

INTEGRATION OF TRANSPORTATION AND EMERGENCY SERVICES:  
IDENTIFYING CRITICAL INTERFACES, OBSTACLES,  
AND OPPORTUNITIES

By

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## **CHAPTER I**

### **INTRODUCTION**

The need for improved coordination among emergency response organizations to deal with terrorist incidents has been well established by several studies, exercises, and reports. It has been asserted that both horizontal synchronization and vertical synchronization among response agencies are necessary for the U.S. to be able to “react to and recover from” a terrorist incident (Holcomb, Perkins et al., 2002).

Although much attention post 9/11 has been on terrorist incidents, improved coordination affects all aspects of emergency response, from day-to-day operations to mass casualty events, whether caused by natural, accidental, intentional acts. One core group involved in responding to emergencies, but which is not typically considered an emergency response group, is state and local transportation departments. Transportation departments, having responsibility for safe and efficient mobility, play a vital role in emergencies that impact the transportation infrastructure or rely on the transportation infrastructure for responding to an incident. Therefore, improved coordination between transportation and emergency response agencies in facilitating emergency transportation operations (ETO) may be vital for effective and efficient response.

More effective ETO coordination can present obvious benefits to those directly impacted by the transportation incident in terms of human health, environmental protection, and continuity of operations. However, the benefits of improved ETO coordination can be far-reaching. The public at large can benefit in that traffic jams will

occur less frequently and last for shorter periods of time, leading to enhanced mobility; improved traffic flow decreases dangerous exhaust emissions, resulting in environmental benefits; driver safety is increased because faster response and recovery to transportation incidents results in a lower likelihood of secondary crashes; and finally impaired traffic flow costs money in that no one is productive when sitting in slow-moving traffic.

The purpose of this research was three-fold: (1) to determine if a need for improvement in the current system exists, the importance of interagency coordination between transportation and emergency services organizations in realizing such improvement, and the associated benefits and challenges of enhancing interagency coordination; (2) to determine the impact of organizational factors on coordination between these groups and to identify the institutional, operational, technological, and financial factors that impact ETO coordination; and (3) to identify short term initiatives that could improve coordination between transportation and emergency services organizations, as well as explore the potential for change agents based on organizational design theory that would result in long term ETO improvement.

The following three chapters are organized according to these respective research objectives. Because these chapters are intended to be independent, yet interrelated manuscripts, certain background information and methodological discussion is repeated. However, efforts were made to keep this redundancy to a minimum.

Following these manuscripts is a concluding chapter in which the key research findings and recommendations are summarized. Directions for future study are also presented.

## **Reference**

Holcomb, A.W., Perkins, W.E., et al. (2002). "Homeland Security Mobilization Requires Greater Coordination." National Defense 87 (586): 41-42.

## CHAPTER II

### ASSESSING THE NEED FOR IMPROVED COORDINATION BETWEEN TRANSPORTATION AND EMERGENCY SERVICES ORGANIZATIONS

#### Introduction

Transportation and emergency services professionals and their respective agencies interact in a myriad of situations, ranging from routine traffic accidents to large-scale events. For the purposes of this paper, this collaboration among agencies is referred to as emergency transportation operations (ETO). ETO represents all actions taken in regards to any incident occurring on the transportation infrastructure, or requiring use of the transportation infrastructure, in order to protect health and safety. For even the simplest of those events, coordination of efforts impacts the severity of adverse consequences as well as the efficient use of limited resources. From a highway transportation perspective, perhaps the most obvious and long-recognized need for coordination is with law enforcement, relative to the shared responsibilities for highway safety, traffic regulation, and response to traffic incidents. However, changing circumstances call for a more integrated system linking transportation and all aspects of emergency services. Contributing circumstances include the increased emphasis on highway “operations,” as opposed to the more limited focus on just “construction” and “maintenance” within the transportation field, continuing concerns for homeland security, and the need to improve overall emergency management at all levels of government (Kalhammer and Bella, 2001; Homeland Security, 2004; U.S. DOT Volpe Center, 2003).

The goals of this research are to determine if a need for improvement in the current ETO system exists, the importance of interagency coordination between

transportation and emergency services organizations in realizing these improvements, and the associated benefits and challenges of enhancing interagency coordination.

The importance of coordination between transportation and emergency services agencies and the need for improvements are evidenced by the many directives and initiatives underway at the federal, state, and local levels. These include the Intelligent Transportation System (ITS) Public Safety Program in the U.S. Department of Transportation, the Transportation Operations Coordinating Committee (TRANSCOM) program in the New York, New Jersey, and Connecticut metropolitan region, the Capital Wireless Integrated Network (CapWIN) initiative in the Washington, D.C. area, and the newly formed National Traffic Incident Management Coalition (U.S. Department of Transportation, 2004; TRANSCOM, 2004; CapWIN, 2004; Helman, 2004).

The US Department of Transportation began the ITS Public Safety Program to establish partnerships between transportation and public safety agencies at the federal, state, and local levels. Program emphasis has been on new technologies to enhance emergency response and more coordinated traffic incident management (U.S. Department of Transportation, 2004). TRANSCOM is a coalition of sixteen transportation and public safety agencies that was formed to provide a coordinated approach to regional transportation management. The mission of TRANSCOM includes improving the mobility and safety of the traveling public through interagency communication and utilization of transportation management systems, ensuring that new systems are implemented in a coordinated manner, and bringing funding into the region to improve traffic and transportation management. The CapWIN project is focused on creating an integrated criminal justice and transportation wireless information network. Project goals

include development of an integrated mobile wireless network infrastructure using shared transportation and public safety agency resources, to identify voice and data communications technologies for enhancing response capabilities of transportation and law enforcement first responders involved in traffic or other critical incident responses, and to deliver appropriate data in a meaningful, relevant, and understandable form, whenever and wherever it is needed. The National Traffic Incident Management Coalition (NTIMC) is an assembly of national organizations representing emergency services, transportation, and towing and recovery operations. The mission of the coalition is to provide a multi-disciplinary partnership forum spanning the public safety and transportation communities to coordinate experiences, knowledge, practices, and ideas toward safer and more efficient management of incidents affecting traffic.

Although the importance of improved coordination is becoming more transparent and widespread, the factors that influence the effectiveness of such efforts are not well understood. A study by Bunn and Savage examined integration issues relative to specific projects and identified some factors that seem to influence project success (Bunn and Savage, 2003). The goal of the research described in this paper was to examine the general level of commitment for improved coordination among highway transportation and emergency services organizations.

For the purposes of this research, the following terms were defined. ETO was used to describe a wide range of activities, including response, recovery, mitigation, prevention, and preparedness, involving incidents or circumstances that impact the transportation system by reducing capacity, increasing demand, or otherwise threatening public health and safety. ETO, as defined here, applies to all of the following situations.

- Minor traffic crashes, disabled or abandoned vehicles, debris in the roadway, and other circumstances that disrupt traffic flow and create hazards
- Major traffic crashes involving fatalities, injuries, overturned vehicles, and serious property damage
- Highway construction and maintenance work zones
- Special events that attract large crowds and create exceptional traffic demands
- Law enforcement and security activities that cause major traffic disruptions
- Hazardous material spills
- Severe weather and natural disasters, including events that require large-scale evacuation
- Public health emergencies or other events that require large-scale travel restrictions or quarantines
- Acts of terrorism that target the transportation system or that create exceptional transportation demands

“Transportation agencies” refers to state departments of transportation, toll road authorities, and local highway, public works, and traffic engineering organizations—the public agencies directly responsible for the construction, maintenance, and operation of roadways in a particular state or community. The focus of this research was on highway transportation, although some of the findings and conclusions may be applicable to all modes. “Emergency services agencies” refers to law enforcement, fire and rescue services, emergency medical services (EMS), emergency communications, emergency management agencies (EMA), and homeland security.

### **Study Methodology**

The study hypothesis was that improvements in ETO are needed, and better coordination between transportation and emergency services agencies is necessary to realize those improvements. In order to test this hypothesis, a survey was developed and administered to key ETO professionals in five southeastern states: Kentucky, Georgia,

Tennessee, North Carolina, and South Carolina. Surveys were administered to the officials whose positions most closely align with the following titles in each state:

- Law Enforcement—Commissioner (Secretary) of state department of safety, Head of state patrol, Director of law enforcement academy, Head of commercial vehicle enforcement, Police chiefs in the three largest cities, and Elected officers of the state association of police chiefs
- Fire and Rescue—State fire marshal, Director of state fire academy, Fire chiefs in the three largest cities, and Elected officers of the state association of fire chiefs
- EMS—State director of EMS, Directors of EMS in the three largest cities, and Directors of emergency services at the largest hospital in the three largest cities
- Emergency Communications—State director for 9-1-1, Directors of emergency communications in the three largest cities
- EMA—State director of emergency management, Emergency managers in the three largest cities, Elected officers of the state association of emergency managers
- Homeland Security—State director of homeland security, Disaster preparedness coordinators at the largest hospital in the three largest cities
- Transportation (State DOT)—Commissioner (Secretary) of transportation, Chief engineer, State traffic engineer, Intelligent transportation systems director, Incident management director, State DOT liaison for the emergency management agency, Head of maintenance, Public Information director, Head of transportation planning

- Transportation (Local)-- Directors of public works in the three largest cities, Traffic engineers in the three largest cities, and Coordinators for the three largest metropolitan planning organizations.

As the focus of this study was on the coordination of transportation agencies with core emergency services agencies, survey respondents were aggregated into two groups; transportation and emergency services. Since this study begins to foster an understanding of the issues that impact relationships between transportation and emergency services agencies, and because of the organizational similarities of the core emergency response groups, it was felt that this level of aggregation was justified. Also, although not every type of emergency responder was represented (e.g., tow truck operators), the groups included in the emergency services group were considered representative of the core agencies involved in on-scene incident response and/or emergency preparedness, training, and planning activities.

Surveys were mailed to a total of 272 individuals, by name and title. A hyperlink to an online version of the survey was e-mailed to these same persons. The survey instrument was designed to obtain opinions and information concerning the following topics:

- Need for improvements in ETO and the importance of interagency coordination
- Perceived benefits of improved ETO
- Incident scenarios most needing improved coordination
- Response actions most needing improved coordination
- Familiarity with existing ETO initiatives

The survey was pilot tested by a focus group comprised of highway transportation and emergency services officials in the Nashville and Knoxville metropolitan areas. The focus group also validated the pertinence of the topics addressed and the appropriateness of survey questions.

## Results

Of the 272 surveys that were distributed, 166 completed responses were received, representing a 61% response rate. The response rate by agency type appears in Table 2.1. The breakdown by state is shown in Figure 2.1.

Table 2.1: Response Rate by Agency Type

	Surveys sent out	Returned	Response rate
Law Enforcement	50	35	70%
Homeland Security	20	9	45%
Fire and Rescue	40	26	65%
EMS	22	13	59%
EMA	34	22	65%
Emergency Communications	18	11	61%
Highway Transportation	88	50	57%
Total	272	166	61%

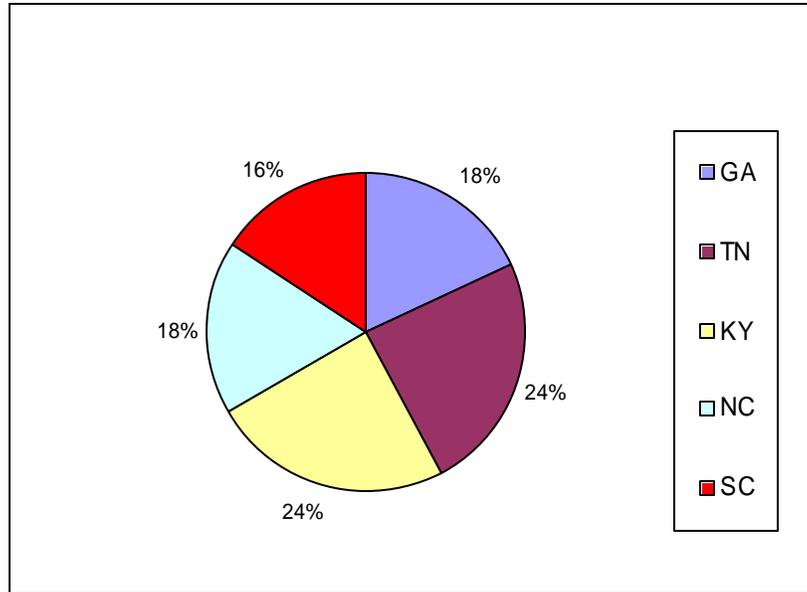


Figure 2.1: Composition of Response by State

#### Analysis of Variance (ANOVA)

A one-way analysis of variance was performed for each survey item where a comparison was made of the mean transportation group response to the mean emergency services group response, to determine if significant differences between those means exist. The existence of significant differences is indicative of variation in opinions between the two groups. An alpha of 0.05 was utilized for the ANOVA test, implying that there is a 5% chance of a Type I error (identifying a significant difference when it does not exist). All items with means that met this criterion are marked with an asterisk (\*) on the following figures.

#### Need for Improvements in ETO and the Importance of Interagency Coordination

Tables 2.2 and 2.3 present survey results related to the perceived need for improvements in ETO and the importance of interagency coordination, for transportation

and emergency services officials, respectively. The respondents solidly support the idea that improvements in ETO are needed and that coordination between emergency services and transportation agencies is necessary to achieve those improvements. The majority of respondents also indicated that the other group (transportation or emergency services) had demonstrated an interest in better coordination.

