metropolitan Toronto, the City of Detroit and the Directors of the Michigan Department of Transportation and the Michigan State Police.

Approximately 200 people attended this conference in which fifty volunteered to serve on committees to begin developing a program for incident management. This volunteer activity lead to the establishment of the Metropolitan Detroit Incident Management Coordinating Committee (MDIMCC). The committee began its regular meetings in early 1992 at the Michigan Intelligent Transportation Center.

The committee had early success in improving communications regarding incidents between the Michigan State Police Post in Northville and Traffic Advisory Services such as Michigan Emergency Patrol, Metro Traffic Control, and AAA Michigan. The fact that metropolitan Detroit had strong ongoing effort developing an Incident Management program was a key factor in the Federal Highway Administration approving a grant 10 the Michigan Department of Transportation for a $500,000 Early Deployment Planning Study for Advanced Traffic Management Systems. This feasibility and planning study is now complete leading to a unique $33 million design/build contract with Rockwell International. When operational, it is anticipated that the project will significantly improve incident management within the region.

To formalize the development of an incident management program for metropolitan Detroit, the directors of the Michigan Department of Transportation, Michigan State Police and the Southeast Michigan Council of Governments invited 55 key individuals in Southeast Michigan with engineering, enforcement, traffic advisory emergency management and communications backgrounds to participate in a program 10 develop recommendations for Detroit Area Incident Management. The initial meeting in March, 1993, chaired by Secretary of State, Richard Austin, launched this effort. Several task forces were allowed ten weeks to complete their recommendations. These groups held meetings mostly at the Michigan Intelligent Transportation Systems Center, at times two or three task force meetings were held daily. The staff support to the task forces was provided by MDOT.

Early discussions among the Incident Management Coordinating Committee members led to the interchange of incident detection and incident response experiences. One of the benefits of establishing task forces was to focus on particular elements of the incident management process so that solutions for incident detection could be separated from solutions for incident response.

Justification for an Incident Management Program

There are many reasons for metropolitan Detroit to improve the handling of freeway and surface street incidents:

- The existing program is a compilation of individual agency responses.
- There is a strong potential to do a better job using existing resources by improving cooperation and coordination.
- Impacts of incidents are serious, resulting in the loss of time, money, and traveling safety.
- Incident management is a part of a larger Congestion Management System program, required by the Intermodal Surface Transportation Efficiency Act (ISTEA).
- Incident management programs provide the base of support (institutional arrangements) needed for Advanced Traffic Management Systems which can furnish additional benefits by reducing the potential for crashes through the application of ITS, computer and communication technology.
- MDOT is committed to pursue the application of ITS Programs at a statewide level, particularly in the metropolitan Detroit area. Success in meeting these goals will most likely result in additional funds brought into the metropolitan Detroit region to improve transportation systems.

Issues and Process

The Blueprint for Action report was created by 33 governmental agencies and private companies as a result of the Incident Management Task Force meetings throughout the spring and summer of 1993.

Key individuals with multi-disciplinary expertise were assigned to eight different task forces which addressed a diversity of issues, including detection, verification, response, removal, alternate routes, information to motorists, jurisdictional boundaries and legalities.

Seven of the task forces met separately to develop recommendations for each of these focused areas. The eighth task force, the Committee on Budget and Priority, assembled the list of recommendations and sorted through the actions to consolidate and eliminate duplication. The top three were selected from each task force. These were further reduced to a list of twelve priority actions.

The final step in the process estimated the time frame for completion of each recommendation and identified a lead agency or agencies. The Priority committee decided to group the recommendations into three time frames:

1. Short	-- less than 18 months to complete
2. Medium	-- 18 - 60 months to complete
3. Long	-- greater than 60 months to complete

Several recommendations related to the creation of an Incident Management Center are independent and important actions in and of themselves. They are listed separately under that category in the summary chart. When implemented, they will bring us that much closer to fulfilling the goal of establishing an Incident Management Center.

