Emergency Response Transport Management

Managing Transportation Systems During Disasters

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TDM Encyclopedia
Victoria Transport Policy Institute

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This chapter discusses emergency response transportation planning and the role mobility management strategies can play in dealing with disasters.

Description

Emergency (also called *Disaster*, *Catastrophe* and *Crisis*) *Response* refers to organized activities to address problems created by unusual events such as fires, crashes, hurricanes, earthquakes, flooding, and blizzards, which cause concentrated damages and risks. Such events can present various transportation issues:

- Evacuations before, during or after an event.
- Delivery of emergency supplies and services, including water, food, medical care, utility maintenance, law enforcement, etc.
- Search and rescue operations.
- Quarantine.
- Transportation infrastructure repair.

Emergency transportation management activities can vary depending on the type and scale of disaster. Table 1 summarizes the types of transportation issues presented by different types of disasters. Many disasters involve a variety of catastrophes, such as an earthquake that causes fires and toxic chemical release. Specific transport issues vary depending on the type and scale of disaster, as summarized below. Major emergencies require regional planning and coordination since disasters do not recognize jurisdictional boundaries.

Table 1 **Disasters Transportation Issues**

Type of Disaster	Geographic Scale	Warning	Evacu-Ation	Emerg. Services	Search & Rescue	Quar-antine	Infrast. Repair
Hurricane	Very large	Days	√	√	√		√
Earthquake	Large	None	√	√	√		√
Tsunami	Very large	Short	√	√	√		√
Flooding	Large	Days	√	√	√		√
Forest fire	Small to large	Usually	√	√	√		√
Volcano	Small to large	Usually	√	√	√		√
Blizzard/ice storm	Very large	Usually		√	√		√
Building fire	Small	Seldom		√	√		
Explosion	Small to large	Seldom	√	√	√		√
Bus/train/aircraft crash	Small to large	Seldom					
Radiation/toxic release	Small to large	Sometimes	√	√	√	√	
Plague	Small to large	Usually		√		√	

Riot	Small to large	Sometimes	√	√			
War	Small to large	Usually	√	√			√
Landslide or avalanche	Small to medium	Sometimes	√	√	√		√

Different types of disasters present different types of transportation issues.

Many jurisdictions and agencies have emergency response plans, but they often lack details. Emergency action plans are needed that specify exactly who will do what, when. Such plans must be tested occasional with multi-agency practice sessions.

Planning For Resilience

A key concept recognized by engineers and planners is the value of Resilience, which refers to a system's ability to accommodate variable and unexpected conditions without catastrophic failure, or "the capacity to absorb shocks gracefully" (Foster, 1993).

Resilience tends to increase if a system has diversity, redundancy, efficiency, autonomy and strength in its critical components. This allows the system to continue functioning if a link is broken, if a particular resource becomes scarce, if a particular decision-maker is unavailable, etc. Resilience is affected by a system's ability to collect and distribute critical information under extreme conditions.

Resilience is also important for addressing long-term changes, such as traffic problems resulting from roadway damage (Giuliano and Golog, 1998), and fuel disruptions. For example, the financial burden faced by consumers from increased fuel prices and shortages is reduced if their community has good travel alternatives (walking and cycling conditions, rideshare and public transit services, telecommuting and delivery services that substitute for physical travel), and so can reduce their vehicle use with minimal problem.

Evacuations

Disasters such as hurricanes, fires and risks of explosions or toxic chemical releases sometimes require major evacuations. Such events require effective planning, communications and management, activities that are important at any time, but become even more critical during major emergencies (Operations).

Efficient mass evacuations may require counterflow lanes (Wolshon, 2002), HOV Priority so buses and trains avoid congestion and bottlenecks. A single highway lane can typically accommodate a maximum of about 2,000 vehicles per hour, but less under mass evacuation conditions because of congestion, diverse and overloaded vehicles (many tow heavily loaded trailers), weather (rain and flooding), infrastructure failures (such as earthquake damage), and vehicle mechanical problems, crashes and driver confusion. Assuming that each highway lane accommodates 1,000 vehicles per hour under such conditions and vehicles carry an average of 2.5 passengers, each lane accommodates 2,500 passengers per hour. A four-lane highway can therefore evacuate about 10,000 people per hour, or 20,000 if inbound lanes are reversed. A city with one million residents and two four-lane highways in functional conditions would therefore require about 50 hours to evacuate all residents by automobile.