The majority of transportation respondents felt their agency could also improve ETO through their own agency's independent actions regardless of emergency service agency involvement. The majority also felt that emergency services organizations could improve ETO though independent action. The majority of emergency services respondents also felt that independent action by transportation agencies could improve ETO, but that emergency services agencies could not improve ETO through independent actions. The implication here is that emergency services organizations expect some ETO leadership, or at least initiative, from transportation agencies.

Table 2.2: Transportation Response to the Need for Improved Coordination

<b>Based on your experience and observations, do you agree that...</b> <i>(Please check one box on each line.)</i>	Strongly Agree	Agree	Disagree	Strongly Disagree	No opinion
Emergency transportation operations (ETO) can be improved in my community/state.	38%	60%	0%	0%	2%
Improvements in ETO in my community/state will require more effective coordination or integration of efforts by multiple agencies.	56%	42%	2%	0%	0%
My agency could significantly improve ETO through our own actions using our own resources, regardless of other agencies.	8%	52%	28%	12%	0%
Emergency services agencies in my community/state could improve ETO through their own actions, regardless of my agency.	18%	56%	14%	8%	4%
My agency's role in ETO does not require improved coordination with emergency services agencies.	2%	10%	56%	28%	4%
Emergency services agencies in my state/community have shown little interest in better coordination with my agency.	2%	16%	56%	14%	12%

Table 2.3: Emergency Services Response to the Need for Improved Coordination

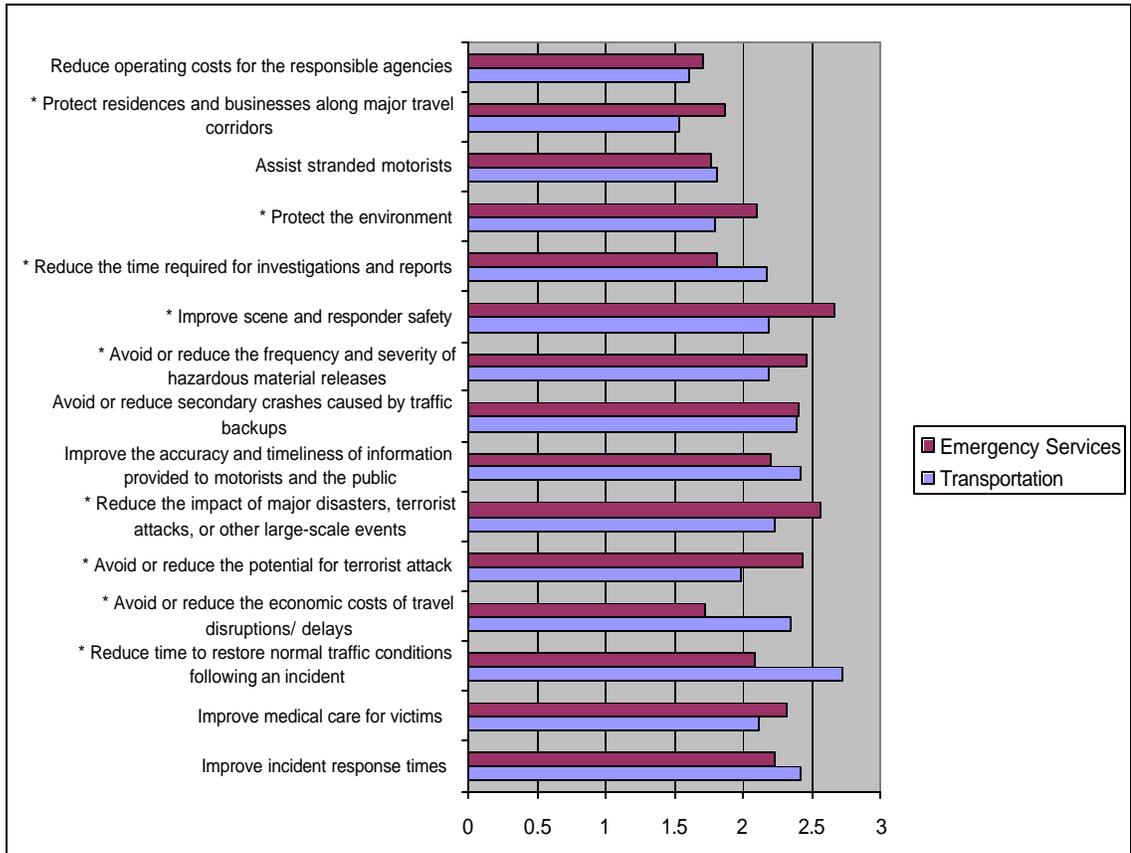
<b>Based on your experience and observations, do you agree that...</b> <i>(Please check one box on each line.)</i>	Strongly Agree	Agree	Disagree	Strongly Disagree	No opinion
Emergency transportation operations (ETO) can be improved in my community/state.	18%	72%	4%	1%	4%
Improvements in ETO in my community/state will require more effective coordination or integration of efforts by multiple agencies.	26%	70%	0%	1%	3%
My agency could significantly improve ETO through our own actions using our own resources, regardless of other agencies.	1%	29%	45%	14%	11%
Transportation agencies in my community/state could improve ETO through their own actions, regardless of my agency.	6%	57%	28%	6%	3%
My agency's role in ETO does not require improved coordination with transportation agencies.	3%	10%	64%	17%	5%
Transportation agencies in my state/community have shown little interest in better coordination with my agency.	1%	21%	51%	16%	11%

### Perceived Benefits of Improved ETO

To evaluate the incentives for transportation and emergency services agencies to work together to improve ETO, respondents were asked the importance they would assign to specific potential benefits using the following rating system: Very Important, Important, Somewhat Important, Not Important. In interpreting the results, these responses were assigned a value score of 3, 2, 1, and 0, respectively. Average scores were then compiled to determine the overall level of importance of each item. Answers of No Opinion were not included in the analysis.

As shown in Figure 2.2, the majority of respondents assigned at least some importance to each of the listed potential benefits, but the rank ordering by each group differed significantly. The top reasons for transportation professionals to seek ETO improvements were (1) reduce time to restore normal traffic conditions following an incident, (2) improve incident response times, (3) improve the accuracy and timeliness of information provided to motorists and the public, (4) avoid or reduce secondary crashes

caused by traffic backups, and (5) avoid or reduce the economic costs of travel disruptions or delays.



\* Items with significantly different means according to ANOVA test at alpha .05

Figure 2.2: Perceived Benefits of Improved Emergency Transportation Operations

In contrast, the top reasons for emergency services professionals were (1) improve scene and responder safety, (2) reduce the impact of major disasters, terrorist attacks, or other large-scale events, (3) avoid or reduce the frequency and severity of hazardous material releases, (4) avoid or reduce the potential for terrorist attack, and (5) avoid or reduce secondary crashes caused by traffic backups.

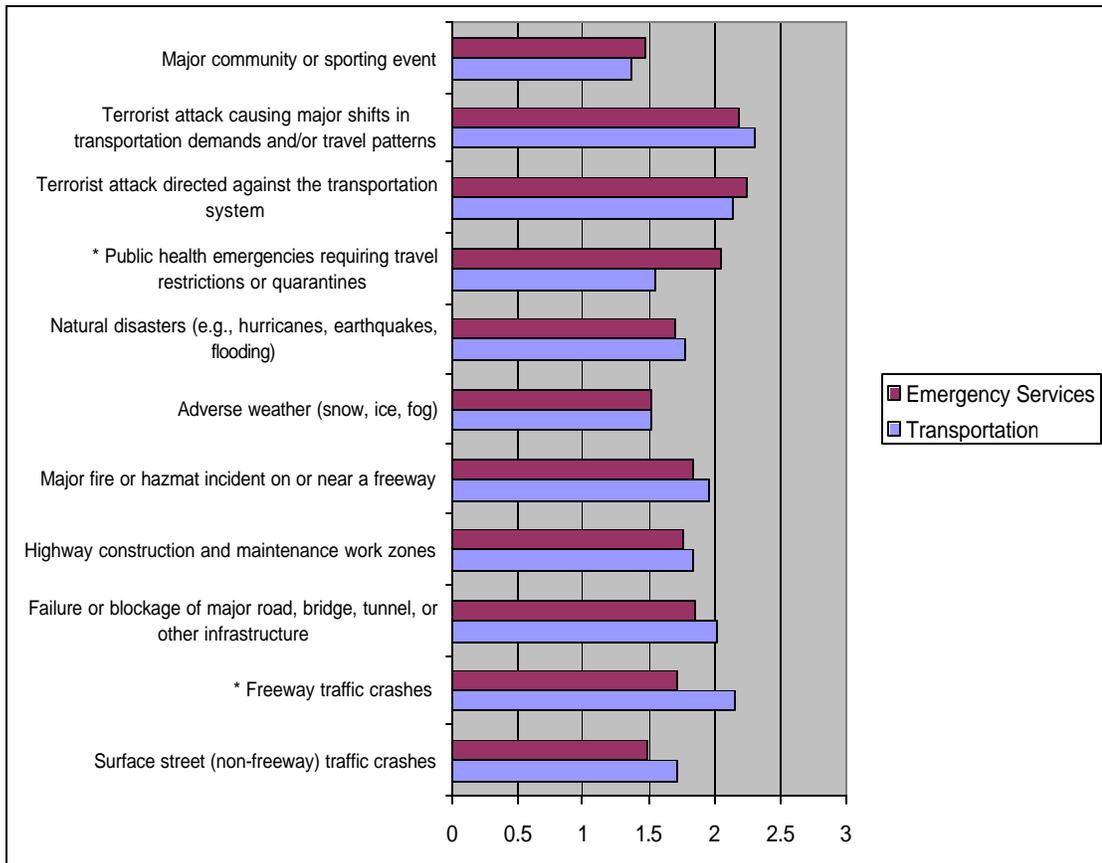
Thus, while both groups see benefits from improved ETO and are presumably willing to invest some of their resources to achieve those benefits, the two groups perceive different benefits, or at least place different values on those benefits. The only benefit that appeared in the “top five” for both groups was to “avoid or reduce secondary crashes caused by traffic backups.”

### Incident Scenarios Most Needing Improved Coordination

Although improved coordination offers some potential benefits regardless of the incident scenario, the need for improved coordination may be more important for particular scenarios. To address this consideration, respondents were asked to rate the need for improved coordination between their agency and their counterparts for specific incident scenarios as: Significant improvements needed (3), Some improvements needed (2), Minor improvements needed (1), or Status quo is adequate (0). Answers of No Opinion were not included in the analysis. Average scores for each item were compiled to determine the overall need for improvement (see Figure 2.3).

The top incident scenarios where improved coordination is needed according to transportation respondents were (1) terrorist attack causing major shifts in transportation demands and/or travel patterns, (2) freeway traffic crashes, (3) terrorist attack directed against the transportation system, (4) failure or blockage of major road, bridge, tunnel, or other infrastructure, and (5) major fire or hazmat incident on or near a freeway. The top incident scenarios where improved coordination is needed according to emergency services respondents were (1) terrorist attack directed against the transportation system, (2) terrorist attack causing major shifts in transportation demands and/or travel patterns,

(3) public health emergencies requiring travel restrictions or quarantines, (4) failure or blockage of major road, bridge, tunnel, or other infrastructure, and (5) major fire or hazmat incident on or near a freeway.



\* Items with significantly different means according to ANOVA test at alpha .05

Figure 2.3: Incident Scenarios Requiring Improved Coordination

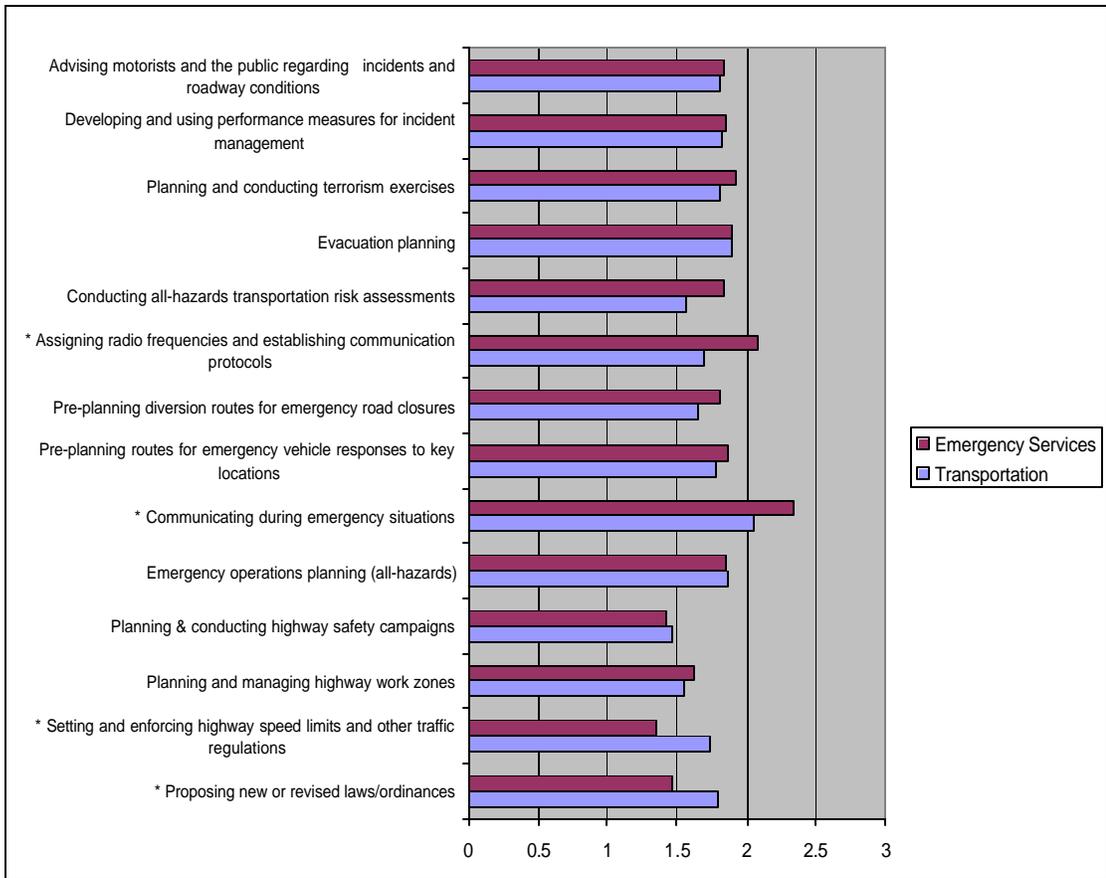
The most significant differences in the group responses were for “freeway traffic crashes,” rated significantly higher by the transportation group, and “public health emergencies requiring travel restrictions or quarantines,” rated significantly higher by the emergency services group. The two scenarios for which the two groups assigned the

highest combined scores both involved terrorism, one scenario involving an attack that caused major shifts in transportation demand and the other scenario involving an attack directed against the transportation infrastructure. The two scenarios for which both groups indicated the least overall need for improvement were “major community or sporting event” and “adverse weather.”