Recommendations

Table 1 lists the original recommendations along with the lead agency for each action, the estimated time frame to accomplish the activity, and the estimated cost.

Table 1 Original Recommendations Summary

Recommendations	Short Range	Med. Range	Long Range	Lead Agency	Total Estimated Cost ($)
	Time Frame (Month)				
A. Create Incident Management Center.		60		MDOT/MSP	1,000,000
Provide more timely incident information to drivers.	18			MDOT/MSP	*
Establish task groups including MSP, MTC, MEP / Metro Traffic.	18			MSP	*
Combine MTC/MSP with 24 hour operation.	18			MDOT/MSP	*
Develop communication network, possibly MEP or LEIN.			72	MDOT/MSP	*
Create a central clearinghouse (planned and unplanned lane closures).		60		MDOT	*
B. Revise 48 hour limit for abandoned vehicle to 4 hours.		60		MDOT/MSP	N/C
C. Develop agreement to allow first agency to take control of scene.		60		MDOT/ Local	N/C
D. Prepare standard boundary maps.		60		SEMCOG	15,000
E. Install intermediate location markers.	18			MDOT	100,000
F. Notify jurisdiction's road agency.	18			MDOT	N/C
G. Expand coverage of Detroit's freeway operations.			72	MDOT	90,000,000
H. Encourage towing / courtesy patrol.	18			MDOT/MSP/ Private	235,000
I. Improve coordination by education of police and fire departments.	18			MDOT/ Local	N/C
J. Seek legislation and educate public to move cars from traffic lanes.	18			MDOT/MSP/ AAA	25,000
K. Develop alternate route plans.			72	MDOT/Local	8,000,000
L. Formalize jurisdictional agreements.		60		SEMCOG/ Local	40,000

* = Cost Included in Recommendation A
N/C = No Cost

PART II: REPORT ON ACCOMPLISHMENTS

A. Create Incident Management Center

Original Recommendation

Create a central "Command Post" for the collection and dissemination of incident information and for the organization of incident management activities. Subtasks are to:

- **Provide more timely incident information to drivers**
  Find ways to keep drivers better informed about incidents and the cleaning of incidents.

- **Establish task groups including MSP, MITSC, MEP/Metro Traffic**
  Establish Task Groups to facilitate incident information exchange. Groups should include MSP, MITSC, MEP/Metro Traffic and local road and police agencies.

- **Combine MITSC/MSP with 24-hour operation**
  The Detroit Freeway Operation Center should be expanded to a 24-hour operation and combine the resources of the Michigan State Police for mutual benefit.

- **Develop communication network**
  Develop standard procedures and methods for keeping all appropriate agencies informed about incidents. This includes consideration of standard media frequencies.

- **Create a central clearinghouse for both planned and unplanned closures**
  Create a central clearinghouse to receive and disseminate information on all planned and unplanned closures and incidents, similar to MISS-DIG.

<u>Report on Accomplishments</u>

Plans have been completed in cooperation with the Michigan State Police that will allow the MSP Dispatch operation, now located in Northville, MI, to begin relocating to the Michigan Intelligent Transportation (MITS) Center early in 1996.

During this past year, detailed renovation plans were completed for the MITS Center that will allow this dispatch operation to be located within an enlarged control room center of activity on the second floor of the MITS Center. Space has also been provided on the second floor for MSP resources needed to support the dispatch operation.

On the first floor of the Greyhound Bus Station there was an unused space that was originally intended as a restaurant. Plans have completed that will allow change rooms for the dispatchers and all electronic and radio equipment to be located within this first floor area, An emergency 50 low generator will also be located within this first floor area, Final plans for this work were completed by Giffels, Inc., an architectural firm in Southfield, MI, and a contract was awarded through the Department of Management and Budget to Bell Construction for actual completion of the work: It is expected that the work will be essentially completed by October 1, 1995. This schedule then provides for the MSP dispatch resources to be relocated to the new M. DOT-MSP Control Dispatch Center starting in February of 1996. The installation of electronic equipment will follow. The dispatchers will maintain a 24 hour, 365 day per year operation, which may include some of the control activities related to the Freeway Operations System, Details and training in this regard are being developed.