#### Response Actions Most Needing Improved Coordination

The survey also included a question that addressed the relative need for improvements in the types of response actions regardless of the scenarios. Respondents were asked to rate the need for improved coordination between their agency and their counterparts for specific response actions as: Significant improvements needed (3), Some improvements needed (2), Minor improvements needed (1), or Status quo is adequate (0). Answers of No Opinion were not included in the analysis. The average score for each item appears in Figure 2.4.

The top actions according to transportation respondents were (1) communicating during emergency situations, (2) evacuation planning, (3) emergency operations planning (all-hazards), (4) developing and using performance measures for incident management, and (5) advising motorists and the public regarding incidents and roadway conditions. The top actions ranked by emergency services respondents were (1) communicating during emergency situations, (2) assigning radio frequencies and establishing communication protocols, (3) planning and conducting terrorism exercises, (4) evacuation planning, and (5) pre-planning routes for emergency vehicle responses to key locations.



\* Items with significantly different means according to ANOVA test at alpha .05

Figure 2.4: Response Actions Requiring Improved Coordination

For both groups, the action most in need of improvement was “communication during emergency situations,” and both groups included “evacuation planning” in their top five choices. Comparing the two groups, “communicating during emergencies” and “assigning radio frequencies and communication protocols” were rated significantly higher by emergency services. The transportation group assigned significantly higher ratings to “setting and enforcing speed limits and other traffic regulations” and to “proposing new or revised laws/ordinances.”

### Familiarity with Existing Initiatives

Many federal, state, and local agencies have responded to the need for improved coordination among transportation and emergency services, and a variety of programs and projects have been implemented. Survey participants were asked to rate their level of familiarity with a representative group of programs and projects to determine the relative visibility, and, by implication, the potential influence of such programs and projects on coordination in the states and communities represented in the survey group. Respondents were asked to rate their familiarity with each choice as: Extensive, Hands-On Experience (4), Very Familiar and Knowledgeable (3), Aware of Purpose; Some Knowledge of Content (2), Vaguely Aware but Not Sure What's Involved (1), or Don't Think I've Ever Heard of It (0). Average scores are displayed in Figure 2.5.

The list of programs and projects used in the survey instrument includes some that were initiated by the transportation community and some by emergency services. Some are examples of interagency cooperation that have been suggested as worthy models for other areas or as a source of lessons learned. Others included in the list have been set forth as national standards or recommendations. Some are focused on transportation, and some have a broader purpose.

Not surprisingly, emergency services professionals were much more familiar with initiatives coming from the public safety and emergency management sectors than with those coming from the transportation sector, and vice versa. However, the differences between the two groups were more dramatic for this question than for any other in the survey.

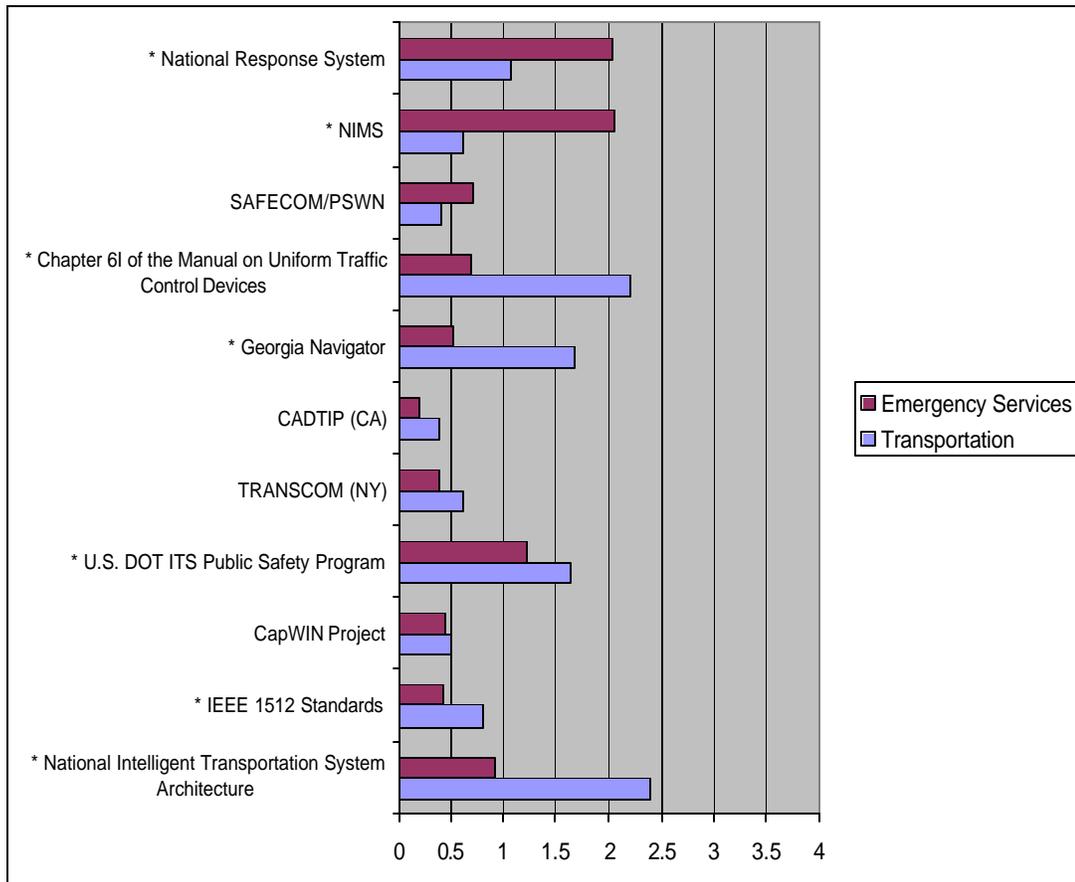
Perhaps more important, however, is that not a single initiative received an overall average score greater than “Some Knowledge of Content.” Regardless of the differences between the responses from transportation and emergency services, the level of awareness of these programs and projects is very low among both groups.

The majority of the survey respondents have very limited awareness of initiatives to improve ETO in other states and regions, are not aware of the lessons learned, and are not aware of national standards and recommendations that have been set forth relative to emergency transportation operations. This suggests that additional efforts are needed to facilitate the sharing of information about ETO improvements and interagency experiences.

## **Conclusions**

The findings from this research support the hypothesis that improvements in ETO are needed, and better coordination between transportation and emergency services is necessary to realize those improvements. To accomplish this objective, emergency services organizations expect some ETO leadership, or at least initiative, from transportation agencies. While both groups see value from improved ETO, they perceive different benefits, or at least place different values on those benefits. The lone exception is general agreement on the importance of avoiding or reducing secondary crashes caused by traffic backups. Opportunities to improve coordination apply to a variety of incident scenarios and response activities. Both groups agree the most important scenarios where coordination is needed are terrorist attacks; however, the groups differ significantly over the importance of improved coordination in freeway traffic crashes and public health

emergencies. The top response action ranked by both groups requiring improved coordination is communicating during emergencies, and both groups included evacuation planning among their top choices.



\* Items with significantly different means according to ANOVA test at alpha .05

Figure 2.5: Familiarity with Existing Initiatives

Finally, it was determined that respondents, both transportation and emergency services officials, had a low level of awareness of existing ETO initiatives, both within their discipline and in other ETO disciplines. This finding suggests that additional efforts

are needed to facilitate the sharing of information about ETO improvements and interagency experiences.

The prioritization of specific aspects established in this study can aid professionals in the field of transportation and/or emergency services in focusing efforts where coordination is most needed. The analysis of variance highlights areas where opinions within transportation agencies differ from those within emergency services agencies. Significant differences were found in items pertaining to potential benefits of improving emergency transportation operations, specific incident types, scenarios, and activities where improved coordination is most needed, and familiarity with existing initiatives to improve coordination or to improve emergency transportation operations. These differences may present challenges to improved coordination.

An example of such a challenge involves the reasons and potential benefits for improving ETO. Transportation respondents consider restoring traffic to normal operating conditions to be critical; whereas, emergency services are focused on improving responder safety. Such differences may imply disconnected motivations for improving ETO, a potential barrier that can be overcome by adopting a coordinated multi-agency structure with common ETO goals.

One difficulty in bringing about change in ETO is the many groups that are involved stakeholders. While this research focused on the core groups involved in ETO, many other parties influence the effectiveness of this activity (e.g., towing companies, the media, other government agencies, and the public). Future studies may be warranted to study the issues surrounding coordination with individual emergency response groups, rather than the aggregated approach taken here.

## References

- Bunn, M. and Savage, G. (2000). "Feasibility of an Integrated Traffic Management and Emergency Communication System for Birmingham, Alabama." University Transportation Center for Alabama.
- Capital Wireless Integrated Network (CapWIN), (2004). "CapWIN Goals." <http://www.capwin.org/goals.html> [accessed July 2004].
- Helman, D. (2004). "Traffic Incident Management." Public Roads. 68:(3).
- Kalhammer, V. and Bella, P. (2001). "National Summit on Transportation Operations: Building the Future of Transportation Operations." ITE Journal, 71(12), 38-40.
- TransCom<sup>sm</sup> (2004). "Transportation Operations Coordinating Committee." <http://www.xcm.org/> [accessed August 2004].
- U.S. Department of Homeland Security (DHS), (2004). "Securing Our Homeland: U.S. Department of Homeland Security Strategic Plan." [http://www.dhs.gov/interweb/assetlibrary/DHS\\_StratPlan\\_FINAL\\_spread.pdf](http://www.dhs.gov/interweb/assetlibrary/DHS_StratPlan_FINAL_spread.pdf) [accessed July 2004].
- U.S. Department of Transportation, (2004). "What is the ITS Public Safety Program?" [http://www.itspubliksafety.net/what\\_is\\_itspub.htm](http://www.itspubliksafety.net/what_is_itspub.htm) [accessed August 2004].
- U.S. Department of Transportation ITS Program, (2000). "Incident Management Successful Practices: A Cross-Cutting Study." ITS Joint Program Office, Federal Highway Administration, and Federal Transit Administration.
- U.S. Department of Transportation, John A. Volpe National Transportation Systems Center (2003). Effects of Catastrophic Events on Transportation System Management and Operations: Cross Cutting Study. U.S. Department of Transportation, ITS Joint Program Office.

## CHAPTER III

### THE IMPACT OF ORGANIZATIONAL FACTORS ON COORDINATION BETWEEN TRANSPORTATION AND EMERGENCY SERVICES ORGANIZATIONS

#### Introduction

Emergency response at all levels involves multiple agencies that must interact and coordinate activities for a successful response effort. Although transportation departments are not typically considered an emergency response group, they are involved in emergency response in several aspects. Table 3.1 shows some examples of incidents requiring emergency response and summarizes the involvement of transportation agencies. The term “emergency transportation operations” (ETO) represents all actions taken in regards to any incident occurring on the transportation infrastructure or requiring use of the transportation infrastructure, in order to protect health and safety.

While it is apparent that ETO is highly valued and requires coordination (Roberts, 2001, McEwen, 2003, Shepherd, et. al., 2005), its effectiveness depends on the way each organization operates, both internally and with outside parties. The broad objective of this research is to define those organizational factors that influence coordination effectiveness. More specifically, it addresses the extent to which institutional, operational, technological, and financial changes are needed to improve ETO.

For the purposes of this research, the following terms were defined. ETO refers to response, recovery, mitigation, prevention, and preparedness actions associated with a transportation-related incident. “Transportation agencies” refers to state departments of transportation, toll road authorities, and local highway, public works, and traffic

engineering organizations—the public agencies directly responsible for the construction, maintenance, and operation of roadways in a particular state or community.

Table 3.1: The Role of Transportation in Emergency Response

Incident Type	Transportation Involvement	Transportation Role	Involved Agencies
Small scale automobile accident (fender-bender) on highway	Occurs on transportation infrastructure; Impacts traffic flow; Impacts highway safety	DOT Service Patrol trucks may be first on scene; May detect and report the incident; TMC resources may aid with logistical issues getting emergency responders to the scene as quickly as possible; Notifies the public of delays due to accident	Transportation; Law Enforcement; Emergency Communications; Privately-owned towing service
Large scale automobile accident with injuries on highway	Occurs on transportation infrastructure; Impacts traffic flow; Impacts highway safety	DOT Service Patrol trucks may be first on scene; May detect and report the incident; Aid with logistical issues getting emergency responders to the scene as quickly as possible; DOT may be able to provide information about the scene to responders; Notify the public of delays due to accident	Transportation; Law Enforcement; Emergency Communications; EMS; possible Fire (Search and Rescue); Privately-owned towing service; Hospital
Enforcement of speed limits	Speeding automobiles impact highway safety	Promotion and education of drivers concerning speed limits, risks of speeding, and fines for violations	Law Enforcement; Transportation
Enforcement of DUI laws	Impacts highway safety	DOTs can help in promotional and educational programs for the public	Law Enforcement; Transportation
Intentional acts of terrorism or other disasters impacting transportation infrastructure	Highway safety for motorists; Safety of infrastructure; Transportation system necessary for evacuations; Post-incident reconstruction	Traffic diversion; Evacuation; Routing for emergency vehicles; Preparation and training; Identifying critical pathways to hospitals and other sensitive locations;	Homeland Security; Transportation; EMS; EMA; Law Enforcement; Emergency Communications; Fire; and Private service providers
Aftermath of a natural disaster or other mass casualty event	Transportation system necessary for evacuations; Impacts to traffic flow;	Traffic diversion; Evacuation planning and management; Routing of emergency vehicles; Preparation and training	Homeland Security; Transportation; EMS; EMA; Law Enforcement; Emergency Communications; Fire; and Private service providers
Vehicle fire on highway	Highway safety; Traffic flow	Traffic diversion; Routing of emergency vehicles	Fire; Transportation; EMS; Law Enforcement; Emergency Communications
Abandoned vehicle on highway	Highway safety	Detect and report the vehicle; Contact the towing service	Transportation; Towing service; Law Enforcement
Highway work zone planning and speed limit enforcement	Transportation worker safety; motorist safety	Inform emergency response agencies of work zones to avoid so they aren't delayed when responding to an emergency; Inform law enforcement so that work zone speed limits are enforced	Transportation; Fire; EMS; Law Enforcement; Emergency Communications

The focus of this research was on highway transportation, although some of the findings and conclusions may be applicable to all modes. “Emergency services agencies” refers to law enforcement, emergency medical services (EMS), fire and rescue services, emergency management agencies (EMA), emergency communications, and homeland security. Each of these core groups has a different mission and plays a unique role in ETO (see Table 3.2).

Table 3.2: Roles of ETO Core Groups

<b>ETO Group</b>	<b>ETO Focus</b>
Law Enforcement	Investigation, Protection
Emergency Medical	Medical Treatment
Fire and Rescue	Extrication, Fire Suppression
Emergency Mgt.	Preparedness, Training, Planning, and Coordination
Emergency Comm.	Dispatch and follow-up Communication
Homeland Security	Terrorism, Disaster Preparedness
Transportation	Mobility, Safe Travel

### **Organizational Factors**

Achieving effective coordination between agencies with differing missions, management structures, operating procedures, and other considerations is no trivial matter. Organizational factors direct how employees behave (i.e., how work gets done). To improve coordination between ETO core groups, the impact of organizational factors

needs to be understood. The factors that were examined most closely in this research were divided into four organizational categories: (1) institutional, (2) operational, (3) technological, and (4) financial.

*Institutional factors* include the policy-level framework for ETO within a community and state, the delineation of responsibilities among affected organizations, the structure of resources and programs within an agency, and the organization's mission, priorities, culture, and performance metrics. Perhaps most important in effective ETO is the decision-making authority among organizations in the response to an incident. Two common approaches to establishing such authority include the Incident Command System and Unified Command. Although these systems are being embraced by more response agencies for on-scene incident management, responsibilities for various planning, training, preparation, and recovery actions can be ambiguous when incidents require multi-agency response. An organization's culture is the set of values, guiding beliefs, and understandings that are shared by its members, and it is represented by the ways people are rewarded and evaluated (Daft, 2001). The agency's mission defines its reason for existence, essentially the stated goal(s) of the organization and an indication of what goes on within the organization. One problem with integration among different organizations with separate missions is that their primary goals typically differ, and they do not take the time to understand the mission(s) of other organizations. Performance metrics refer to how an organization is evaluated and encompasses what is important to the organization.

*Operational factors* that impact agency coordination and integration include tactical planning and preparation for incidents, procedures that guide incident response

and management, and the informal practices that define the way work is carried out. Coordinated planning, operating procedures, and training can be vital to creating an integrated response, where all agencies understand the roles and responsibilities of everyone involved and are working toward the same goal(s). Research in behavioral science has found that both of these considerations contribute significantly to human performance (Reason, 1990; Gertman, Byers, et al., 2002).

*Technological factors* include the development, deployment, and use of equipment, networks, and systems, as well as the associated hardware and software that support ETO. A significant issue in ETO may be the lack of compatible communications equipment. Although this issue may seem simple to remedy, many response agencies, even within the same geographical area, have equipment produced by different manufacturers that are not compatible and costly to replace. During the Tucson Fire Department's recent Metropolitan Medical Response System (MMRS) exercise, participants reported that "interoperability of communications remains the biggest challenge facing all response agencies (Caid, 2003)." An example of technological resource sharing is the co-location of transportation management centers (TMC) and emergency communication centers (ECC). In Minneapolis, the Regional Transportation Management Center (RTMC) integrates the Minnesota Department of Transportation's (MnDOT) Metro Maintenance Dispatch, the area's Freeway Incident Response Safety Teams (FIRST), the Office of Traffic, Security, and Operations, and the Minnesota Department of Public Safety's State Patrol Dispatch into a unified communications center (Brook, Dopart, et al., 2004).

Finally, *financial factors* include funding sources, operating budgets, competing priorities, and economic incentives for improving coordination. State departments of transportation tend to have larger operating budgets than respective emergency response organizations. However, ETO may not be a budget priority of either agency. Several cost-sharing examples demonstrate the potential financial benefits of collaboration, such as the Arkansas EMS Prehospital Data Collection System, a trauma registry as part of an integrated injury prevention program in South Dakota, and Wisconsin's Comprehensive Uniform Data Collection project (National Highway Traffic Safety Administration, et al., 2000).

### **Study Methodology**

The study hypothesis was that institutional, operational, technological, and financial factors impact coordination between transportation and emergency services agencies, and changes in these areas are necessary to improve ETO. In order to test this hypothesis, a survey was developed and administered to key transportation and emergency services professionals in five southeastern states: Kentucky, Georgia, Tennessee, North Carolina, and South Carolina. Surveys were administered to the following ETO officials in each of these states:

- Law Enforcement—Commissioner (Secretary) of state department of safety, Head of state patrol, Director of law enforcement academy, Head of commercial vehicle enforcement, Police chiefs in the three largest cities, and Elected officers of the state association of police chiefs

- Fire and Rescue—State fire marshal, Director of state fire academy, Fire chiefs in the three largest cities, and Elected officers of the state association of fire chiefs
- EMS—State director of EMS, Directors of EMS in the three largest cities, and Directors of emergency services at the largest hospital in the three largest cities
- Emergency Communications—State director for 9-1-1, Directors of emergency communications in the three largest cities
- EMA—State director of emergency management, Emergency managers in the three largest cities, Elected officers of the state association of emergency managers
- Homeland Security—State director of homeland security, Disaster preparedness coordinators at the largest hospital in the three largest cities
- Transportation (State DOT)—Commissioner (Secretary) of transportation, Chief engineer, State traffic engineer, Intelligent transportation systems director, Incident management director, State DOT liaison for the emergency management agency, Head of maintenance, Public Information director, Head of transportation planning
- Transportation (Local)-- Directors of public works in the three largest cities, Traffic engineers in the three largest cities, and Coordinators for the three largest metropolitan planning organizations.

Surveys were mailed to a total of 272 individuals, by name and title. A hyperlink to an online version of the survey was e-mailed to these same persons. The survey

instrument was designed to obtain opinions and information concerning the following topics:

- Need for institutional, operational, and technological changes to improve ETO
- Current state of understanding of other agencies' missions
- Importance of specific institutional / operational factors in interagency coordination
- Potential benefits of specific technologies
- Priorities for resource allocation and opinions regarding funding sources

The survey was pilot tested by a focus group comprised of transportation and emergency services representatives in the Nashville and Knoxville metropolitan areas. The focus group also validated the pertinence of the topics addressed and the appropriateness of survey questions.

## **Results**

Of the 272 surveys that were distributed, 166 completed responses were received, representing a 61% response rate. The response rate by agency type appears in Table 3.3. The breakdown by state is shown in Figure 3.1.

### Analysis of Variance (ANOVA)

A one-way analysis of variance was performed for each survey item, comparing the mean transportation group response to the mean emergency services group response to determine if significant differences between those means exist. The existence of a significant difference is indicative of variation in opinion between the two groups.

Table 3.3: Response Rate by Agency Type

	Surveys sent out	Returned	Response rate
Law Enforcement	50	35	70%
Homeland Security	20	9	45%
Fire and Rescue	40	26	65%
EMS	22	13	59%
EMA	34	22	65%
Emergency Communications	18	11	61%
Highway Transportation	88	50	57%
Total	272	166	61%

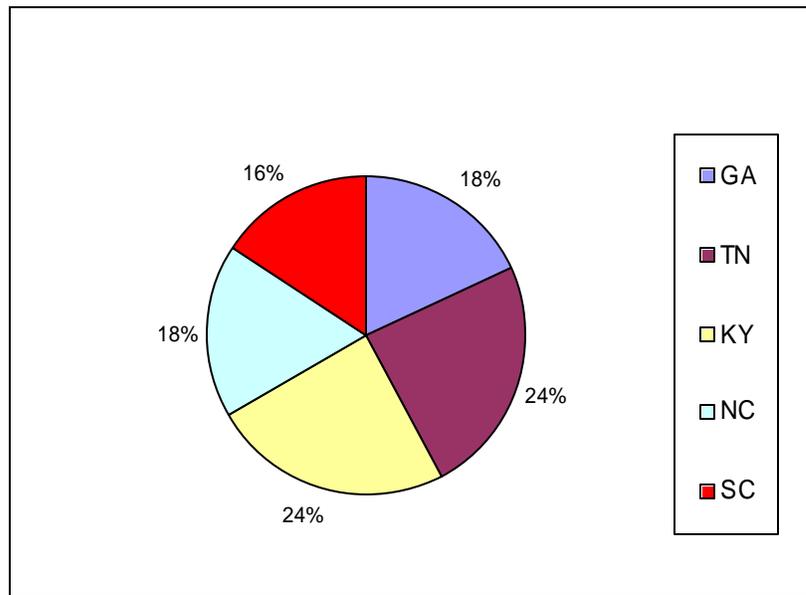


Figure 3.1: Composition of Response by State

An alpha of 0.05 was utilized for the ANOVA test, implying that there is a 5% chance of a Type I error (identifying a significant difference when it does not exist). All items with means that met this criteria are marked with an asterisk (\*) on the following figures.

Need for Institutional, Operational, and Technological Changes to Improve ETO

The majority of transportation and emergency services respondents “agreed” and another large percentage “strongly agreed” that institutional, operational, and technological changes are needed to improve ETO (see Tables 3.4 and 3.5). Because these responses indicate that changes are needed in all three categories, it suggests that improvements in ETO will be extremely difficult without improvements in *each* of the three categories. Therefore, efforts to improve ETO can best be utilized by a multi-faceted approach, and that a singular focus on one aspect of change may have a lower chance of success.

Table 3.4: Transportation Response to the Need for Changes to Improve ETO

<b>Based on your experience and observations, do you agree that...</b> <i>(Please check one box on each line.)</i>	Strongly Agree	Agree	Disagree	Strongly Disagree	No opinion
<i>Institutional</i> changes are needed to improve emergency transportation operations (ETO) in my community/state.	24%	64%	6%	0%	6%
Without <i>institutional</i> changes, improvements in ETO will be extremely difficult.	18%	56%	14%	0%	12%
<i>Operational</i> changes are needed to improve emergency transportation operations (ETO).	30%	58%	6%	0%	6%
Without <i>operational</i> changes, improvements in ETO will be extremely difficult.	20%	56%	16%	0%	8%
<i>Technological</i> advancements are needed to improve emergency transportation operations (ETO).	30%	62%	4%	0%	4%
Without deploying new or improved <i>technologies</i> , improvements in ETO will be will be extremely difficult.	18%	56%	16%	2%	8%

Table 3.5: Emergency Services Response to the Need for Changes to Improve ETO

<b>Based on your experience and observations, do you agree that...</b> <i>(Please check one box on each line.)</i>	Strongly Agree	Agree	Disagree	Strongly disagree	No opinion
<i>Institutional</i> changes are needed to improve emergency transportation operations (ETO) in my community/state.	15%	69%	8%	2%	7%
Without <i>institutional</i> changes, improvements in ETO will be extremely difficult.	11%	62%	17%	1%	10%
<i>Operational</i> changes are needed to improve emergency transportation operations (ETO).	12%	72%	9%	1%	6%
Without <i>operational</i> changes, improvements in ETO will be extremely difficult.	10%	70%	11%	0%	9%
<i>Technological</i> advancements are needed to improve emergency transportation operations (ETO).	15%	73%	5%	0%	7%
Without deploying new or improved <i>technologies</i> , improvements in ETO will be will be extremely difficult.	12%	66%	12%	0%	10%

### Understanding of Other Agencies' Missions

Transportation professionals were asked how well leaders in their respective organizations understand the mission, capabilities, and limitations of emergency services organizations and how well they believe that emergency services agencies understand the transportation group's mission, capabilities, and limitations. Emergency services professionals were asked the same questions about transportation agencies.