Also related to the MSP dispatch move is the renovation of the adjacent parking lot to the MITS Center. This lot is being upgraded to include a complete security system which would be provided for those who find it necessary to work at the center during nighttime hours proceeding to and from vehicles located within the parking lot. This work is expected to be completed by October 1, 1995.

In addition to the parking lot renovation, the Bureau of Highways has also acquired an adjacent structure known as the FTD Building located on the same block as the MITS Center. At this time, plans for occupancy and renovation are not complete. However, MDOT Freeway Operations workshop resources, including staff, will hopefully be relocated to an area of approximately 5000 sq. ft. on the first floor, since the MSP dispatch move has resulted in limited space availability on the second floor of the MITS Center. The relocation of the workshop should allow greatly expanded space allocation that can be used to help provide logistical support for the Freeway Operations System and other ITS project activities as required.

Another aspect of the Incident Management Center concerns the location of a Metro Traffic Networks staff person for the duration of the Driver Information Radio utilizing Experimental Communication Technology (DIRECT) Project within the control dispatch center. This will allow immediate contact on the part of the center with Metro Traffic's aircraft in the Detroit metropolitan area, and should greatly improve response times for incident management
All of the above action will create a world class control and dispatch center serving the entire Detroit metropolitan area,

In addition, Michigan Emergency Patrol (ME?) is also planning to relocate to the second floor of the MITS Center to allow for improved coordination of incident management with respect to information that is now being received via teletype from MEP concerning traffic congestion.

At this time, the DIRECT-Metro Traffic activity is scheduled to last approximately 18 monthly beginning around January of 1996. Successful implementation of this technology, however, may grow into a permanent communications network for dealing with traffic incidents at the center.

B. Revise 48-Hour limit for Abandoned Vehicles to 4 hours

Original Recommendation

It is desirable to have abandoned vehicles removed as soon as possible. Legislation should be amended to require removal within 4 hours rather than the current 48 hour limit.

Report on Accomplishments

Michigan law presently requires that vehicles be abandoned along Michigan's roadsides for at least 48 hours before enforcement officers are allowed to ticket the vehicle for eventual removal. This means vehicles can remain abandoned on the shoulders of freeways, in particular on the Detroit Metropolitan freeway system, for four, five, or sir days. The task force study suggested that the 48 hour requirement be changed by legislation to four hours.

As a result, a legislative recommendation is in the process of being prepared that will if successful reduce the time that a vehicle must remain abandoned from 48 hours to four hours, so that abandoned vehicles can be removed much more quickly. This recommendation, if legislatively successful, will reduce the congestion that is caused by abandoned roadside vehicles. Approximately 4, 000 vehicles per year are abandoned on the Detroit metropolitan freeway system.

C. Develop Agreement to Allow the First Agency on the Scene to Take Control

Original Recommendation

Formal agreements should be in place to allow the first agency on the scene to take control, rather then waiting for the agency that has "jurisdiction" as now defined.

Report on Accomplishments

Subsequent review within the Metropolitan Detroit Incident Management Coordinating Committee indicates that the necessity for these agreements no longer exists. Many local jurisdictions have exercised what are known as Mutual Pack agreements that set forth action relative to the many activities that need to be considered relative to the first agency to arrive at or be asked to take control of a particular scene that may be outside of jurisdiction. The agreements consider protocol and housekeeping activities such as funding when it becomes necessary for a particular agency to act outside of jurisdiction.

D. Prepare Standard Boundary Maps

Original Recommendation

Standard maps for fire, legal, city, county boundaries need to be created and distributed to all cities and counties to clearly define jurisdiction for dispatchers of response.