The majority of respondents from both groups felt that “limited knowledge and understanding of some aspects” best described this level of understanding (see Tables 3.6 and 3.7). None of the transportation officials selected “thorough knowledge and understanding”, and only a few of the emergency services officials thought that the mutual knowledge and understanding could be described as “thorough”. In both groups, a slightly larger number selected “serious lack of knowledge and understanding”.

These results point to some fundamental gaps in mutual understanding—gaps which both groups recognize. The survey did not address the implications, i.e., the extent to which this limited knowledge and understanding impacts the effectiveness of ETO.

However, fundamental improvements in mutual understanding seem to be an obvious and essential step towards more effective coordination.

Table 3.6: Transportation Response Regarding Understanding of Missions

<b>Based on your experience and observations...</b> <i>(Please check one box on each line.)</i>	Thorough knowledge and understanding	Good knowledge and understanding of the most critical aspects	Limited knowledge and understanding of some aspects	Serious lack of knowledge and understanding	No opinion
How well do most <i>emergency services</i> agencies understand <i>your agency's</i> mission, capabilities, and limitations?	0%	32%	50%	12%	6%
How well do most of the leaders in <i>your organization</i> understand the mission, capabilities, and limitations of emergency services agencies?	0%	44%	46%	6%	4%

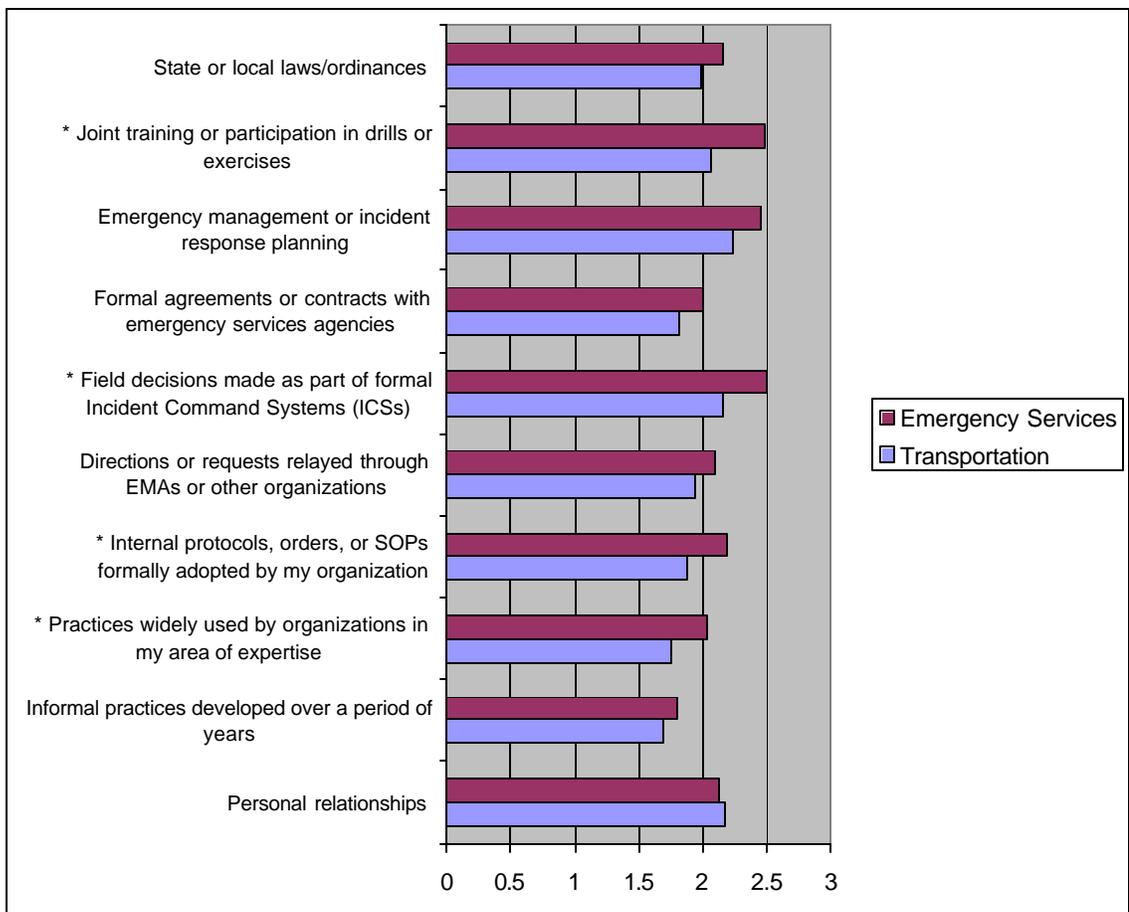
Table 3.7: Emergency Services Response Regarding Understanding of Missions

<b>Based on your experience and observations...</b> <i>(Please check one box on each line.)</i>	Thorough knowledge and understanding	Good knowledge and understanding of the most critical aspects	Limited knowledge and understanding of some aspects	Serious lack of knowledge or understanding	No opinion
How well do most <i>transportation</i> agencies understand <i>your agency's</i> mission, capabilities, and limitations?	3%	39%	43%	10%	5%
How well do most of the leaders in <i>your organization</i> understand the mission, capabilities, and limitations of <i>transportation</i> agencies?	3%	41%	43%	7%	5%

### Importance of Institutional/Operational Factors in Coordination

Respondents were asked to rate the importance of specific institutional and operational factors in their agency's interactions with their counterparts as: Very Important (3), Important (2), Somewhat Important (1), Not Important (0). The scores for each item were then averaged to determine the overall level of importance of that particular item. Answers of No Opinion were not included in the analysis.

Transportation and emergency services respondents agreed in most of their rankings for this question (see Figure 3.2). The top five items ranked by transportation respondents were (1) emergency management or incident response planning, (2) field decisions made as part of formal Incident Command Systems (ICSs), (3) personal relationships, (4) joint training or participation in drills or exercises, and (5) state or local laws/ordinances.



\* Items with significantly different means according to ANOVA test at alpha .05

Figure 3.2: Importance of Institutional/Operational Factors in Coordination

The top five ranked items by emergency services respondents were (1) field decisions made as part of formal Incident Command Systems (ICSs), (2) joint training or participation in drills or exercises, (3) emergency management or incident response planning, (4) internal protocols, orders, or SOPs formally adopted by my organization, and (5) state or local laws/ordinances.

Although the rank order is different, four of the top five choices are the same. Also noteworthy is that the emergency services group assigned significantly more importance to each of the following:

- Joint training or participation in drills or exercises
- Field decisions made as part of formal Incident Command Systems
- Internal protocols, orders, or SOPs
- Practices widely used by organizations in my area of expertise

### Potential Benefits of Specific Technologies

Survey respondents were asked to rate the potential benefits offered by specific technologies to improve ETO. Respondents were asked to rate each item as Major potential benefits for ETO (3), Moderate potential benefits for ETO (2), or Minor potential benefits for ETO (1). Answers of No Opinion were not included in the analysis. The scores for each item were then averaged to determine the overall level of potential benefits of that particular item (see Figure 3.3).

The top ranked technologies by transportation respondents were (1) overhead changeable (dynamic) message signs, (2) closed circuit television (CCTV) roadway surveillance systems, (3) interoperable radio communication systems, (4) co-located or interconnected transportation and public safety dispatch centers, and (5) other GPS and/or GIS based information systems. The top ranked technologies by emergency services

professionals were (1) interoperable radio communication systems, (2) enhanced 911 systems, (3) overhead changeable message signs, (4) sensors and detectors for WMD, (5) other GPS or GIS based information systems.

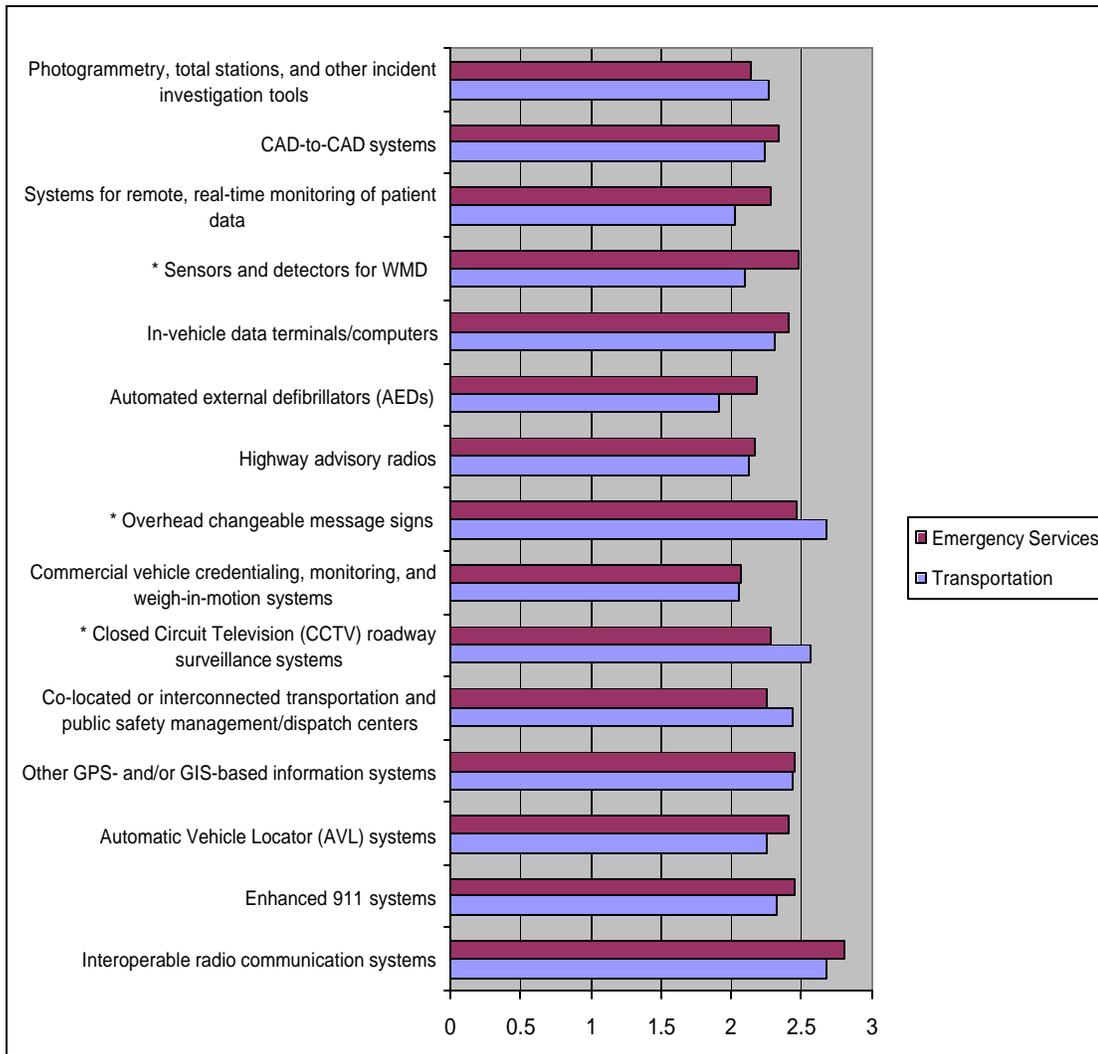


Figure 3.3: Potential Benefits of Specific Technologies to Improve ETO

Every technology was considered to have at least moderate potential benefits for ETO. The combined ratings of the two groups were highest for interoperable radio

communications, overhead changeable (dynamic) message signs, and GPS/GIS systems. These areas of agreement demonstrate where shared resources and coordinated implementation of technology can benefit all ETO groups.

#### Priorities for Resource Allocation and Opinions Regarding Funding Sources

Finally, participants were asked to evaluate the relative priorities for the allocation of resources concerning ETO, recognizing that each organization has multiple responsibilities beyond emergency transportation operations. As shown in Tables 3.8 and 3.9, the most prevalent response was “moderate priority/importance”. Transportation and emergency services professionals rated ETO as a moderate priority in nearly every aspect. It is interesting to note that, relative to “all the highway needs in your community/state,” the transportation group assigned a higher priority to ETO than the emergency services group, i.e., more than the transportation group, the emergency services group seemed to believe that other transportation needs might warrant higher priority than improvements in ETO.

Participants were also asked their opinions on funding for ETO, including the need for additional funds and potential funding sources (see Tables 3.10 and 3.11). The majority of respondents believed that more funding is needed to accomplish ETO improvements. Emergency services representatives felt that transportation agencies have more funding available and should use those resources to pay for ETO. However, most of the transportation respondents disagreed. Emergency services respondents were more optimistic than the transportation group about public support for shifting funds from other sources.

Table 3.8: Transportation Resource Allocation Priorities

<b>Based on your experience and observations...</b> <i>(Please check one box on each line.)</i>	High priority/ importance	Moderate priority/ importance	Low priority/ importance	No opinion
Relative to all of your agency’s current responsibilities, how important are emergency transportation operations (ETO)?	35%	42%	23%	0%
Relative to your agency’s need to invest in more effective relationships with all other state and local agencies, how important are your relationships with emergency services agencies?	42%	42%	17%	0%
Relative to all of your agency’s needs for additional manpower, how important are your manpower needs for ETO-related activities?	31%	35%	33%	0%
Relative to all of your agency’s needs for expanded/enhanced training, how important are the needs for ETO-related training?	25%	46%	27%	2%
Relative to all of your agency’s needs for new or improved technology, how important are the technologies needed for improved ETO?	38%	42%	19%	2%
In your agency’s plans for the future, what priority is given to ETO?	25%	42%	29%	4%
Relative to all the highway needs in your community/state (e.g., maintenance, added capacity, improved signalization, hazard elimination), what priority do you believe should be assigned to ETO improvements?	49%	34%	15%	2%

Table 3.9: Emergency Services Resource Allocation Priorities

<b>Based on your experience and observations...</b> <i>(Please check one box on each line.)</i>	High priority/ importance	Moderate priority/ importance	Low priority/ importance	No opinion
Relative to all of your agency’s current responsibilities, how important are emergency transportation operations (ETO)?	41%	44%	15%	0%
Relative to your agency’s need to invest in more effective relationships with all other state and local agencies, how important are your relationships with transportation agencies?	41%	46%	12%	2%
Relative to all of your agency’s needs for additional manpower, how important are your manpower needs for ETO-related activities?	24%	45%	25%	6%
Relative to all of your agency’s needs for expanded/enhanced training, how important are the needs for ETO-related training?	25%	54%	17%	4%
Relative to all of your agency’s needs for new or improved technology, how important are the technologies needed for ETO?	36%	45%	15%	4%
In your agency’s plans for the future, what priority is given to ETO?	9%	54%	29%	7%
Relative to all the highway needs in your community/state (e.g., maintenance, added capacity, improved signalization, hazard elimination), what priority do you believe should be assigned to ETO improvements?	38%	49%	9%	4%

Table 3.10: Transportation Opinions on Funding for ETO

<b>Based on your experience and observations, do you agree that...</b> <i>(Please check one box on each line.)</i>	Strongly Agree	Agree	Disagree	Strongly Disagree	No opinion
The most needed ETO improvements can be accomplished without new sources of funding.	6%	15%	52%	25%	2%
Dedicated federal funding sources are needed to pay for ETO projects and programs.	38%	54%	8%	0%	0%
Dedicated state funding sources are needed to pay for ETO projects and programs.	25%	60%	13%	2%	0%
Transportation agencies have more funding available than emergency services agencies and should share those resources to improve ETO.	0%	21%	31%	29%	19%
The public would support shifting funds from other existing programs to improve ETO.	8%	25%	40%	8%	19%

Table 3.11: Emergency Services Opinions on Funding for ETO

<b>Based on your experience and observations, do you agree that...</b> <i>(Please check one box on each line.)</i>	Strongly Agree	Agree	Disagree	Strongly disagree	No opinion
The most needed ETO improvements can be accomplished without new sources of funding.	2%	17%	53%	24%	4%
Dedicated federal funding sources are needed to pay for ETO projects and programs.	29%	59%	5%	0%	6%
Dedicated state funding sources are needed to pay for ETO projects and programs.	24%	59%	8%	1%	8%
Transportation agencies have more funding available than emergency services agencies and should share those resources to improve ETO.	24%	37%	10%	1%	29%
The public would support shifting funds from other existing programs to improve ETO.	12%	32%	21%	7%	28%

## Conclusions

The findings from this research indicate that institutional, operational, technological, and financial changes are necessary to improve ETO. Because the survey results indicate that changes are needed in all four categories, it suggests that improvements in ETO will be difficult without improvements in each category. Therefore, efforts to improve ETO can best be utilized by a multi-faceted approach. The majority of both transportation and emergency services respondents felt that “limited knowledge and understanding of some aspects” best described their understanding of other agency missions, capabilities, and limitations. Closing the gap in mutual

understanding would seem to be an obvious and essential step towards more effective coordination.

There was general agreement on the institutional/operational factors considered most important by each group in their interactions with one another. These factors included emergency management or incident response planning; field decisions made as part of formal ICS; joint training or participation in drills or exercises; and state or local laws / ordinances. In general, emergency services officials associated greater importance with these considerations.

Every technology was considered to offer at least moderate potential benefits for ETO. The technologies rated by both groups as having high potential benefit were interoperable radio communications, overhead changeable (dynamic) message signs, and GPS/GIS systems. These areas of agreement demonstrate where shared resources and coordinated implementation can benefit all ETO groups.

Financial aspects are always a concern when improvements in any system are needed. This study sought to identify issues surrounding funding priorities within agencies as well as potential funding sources for improving ETO. Both transportation and emergency services rated ETO as a moderate priority relative to all agency responsibilities and relative to the need for additional manpower, training, and technology. Both groups felt that more funding is needed to accomplish ETO improvements, coming from federal and state dedicated funds. Emergency services believe that transportation departments have more money available and thus should share those resources to improve ETO and the public would support shifting funds from other

areas to improve ETO. Transportation respondents disagree with both of these points of view.

The prioritization of specific aspects established in this study can aid the transportation and emergency response communities to focus on actions to improve ETO coordination by making appropriate organizational changes. The analysis of variance highlights areas where opinions within transportation agencies differ from those within emergency services agencies. Significant differences were found in items pertaining to the importance of specific institutional/operational factors in interagency interactions and the potential for certain technologies to improve emergency transportation operations. These differences may present challenges to improved coordination. For example, sensors and detectors for weapons of mass destruction was considered to be more beneficial for ETO by emergency services than by transportation respondents; whereas closed circuit television roadway surveillance systems were considered more beneficial for ETO by transportation than by emergency services respondents. Sharing in the costs of technological resources can benefit all ETO groups; however, if these groups cannot agree on funding priorities, the benefits will not be achieved. The aforementioned differences can perhaps be overcome by establishing a coordinated multi-agency framework for ETO, through which decisions can be made that will benefit all ETO core groups.

This research begins to clarify some of the ways that organizational factors can impact coordination between ETO groups. More research needs to be performed to enhance understanding of the role that organizational design plays in these relationships. For example, a deeper examination of the cultures and motivations of these various

organizations can highlight additional opportunities or barriers to full ETO integration. In addition, this study did not address the level of accountability of managers or on-scene responders for meeting the goals of their respective agencies nor how competing goals between transportation departments and emergency response agencies might impede effective coordination.

## References

- Brook, K., Dopart, K., Smith, K. and Flannery, A. (2004). National Cooperative Highway Research Program (NCHRP) "Sharing Information between Public Safety and Transportation Agencies for Traffic Incident Management."
- Caid, L. (2003). "Tucson Fire Department's MMRS Exercise: A Bioterrorism Response Plan." Public Management. 85: (6) 12.
- Daft, R.L. (2001). Essentials of Organization Theory and Design 2<sup>nd</sup> ed. South-Western College Publishing.
- Gertman, D., Byers, J., Blackman, H., Haney, L., Smith, C., Marble, J., and Nadeau, J. (2002). Spar-H Method.
- McEwen, H. R. (2003). "Public Safety Support for Intelligent Transportation Systems." The Police Chief, Feb.
- National Highway Traffic Safety Administration (NHTSA), National Association of Governors' Highway Safety Representatives, National Association of State EMS Directors, (2000). "Cooperation and Partnership: Keys to Success: State Highway Safety and EMS Agencies Working Together to Improve Public Health." <http://www.nhtsa.dot.gov/people/injury/ems/pub3/index.htm> [accessed July 2004].
- Reason, J. (1990). Human Error. Cambridge University Press, Cambridge.
- Roberts, C.D. (2001). "Regional Operating Organizations." <http://www.itspublicsafety.net/Robertsarticle.htm> [accessed August 2004].
- Shepherd, K., Baird, M., Abkowitz, M., and Wegman, F., "Assessing the Need for Improved Coordination between Transportation and Emergency Response Organizations," [Unpublished working paper].

## CHAPTER IV

### INITIATIVES TO IMPROVE COORDINATION BETWEEN TRANSPORTATION AND EMERGENCY SERVICES ORGANIZATIONS

#### Introduction

Transportation and emergency response agencies work together on a routine basis to handle emergencies that impact the transportation system and threaten public health and safety. It has been established through prior research that the current state of coordination between these groups needs to be improved through changes in the way these organizations function and interact (Shepherd, et al, 2005a). Although short-term initiatives can effect minor improvements in coordination, to thoughtfully address this problem, changes in organizational design may be necessary to achieve long-term gains. The focus of this research is to identify short term initiatives that could improve coordination between transportation and emergency services organizations, and to explore the potential for change agents based on organizational design theory that would result in long term improvement.

Emergency transportation operations (ETO) is defined herein as all actions taken in regards to any incident occurring on the transportation infrastructure, or requiring use of the transportation infrastructure, in order to protect health and safety. ETO refers to response, recovery, mitigation, prevention, and preparedness actions taken in the following situations:

- Minor traffic crashes, disabled or abandoned vehicles, debris in the roadway, and other circumstances that disrupt traffic flow and create hazards
- Major traffic crashes involving fatalities, injuries, overturned vehicles, and serious property damage

- Highway construction and maintenance work zones
- Special events that attract large crowds and create exceptional traffic demands
- Law enforcement and security activities that cause major traffic disruptions
- Hazardous material spills on or near the transportation infrastructure
- Severe weather and natural disasters, including events that require large-scale evacuation
- Public health emergencies or other events that require large-scale travel restrictions or quarantines
- Acts of terrorism that target the transportation system or that create exceptional transportation demands

“Transportation agencies” refer to state departments of transportation, toll road authorities, and local highway, public works, and traffic engineering organizations—the public agencies directly responsible for the construction, maintenance, and operation of roadways in a particular state or community. The focus of this research was on highway transportation, although some of the findings and conclusions may be applicable to other modes. “Emergency services agencies” refer to law enforcement, fire and rescue services, emergency medical services (EMS), emergency communications, emergency management agencies (EMA), and homeland security.

### **The Need for Improved Coordination**

The need for improved coordination among ETO agencies is widely supported by both transportation and emergency services literature and initiatives at local, state, and federal levels of government. Interaction among these agencies is inherent in the work they do; it is a given. Communication of information and interoperability of technologies are often raised as issues impeding effective communication. However, ETO agencies are seeing the need to move these considerations to improved cooperation and coordination through the establishment of protocols on how agencies are to work together

in managing ETO situations (PIMA Association of Governments, 2003; FEMA, 2001; PSWN, 2005). A study conducted by the Federal Highway Administration and the Federal Transit Administration to investigate and highlight successful practices for traffic incident management across the country found that interagency coordination and cooperation facilitate efficiency in operations but require constant attention to keep agencies focused on shared incident management objectives. In addition, this study concluded that, without a high degree of interagency coordination, the full benefits of technology cannot be realized (FHWA and FTA, 2000).

The current system for ETO imitates a functional organization design. Each agency supplies a different function for the response effort (See Table 4.1).

Table 4.1: Functional Expertise of Core ETO Organizations

<b>ETO Group</b>	<b>ETO Focus</b>
Law Enforcement	Investigation, Protection
Emergency Medical	Medical Treatment
Fire and Rescue	Extrication, Fire Suppression
Emergency Mgt.	Preparedness, Training, Planning, and Coordination
Emergency Comm.	Dispatch and follow-up Communication
Homeland Security	Terrorism, Disaster Preparedness
Transportation	Mobility, Safe Travel

This type of organizational architecture can create both benefits and problems. In general, benefits include promoting effective coordination within the functional areas and development of functional expertise. Potential problems include the loss of important information in transfers between departments, a tendency for employees to concentrate on their functional specialties rather than on big-picture goals, and stifled innovation (Brickley, Smith, and Zimmerman, 2001; Daft, 2001).

A functional organization design leads to an inherent lack of coordination among departments unless specific initiatives are in place to promote coordination. Such initiatives include bringing representatives together to surface conflict and to plan improvement in coordination, developing cross functional teams for a specific purpose, and support and encouragement of idea champions (Daft, 2001; Brown and Eisenhardt, 1995; Frost and Egri, 1991).

### **Initiatives to Improve Coordination**

To develop a list of specific ETO initiatives that might improve coordination between transportation and emergency service agencies, one must take into consideration (1) motivation for improving coordination, (2) scenarios and activities where improved coordination is most needed, and (3) organization factors that impact coordination.

Surveys administered to transportation and emergency service professionals explored these topics as they relate to ETO (Shepherd, et al, 2005a, Shepherd, et al, 2005b). Respondents reported the most important reasons to improve coordination to be (1) reduce the time to restore normal traffic conditions, (2) improve scene and responder safety, (3) improve incident response times, (4) reduce the impact of major disasters,

terrorist attacks, or other large-scale events, (5) improve the accuracy and timeliness of information provided to motorists and the public, and (6) avoid or reduce the frequency and severity of hazardous material releases.