Report on Accomplishments

This item also appears to be resolved and relates to training with respect to the knowledge of dispatchers relative to boundaries and roadways within various jurisdictions. Continuous and accurate training with respect to boundaries and jurisdictions utilizing existing mapping strategies appears to have eliminated the need for further action on this particular item.

E. Install Intermediate Location-Markers

Original Recommendation

Install markers along highways and encourage their use for incident reporting and response.

Report on Accomplishments

One of the recommendations from the task force committees was to install intermediate mile location markers along urban freeways so that incidents could be located more quickly. The Chicago freeway system currently uses markers of this type in the form of painted numbers at 1/10 mile spacings on light poles located throughout the urban freeway system, Chicago personnel familiar with incident activity on its freeway system indicated to us that there did not appear to be any advantage to utilization of intermediate markers. Discussion indicated that most motorist and emergency resources locate incidents indicating the nearest crossroad, interchange, or bridge.

A recommendation was prepared for the Metropolitan Detroit Incident

Management Coordinating Committee recommending that markers not be installed on the Detroit system, although a trial on a short section of road was encouraged, The vote taken at a monthly meeting was unsuccessful As a result, intermediate location markers will not be installed on the Detroit Metropolitan freeway system. Existing mile markers will be retained however.

F. Notify the Jurisdiction's Road Agency

Original Recommendation

Prompt notification of the jurisdiction's road agency will ensure their prompt response in incidents requiting their involvement.

Report on Accomplishments

This item is still being reviewed to determine the best approach to ensure the agency responsible with respect to traffic operation and maintenance of a road will be promptly involved, The intent is to ensure that proper traffic operation and maintenance concerns are considered and employed at the site of an incident.

G. Expand Coverage of Detroit Freeway Operations Project

Original Recommendation

Both the density and the geographic extent of the Detroit Freeway Operations Project coverage should be expanded. Expansion would be a continuing activity.

Report on Accomplishments

A deployment study was completed in 1994 by Rockwell International recommending that an Advanced Traffic Management System/Advanced Traffic Information System (ATMS/ATIS) be installed within the Detroit Metropolitan area, As a result, a design-build contract was prepared and a contract awarded to Rockwell International to design and install an extensive system that will significantly expand the coverage of the Detroit Freeway Operations Center. At present 32 miles are covered. The new project will provide for surveillance, some detection, highway advisory radios, changeable message sign systems, and limited ramp metering on 148 additional miles of the Detroit Metropolitan freeway system. This is a two year contract, and it is expected to be completed sometime in 1997.

This project is extremely significant since it is one of the first design-build projects originally funded by the Federal Highway Administration. This system, when complete, will greatly improve incident management detection on approximately 150 miles of the Detroit metropolitan freeway system by providing detailed camera surveillance. in addition, a tie-in to the FAST-TRAC project in Oakland County will integrate incident detection and camera surveillance of the Oakland County area to the MITS Center.

Also, plans are underway to provide surveillance capabilities for the Detroit-Windsor tunnel, and also to allow for an exchange of pictures with a television station in the Detroit area. The expanded surveillance also includes camera surveillance in the area of the Pontiac Silverdome and also Metro Airport.

H. Encourage Towing/Courtesy Patrol

Original Recommendation

Contract with private towing companies for removal of disable vehicles and encourage other private groups such as the Road Angels to provide courtesy patrols.

Report on Accomplishments

The Alliance for a safer greater Detroit implemented a Courtesy patrol program on a pilot basis in September 1994. The pilot program has from the beginning concentrated its resources on enhancing motorist's safety and security while reducing traffic congestion that is so often associated with vehicle breakdowns and accidents on Detroit area freeways.

Operated under contract with AAA Michigan, the Courtesy Patrol has consistently provided responsive mechanical and personal assistance to motorist on one of the Detroit areas' heaviest traveled freeways. Aid provided by the two Courtesy patrol van drivers to stranded motorists has involved a range of services related to detecting responding and clearing incidents. Similar to patrol type programs that have been implemented in other U.S. cities, the Alliance pilot project is an integral part of a comprehensive incident management program on major roadways during rush hour periods while also providing vital assistance to stranded motorists during non-rush hour intervals..