Survey results also indicated that the most important scenarios in terms of need for improved coordination were terrorist attacks, freeway crashes, public health emergencies, and failure or blockage of transportation infrastructure. The most important response activities in terms of the need for improved coordination were response planning, training, communicating, advising motorists, and evacuation planning. Finally, institutional, operational, and technological factors that most significantly impact coordination include emergency management planning, decisions made as part of the Incident Command System (ICS), joint training, and systems that aid in communication among responders and with the public.

### Study Methodology

Following analysis of the survey results, a focus group was convened consisting of individuals representing state and local transportation, emergency medical services, fire and rescue, emergency communications, and law enforcement agencies from Nashville, TN. Its purpose was to use the survey results as a basis for identifying practical and cost-effective strategies to improve ETO coordination.

The focus group was presented with a list of six highly-ranked objectives for improved ETO and asked to evaluate the achievability of each objective relative to institutional, operational, technological, and financial factors, using a relative scale of

high, medium, and low. Each member completed the matrix, and the focus group then discussed and reached consensus as summarized in Table 4.2.

The focus group concluded that the objectives that appeared most achievable (i.e., would encounter the fewest institutional, operational, technological, and financial factors) were “advising the public of incidents and roadway conditions” and “reducing the time to restore normal traffic conditions after an incident.” “Improving incident response times” was also seen as highly achievable subject to financial constraints.

Table 4.2: Achievability of Key Objectives for Improving ETO Coordination

Objective	Achievability		
	Institutional/ Operational	Technological	Financial
1. Avoid or reduce the frequency and severity of hazardous material releases	Medium	Medium/High	Low
2. Better advise motorists and the public of incidents and roadway conditions	High	Medium/High	Medium/High
3. Improve scene and responder safety	High/Medium	High/Medium	Medium
4. Reduce the time to restore normal traffic conditions following incidents	High/Low <sup>1</sup>	High	High/Low <sup>1</sup>
5. Reduce the impact of major disasters, terrorist attacks, or other large-scale events	Medium	Medium	Medium/Low
6. Improve incident response times	High/Low <sup>2</sup>	High	Medium

<sup>1</sup>This item was considered to depend on the specific incident and geographic location, thus low might be appropriate in some situations and high might be appropriate in others.

<sup>2</sup>One transportation professional reported seeing less commitment to this objective, but the other participants consider it of high institutional/operational achievability and fairly high commitment by their respective organizations.

The focus group was also asked to evaluate a list of potential strategies for short-term action to improve emergency transportation operations. This list was prepared by combining the scenarios and response activities identified as most in need of improvement. The most highly ranked incidents needing coordination improvement were terrorist attacks, freeway crashes, public health emergencies, and failure or blockage of transportation infrastructure. The response activities identified as most important for improved ETO were planning, training, communicating, advising motorists, and evacuation and quarantine planning.

From this process, four strategies for short-term actions emerged as the top priorities:

- Include more transportation topics in training for emergency response personnel and more emergency services topics in training for transportation personnel
- Implement new interagency (joint transportation and emergency services) training programs
- Increase participation in multi-agency operations planning for all types of hazards
- Improve interoperability of communication and other information technologies

Two other strategies were recommended for consideration, but these were assigned “medium” rather than “high” importance:

- Plan and conduct more terrorism exercises with transportation-specific components
- Improve communication at the policy and operational levels

## **Long-term Changes to Improve Coordination**

The aforementioned initiatives to improve coordination would only begin to address the issues that currently impede ETO coordination effectiveness. Although implementing these actions may improve coordination in the short-term, long-term improvements would require redesigning the ETO system based on existing organizational design theories.

The current ETO system is predominantly a functional design with inherent coordination problems. Other common organization structures were considered for ETO, including the divisional and matrix structures.

In the divisional structure, divisions are organized according to individual products or services. In the ETO system, this would mean having teams with specialists from each ETO group that respond to a specific type of incident, such as a hazmat response task force or a team that specializes in freeway traffic crashes. Strengths of this design include being well-suited to fast change in an unstable environment and high coordination across functions. However, weaknesses are poor coordination across product lines (response teams in the ETO case) and it eliminates in-depth competence and technical specialization (Duncan, 1979).

Although coordination is a problem in the current ETO system, functional expertise and in-depth competence is vital for effective response. A matrix structure is a type of horizontal linkage with a dual hierarchy. It is a combination of two structures, such as the functional and divisional. In this organization form, a police officer who specializes in traffic incidents would report to both the police chief and to a manager overseeing a multi-agency traffic incident task force. In this situation, both the vertical

(police chief) and horizontal (task force manager) lines of authority must be given equal power and influence. The strengths of this model are that it achieves coordination and provides for functional as well as specialty expertise. However, the weaknesses are that dual authority can be frustrating and confusing, employees must have good interpersonal skills, and this structure can be time consuming and require frequent conflict resolution meetings (Duncan, 1979).

While there are inherent problems with divisional and matrix structures for handling ETO coordination, several promising organizational design concepts have been developed that could result in greater external coordination effectiveness. Foremost among these is the Functional Model with Horizontal Linkages organizational structure. This approach could be implemented in isolation and render value, or could be implemented in conjunction with complementary approaches to achieve greater benefit.

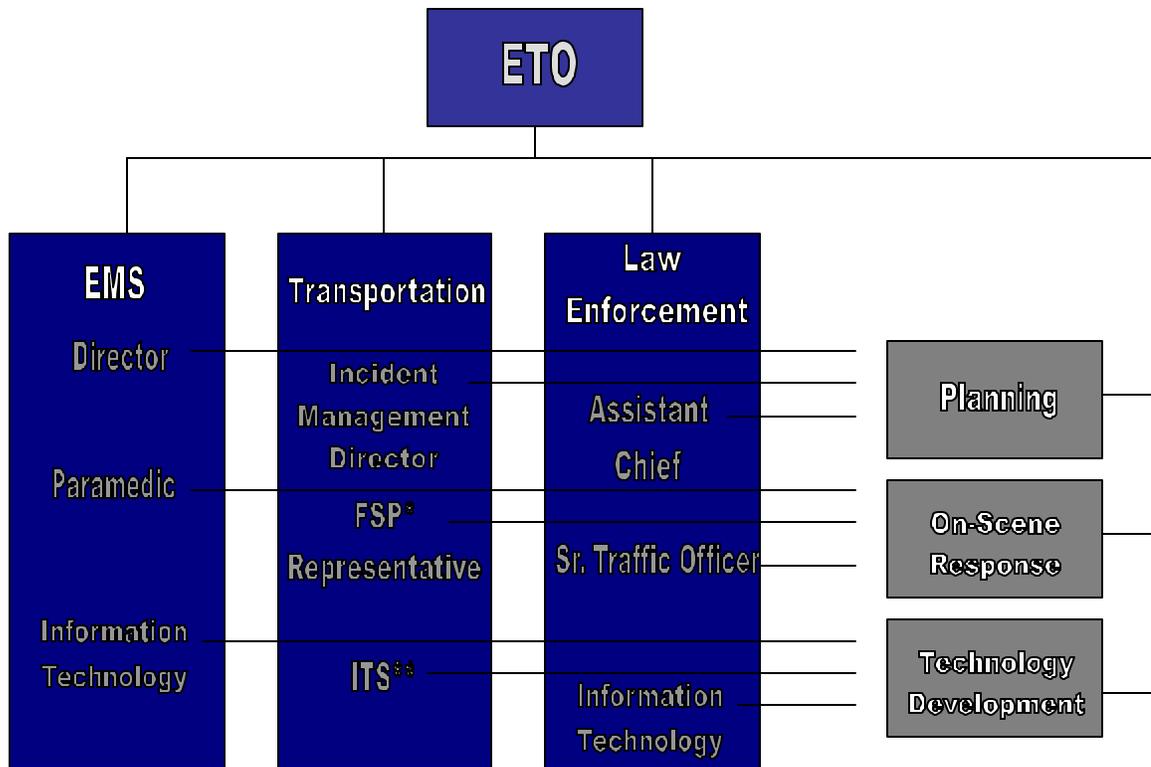
#### Functional Model with Horizontal Linkages

The term horizontal linkage refers to communication and coordination horizontally across organizational departments (Daft, 2001). Horizontal linkages can be established by a number of mechanisms. The following examples of devices to create horizontal linkages are listed in order from the weakest to the strongest (Galbraith, 1973):

- Shared Information Systems—enables responders to routinely exchange information regarding problems, potential solutions, ideas, activities, and decisions.

- Direct contact—one method for achieving direct contact between organizations is to establish a liaison within each organization who has the specific responsibility for communicating and coordinating with the other organization.
- Task forces—a task force is a temporary committee made up of representatives from each organization affected by an issue (Kiechel, 1991). These committees are effective for temporary issues or to achieve a specific task, such as ETO planning, but are typically disbanded after the task is complete.
- Full-time integrator—in a business setting in which the goal is to improve coordination among several departments, the integrator's sole responsibility is coordination and he/she does not report to one of the other functional departments. In the ETO environment, a role such as this could be carried out by a member of homeland security or emergency management.
- Teams—the primary difference between a team and a task force is that teams are permanent and are most effective when strong coordination is required among organizations over a long period of time. In the ETO system, incident management and on-scene response are always going to require strong coordination.

A conceptual model of how horizontal linkages could work in ETO is shown in Figure 4.1. The organizations portrayed in the model are for illustration purposes only. Some of the core ETO organizations were not included in this example for the sake of simplicity. Although the functional horizontal linkages model for organizational relationships might improve ETO coordination, the challenge lies in convincing respective organizations to care enough about ETO and the current lack of coordination to desire change.



\* Freeway Service Patrol    \*\* Intelligent Transportation Systems

Figure 4.1: Horizontal Linkages Model for ETO

The following steps are involved in implementing change (Daft, 2001):

1. A true need for change must exist—if the organizations involved in the change do not believe the problem exists, success is improbable.
2. The change idea must fit the problem—finding the right solution requires much research and effort. All organizations involved should be included in developing the solution.
3. Top management support is required—The lack of top management support is one of the most frequent causes of implementation failure (Rogers and Shoemaker, 1971).

4. Incremental implementation works best—Responders may feel overwhelmed and resist the change if large-scale change is implemented all at once.
5. Plan to overcome resistance to change—Anticipation of conflict and resistance will help those implementing the change to prepare strategically to quell fears and uncertainties.
6. Work in teams—a task force with representatives from the different organizations will insure that the concerns of various organizations are addressed and will aid in obtaining buy-in from the employees in the different organizations.
7. Foster idea champions—Someone who sincerely believes in the idea will be the best salesperson of that idea.

#### Complementary Approaches

One of the core problems with improving coordination between transportation and emergency response organizations is the differing missions and objectives of the involved agencies. A unique Japanese form of corporate organization addresses this very issue. The Keiretsu model of multi-organizational relationships is comprised of a network of affiliated companies that form a tight-knit alliance to work toward each other's mutual success. The vertical Keiretsu defines the type of relationship between Japanese manufacturers and their suppliers. This relationship is essentially a pyramid with the dominant manufacturer at the top. For example, The Toyota Group sits atop its Keiretsu with three levels of suppliers below it. In the upper level are ten first-tier subcontractors. The middle level of the pyramid is made up of about 250 second and third tier

subcontractors. Finally the lower level is composed of “hundreds upon hundreds of smaller companies (Miyashita and Russell, 1994).” The relevant point from this model of supplier relationships is that all of the organizations in a Keiretsu work with the same vision and objectives in mind.

An American company that has adopted a Keiretsu-style of supplier relations is Chrysler. Six years into this organizational change, Chrysler had reduced its product development cycle by 51 weeks, significantly reducing the overall costs of developing and launching a new model, reducing procurement costs, and increasing market share and profitability. In addition, Chrysler implemented the Supplier Cost Reduction Effort (SCORE) program, a formal method for obtaining, considering, and implementing cost-cutting ideas from suppliers. In one year alone, Chrysler implemented 5,300 ideas that generated more than \$1.7 billion in annual savings for the company (Dyer, 2000).

One of the most significant contributing factors to the success of Chrysler’s new supplier management model was enhanced communication between Chrysler and its suppliers. Chrysler’s executives found that “people...must have a common vision of how to collaborate to create value jointly (Dyer, 2000).” The following factors contributed to the success of Chrysler’s Keiretsu:

- **Necessity:** Change does not usually occur until someone realizes that it must. Chrysler was in a dire financial situation and something had to change.
- **Executive management embrace and direction:** The top managers at Chrysler instituted this strategy change by benchmarking competitors, listening to suppliers, and experimenting with ideas and programs.

- Clearly outlined benefits: Chrysler had to develop an incentives structure to provide benefits to its suppliers for this type of relationship and had to convince its own engineers of the benefits to their company.
- Enhanced communication: Chrysler employed resident engineers (suppliers' engineers who worked side by side with Chrysler's employees), instituted a common e-mail system, created an advisory board of executives from its top 14 suppliers, established an annual meeting of its top 150 strategic suppliers, and held quarterly meetings with each supplier to discuss strategic and performance issues and to review priorities for the coming year.

SCORE was developed to motivate Chrysler suppliers to participate in continuous improvement. The three steps followed by Chrysler to enhance supplier relationships were (1) focus on what Chrysler was doing wrong first, (2) ask suppliers to make suggestions for changes involving materials or parts provided by lower-tier suppliers, and (3) focus on what key suppliers could change to reduce costs. The real motivation was that suppliers were given 50% of the cost savings from good ideas. In addition, suppliers received a score based on the number of cost-saving proposals, the dollar amount of savings they generated, along with price, quality, delivery, and technology to grade performance. Chrysler used these ratings in selecting suppliers for future business.

At issue is whether the Keiretsu model can be applied to improve ETO effectiveness. Transportation departments could perhaps utilize a similar strategy to motivate emergency service organizations to participate in continuous ETO improvement. By establishing specific incentives to encourage other agencies to work with transportation and to generate ideas to improve the efficiency and effectiveness of

emergency transportation operations, successful coordination is more likely. Table 4.3 highlights the factors that contributed to Chrysler’s success and related mechanisms transportation departments could employ to improve coordination with emergency services agencies.

Table 4.3: Key Findings from Chrysler Applicable to Transportation Departments

Success Factors	Chrysler Specifics	Potential Transportation Specifics
Necessity	Financial crisis made change necessary	Increased demand on the transportation system makes more efficient and effective ETO necessary
Executive management support	Top managers at Chrysler developed and instituted the change	Top managers would need to develop and implement the change
Clearly outlined benefits	Incentives for suppliers included shared cost savings and consideration for future work	Incentives could include shared technology and grants for ETO-related equipment and training
Enhanced communication	Resident engineers, common e-mail system, advisory board of top executives from top suppliers, annual meeting with top suppliers	Organization liaison, interoperable radio communications equipment, planning committee with top agency management, annual meeting with larger group of ETO responders

A key challenge to the successful implementation of an ETO keiretsu would be the ability of transportation departments to serve at the top of the pyramid and the willingness of emergency service organizations to act as “suppliers.” Certainly, transportation departments lack the leverage that an automobile manufacturer has over its part providers. Significant buy-in on the part of emergency services organizations would

be necessary, along with transportation departments acting as the lead agency without imposing its will on the other organizations.

## **Conclusions**

The present transportation and emergency services inter-organizational structure consists of disjointed agencies in need of improved coordination. Consequently, development of an action-oriented plan for improvement is appropriate, one that considers both short-term and long-term initiatives.

In the short-term, the most achievable objectives appear to be improving the ability to advise the public of incidents and roadway conditions, reduce the time to restore normal traffic conditions after an incident, and improve incident response times. This may be most effectively accomplished through: (1) including more transportation topics in training for emergency response personnel and more emergency services topics in training for transportation personnel, perhaps through new interagency training programs; (2) increasing participation in multi-agency operations planning for all types of hazards; and (3) improving interoperability of communication and other information technologies.

Although some improvements in coordination between transportation and emergency services can be made by implementing the aforementioned initiatives, greater coordination will only occur if organizational changes are made that induce ETO organizations to work together and to share a common vision and objectives for success. Key components of change include having all relevant parties believe there is need for

change, share in the planning process, and be led by decision makers committed to change.

Findings from models of organizational design and supplier relations in various industries can offer insight into problems and successes that can be expected when changing organizational policies and procedures to improve ETO relationships. The functional design with horizontal linkages organizational structure, including such devices as shared information systems, direct contact, task forces, full-time integrators, and teams, can improve horizontal coordination between ETO agencies. Furthermore, the Keiretsu model for multi-organizational relationships may offer added benefits of coordination if a common vision of success is shared by the involved organizations. Central to the Keiretsu model is building relationships among organizations that foster improved outcomes through sharing of responsibility and benefits. Key components of this model include awareness of necessity for change, executive management embrace and direction, clearly outlined benefits, and effective communication.

Whether the Keiretsu model could be successfully implemented for ETO will be dependent, however, on the ability and willingness of transportation departments to lead and emergency services organizations to follow. Leaders in transportation and emergency agencies have indicated that change is needed through the results of surveys and focus group activities. The challenge in creating a new organizational paradigm is in motivating champions at the executive level from all relevant agencies to care enough about ETO and the current lack of coordination to desire change, share in the vision and establish common objectives, see the benefits of joint responsibility and working under a common structure, and establish an effective communication network.

## References

- Brickley, J.A., Smith, C.W., and Zimmerman, J.L. (2001). *Managerial Economics and Organizational Architecture*, 2<sup>nd</sup> ed, McGraw Hill Irwin, Boston.
- Brown, S.L. and Eisenhardt, K.M. (1995). "Product Development: Past Research, Present Findings, and Future Directions," *Academy of Management Review* 20 no.2: 343-378.
- Daft, R.L. (2001). *Essentials of Organization Theory and Design*, 2<sup>nd</sup> ed, Southern-Western, USA.
- Duncan, R. (1979). "What is the Right Organization Structure? Decision Tree Analysis Provides the Answer," *Organizational Dynamics*, 429.
- Dyer, J.H. (2000). "How Chrysler Created an American Keiretsu," in *Harvard Business Review on Managing the Value Chain*, Boston, MA: Harvard Business School Press, 61-90.
- Federal Emergency Management Agency (FEMA), (2001). *Guide for All-Hazard Emergency Operations Planning State and Local Guide* 101.
- Federal Highway Administration (FHWA) and Federal Transit Administration (FTA), (2000). *Incident Management Successful Practices: A Cross-Cutting Study*, April.
- Frost, P.J. and Egri, C.P. (1991). "The Political Prowess of Innovation," in *Research in Organizational Behavior* editors Cummings, L.L. and Staw, B.M., vol. 13 New York: JAI Press, 229-295.
- Galbraith, J.R. (1973). *Designing Complex Organizations*, Reading, MA: Addison-Wesley.
- Kiechel, W. (1991). "The Art of the Corporate Task Force," *Fortune*. 28 January, 104-105.
- Miyashita, K. and Russell, D. (1994). *Keiretsu: Inside the Hidden Japanese Conglomerates*, McGraw-Hill: New York.
- PIMA Association of Governments. (2003). "2030 Regional Transportation Plan: Regional Transportation Incident and Emergency Management (Fact Sheet)", July.
- Public Safety Wireless Network (PSWN), Public Safety Coordination and Partnerships Awareness Guide, [http://www.safecomprogram.gov/NR/rdonlyres/E456109A-CDEC-4679-948F-DE818E1CB8DE/0/coordination\\_and\\_partnerships\\_guide.pdf](http://www.safecomprogram.gov/NR/rdonlyres/E456109A-CDEC-4679-948F-DE818E1CB8DE/0/coordination_and_partnerships_guide.pdf) [accessed March 3, 2005].

Rogers, E.M. and Shoemaker, F.(1971). *Communication of Innovations: A Cross-Cultural Approach*, 2<sup>nd</sup> ed. New York: Free Press.

Schon, D.A. (1963). Champions for Radical New Inventions, *Harvard Business Review*, (March-April), 77-86.

Shepherd, K., Baird, M., Abkowitz, M., and Wegman, F. (2005). "Assessing the Need for Improved Coordination between Transportation and Emergency Response Organizations," [Unpublished working paper].

Shepherd, K., Baird, M., Abkowitz, M., and Wegman, F. (2005). "The Impact of Organizational Factors on Coordination between Transportation and Emergency Services Organizations," [Unpublished working paper].

## **CHAPTER V**

### **CONCLUSIONS**

This study demonstrates how the fundamentally different missions of transportation and emergency services agencies affect how they view the needs for coordinated efforts in handling emergency transportation operations. While a priori one might have assumed that each group cares little about the other, it appears that the issue is more about not having a clear understanding of respective roles. This research has provided an opportunity to delve into these considerations with an eye towards charting a path that can lead to improved ETO coordination.

The findings from this research support the hypothesis that improvements in ETO are needed, and better coordination between transportation and emergency services is necessary to realize those improvements. To accomplish this objective, emergency services organizations expect some ETO leadership, or at least initiative, from transportation agencies. While both groups see value from improved ETO, they perceive different benefits, or at least place different values on those benefits. The lone exception is general agreement on the importance of avoiding or reducing secondary crashes caused by traffic backups.

Opportunities to improve coordination apply to a variety of incident scenarios and response activities. Both groups agree the most important scenarios where coordination is needed are terrorist attacks; however, the groups differ significantly over the importance of improved coordination in freeway traffic crashes and public health

emergencies. The top response action ranked by both groups requiring improved coordination is communicating during emergencies, and both groups included evacuation planning among their top choices.

Finally, it was determined that respondents, both transportation and emergency services officials, had a low level of awareness of existing ETO initiatives, both within their discipline and in other ETO disciplines. This finding suggests that additional efforts are needed to facilitate the sharing of information about ETO improvements and interagency experiences.

This research also concluded that institutional, operational, technological, and financial changes are necessary to improve ETO. As it appears that changes are needed in all four categories, this finding suggests that improvements in ETO will be difficult without improvements in each category. Therefore, efforts to improve ETO can best be utilized by a multi-faceted approach.

The majority of both transportation and emergency services respondents felt that “limited knowledge and understanding of some aspects” best described their understanding of other agency missions, capabilities, and limitations. Closing the gap in mutual understanding would seem to be an obvious and essential step towards more effective coordination.

There was general agreement on the institutional/operational factors considered most important by each group in their interactions with one another. These factors included emergency management or incident response planning; field decisions made as part of formal ICS; joint training or participation in drills or exercises; and state or local

laws / ordinances. In general, emergency services officials associated greater importance with these considerations.

Every technology was considered to offer at least moderate potential benefits for ETO. The technologies rated by both groups as having the greatest potential benefit were interoperable radio communications, overhead changeable (dynamic) message signs, and GPS/GIS systems. These areas of agreement demonstrate where shared resources and coordinated implementation can benefit all ETO groups.

Both transportation and emergency services rated ETO as a moderate priority relative to all agency responsibilities and relative to the need for additional manpower, training, and technology. Both groups felt that more funding is needed to accomplish ETO improvements, coming from federal and state dedicated funds. Emergency services believe that transportation departments have more money available and thus should share those resources to improve ETO, and the public would support shifting funds from other areas to improve ETO. Transportation respondents disagree with both of these points of view.

In the short-term, the most achievable objectives for enhanced ETO coordination are to improve the ability to advise the public of incidents and roadway conditions, reduce the time to restore normal traffic conditions after an incident, and improve incident response times. The proposed approach for accomplishing these goals is to: (1) include more transportation topics in training for emergency response personnel and more emergency services topics in training for transportation personnel, perhaps through new interagency training programs; (2) increase participation in multi-agency operations

planning for all types of hazards; and (3) improve interoperability of communication and other information technologies.

Although some improvements in coordination between transportation and emergency services can be made by implementing the proposed initiatives, greater coordination will only occur if organizational changes are made that induce ETO organizations to work together, sharing a common vision and objectives for success. Key components of change include having all relevant parties believe there is need for change, share in the planning process, and be led by decision makers committed to change.

From reviewing models of organizational design and supplier relations in various industries, insight can be gained into problems and successes that can be expected when changing organizational policies and procedures to improve ETO relationships. The functional design with horizontal linkages organizational structure, including such devices as shared information systems, direct contact, task forces, full-time integrators, and teams, would offer an opportunity to improve horizontal coordination between ETO agencies. Furthermore, the Keiretsu model for multi-organizational relationships may offer added ETO coordination if a common vision of success is shared by the involved organizations. It is uncertain, however, whether transportation and emergency services organizations could successfully adopt a keiretsu approach for ETO unless there is a willingness on the part of transportation departments to lead and emergency services organizations to follow.

Based on the results of surveys and focus group activities, leaders in transportation and emergency agencies have indicated that change is warranted. The challenge in creating a new organizational paradigm is in motivating champions at the

executive level from all relevant agencies to care enough about ETO and the current lack of coordination to desire change, share in the vision and establish common objectives, see the benefits of joint responsibility and working under a common structure, and establish an effective communication network.

Questions regarding the representativeness and transferability of the research findings must also be addressed. The recent occurrence of a large-scale incident in or near an area where the survey was administered could have introduced bias in the study in that responders in that particular area would be more aware of coordination needs than the general ETO population. Key officials in the states where the survey was administered were interviewed regarding this potential problem, and all confirmed that no such bias existed.

Some may argue that even if this study was representative within the southeast region, similar findings would not have been achieved in other parts of the country. However, when one considers the range and area of perspective shown by the responding agencies from both local and state levels, it is likely that the findings reported herein are transferable across the U.S.

This research only begins to clarify some of the factors that can impact the effectiveness of interagency coordination to improve emergency transportation operations. More research needs to be performed to enhance understanding of the role that organizational design plays in these relationships. For example, a deeper examination of the cultures and motivations of these various organizations can highlight additional opportunities or barriers to full ETO integration. In addition, this study did not address the level of accountability of managers or on-scene responders for meeting the

goals of their respective agencies nor how competing goals between transportation departments and emergency response agencies might impede effective coordination.

The focus of this study was on the coordination of highway transportation agencies with core emergency services agencies; therefore, the study groups were aggregated into two groups, transportation and emergency services. Although many groups affect or are affected by ETO, the agencies included in the transportation and emergency services core groups represent those most involved in on-scene incident response and/or emergency preparedness, training, and planning activities. Future studies may be warranted to consider coordination between individual transportation and individual core emergency services agencies, rather than the aggregated method chosen for this study. Additionally, future work should include other organizations involved in ETO, such as the media, towing agents, the Red Cross, and the Environmental Protection Agency, as well as other transportation modes, such as public transit, air, marine, and rail.