The Courtesy Patrol vans operate on 1- 75 in the City of Detroit between 4 p.m. and midnight, Tuesday through Saturday. One van drives southbound while the other goes northbound. In the 11 months of operation, the courtesy patrol has provided aid to over 2,000 stranded vehicles. Plans are currently underway to expand the Courtesy Patrol from 1-75 to the Lodge (M-I0), 1-94 and 1-375. The hours of operation will also be revised to provide some morning, afternoon and evening service.

All in all, the Courtesy Patrol demonstration has proven to be a great success..

I. Improve Coordination by Education of Police and Fire Departments

Original Recommendation

Response could be improved by educating police and fire departments as to each others expertise and procedures for unseen command post operations.

Report on Accomplishments

A subcommittee was formed approximately two years ago following action at the Metropolitan Detroit Incident Management Coordinating Committee to lead an outreach effort. This resulted in a slide presentation being prepared that was presented to many of the local enforcement and fire departments within the Detroit metropolitan area. Efforts are continuing to present this program to as many agencies as possible to develop and understanding of the necessary coordination and action required on the part of police and fire agencies following a highway of the necessary coordination and action required on the part of police and fire agencies following a highway incident.

J. Seek Legislation and Educate Public to Remove Car from Traffic Lanes if Possible

Original Recommendation

Drivers must be refreshed on guidelines and laws regarding when vehicles should and should not be moved following an accident. Minor accidents should be cleared 10 shoulder or off the main highway.

Report on Accomplishments

Efforts are underway to provide additional information in the booklet entitled, 'What Every Driver Must Know, ' that is available to all licensed drivers within the State of Michigan, Additional encouragement will be added to spell out clearly a motorist responsibility with respect to clearing their vehicles from traffic lanes following an accident or an incident.

K. Develop Alternate Route Planning

Original Recommendation

A comprehensive program is required to pursue methodical development of appropriate, detailed, alternate route plans.

Report on Accomplishments

Michigan has had an extensive program to develop alternate route incident management plans on a statewide basis. Approximately 600 miles of incident management planning has been completed and another 120 miles are in progress. In addition, a detailed alternate routing and analysis has been developed for 1-75 in the Detroit metropolitan area An incident management plan has also been incorporated to an advanced traffic management program study now under way in the city of Grand Rapids, Michigan. Ultimately, it is planned to proceed to develop alternate route plans not only for the Detroit metropolitan area, but for the remainder of outstate Michigan freeways where appropriate.

L. Formalize Inter-Jurisdictional Agreements

Original Recommendation

Inter-jurisdictional agreements which exist informally now should be formalized.

Report on Accomplishments

The committee spent a great deal of additional time further researching this related issue. The recommendation was based on initial data that suggested the best approach would be to formalize the informal inter-jurisdictional agreements that currently exist to allow more freedom for enforcement personnel from one community of offer assistance in instances where they are closer to an incident formally located in another community.

The thought was that this formalization of these agreements would result in certain efficiencies and potentially more timely assists. To facilitate this, better jurisdictional boundary maps would aid police dispatch personnel where areas of jurisdiction were complicated.

After a great deal of additional review of these recommendation including meetings with and presentations to local chiefs of police and the Michigan State Police, the Incident Management Committee believes the coordination is occurring without need of implementing recommendations. Inter-jurisdictional agreements are in place in many areas and local and state police departments are continuing to work together.

The Incident Management Committee will continue to monitor and hold educational workshops and conferences on this issue.

Conclusion

Some of these measures were introduced without major increases in capital or operating expenses. Many of the more sophisticated measures will require a major ongoing budget commitment. Technology and techniques are useful, but the key ingredients are inter-agency cooperation, an openness to innovation and a conviction that it is worthwhile to reduce motorist delay.