Assuming that a highway lane can accommodate 600 buses per hour and buses carry an average of 25 passengers, each bus lane accommodates 15,000 passengers per hour, the same as six lanes of automobile

traffic. Highway capacity can therefore more than double by dedicating one lane to buses and encouraging residents to use buses and other high occupant vehicles such as vans with more than six passengers. A city with one million residents and two four-lane highways in functional conditions would therefore require only about 24 hours to evacuate all residents if about half are transported by bus and other high occupancy vehicles. In some situations trains may also be useful for mass evacuations. Similarly, HOVs and service vehicles should receive priority for fuel and maintenance services if these resources are limited.

Automobile-oriented evacuations can create other problems. For example, during one Washington DC evacuation drill, traffic control systems on city streets were adjusted to give priority to automobile traffic exiting the city, but the resulting higher speed vehicle traffic created a barrier to pedestrians crossing streets, causing delay for the majority of evacuees. During evacuations, automobiles also tend to be overloaded, are prone to mechanical problems, and drivers are often stressed and confused. On the other hand, bus operators are professional drivers, can maintain direct communication with control centers, and some buses have washrooms. With good planning, buses can be relatively secure and comfortable evacuation vehicles.

This is not to say that every evacuation must be entirely by public transportation. Usually, a mixture of modes is sufficient, with a portion of evacuees using public transportation, some using high occupant private vans, and the rest in automobiles with fewer occupants. However, to the degree that roadspace, fuel or other resources are limited, or that a larger portion of evacuees lack personal vehicles, the role of public transportation should increase.

It is important to address barriers that may prevent some people from evacuating when ordered (Litman 2005):

- Many lower income people lacked a vehicle and money.
- Many had no place to go and were fearful of conditions in emergency shelters.
- Many had survived previous hurricanes safely in their homes.
- Many did not expect the hurricane to be as bad as it was.
- Some wanted to protect their homes or pets.
- Some were proud of their ability to endure the risks and discomfort of the disaster.

Various strategies would probably be needed to increase evacuation rates, including more information on the risks facing people who stay, subsidized transportation, more comfortable and secure shelters, and better protection of homes.

Non-drivers include a diverse group of people who face various combinations of physical, economic and social disadvantages. A system designed for non-drivers must therefore be able to accommodate a wide range of needs, including poverty, physical and mental disabilities (Access Board, 2005), illnesses, inability to speak or read English, parents with young children, distrust of authority, frustration and anger. Many non-drivers lack convenient access to the Internet, and some lack regular telephone and mail service. Some may lack a secure place to stay. Understanding and responding to these diverse needs is therefore important for effective disaster management and evacuation planning.

Under emergency conditions public infrastructure may be stressed. For example, a typical bus can normally carry about 50 passengers, but in an emergency, with evacuees carrying baggage, some in wheelchairs, and communication systems overwhelmed, 30-40 passengers is a more realistic load. It will therefore be important to provide a generous amount of overcapacity and redundancy.

Pets can present a particular challenge. Before a disaster strikes it seems unreasonable to abandon or destroy pets. It is therefore important to try to accommodate pets, by allowing animals to accompany evacuees (perhaps only small animals in a carrying cage) or by having special SPCA services to collect pets and house them in kennels.

Best Practices

Below are some recommendations for effective emergency response transportation planning.

- Include disaster response as part of all Transportation Planning (local, regional, national, transit, etc.). Consider the widest possible range of possible disasters and stresses on the transport system, and consider the widest possible range of possible solutions.
- Develop an emergency action plan that identifies specifically who will do what during disasters. Update the plan regularly, particularly after a disaster event tests its effectiveness.
- Value Diversity, flexibility and redundancy. Develop a multi-modal transportation system that provides a variety of mobility options.
- Design transportation facilities to withstand extreme conditions (earthquakes, storms, etc.).
- Create transportation system networks that provide multiple links to each destination, including multiple rail lines, roads, paths and bridges.
- Develop plans to provide Basic Mobility under all conditions. Insure that transport planning takes into account people with special needs (physical disabilities, low incomes, inability to speak the local language, etc.). Work with community organizations to identify their needs and maintain effective communications with vulnerable groups.
- Develop effective ways to maintain information and communication systems among transport system managers, staff and users under normal and extreme conditions (Operations). Develop ways to communicate with residents and travelers under emergency conditions.
- Develop ways to Prioritize transport system resources when necessary. For example, design systems to allow emergency, service and freight vehicles priority over general traffic. Maintain contingency plans to allocate fuel and other resources in emergencies.
- Design critical components of the transportation system to be fail-safe, self-correcting, repairable, redundant and autonomous. For example, where possible use Roundabouts instead of traffic signals, since they function without electricity.
- Cross-train staff to perform critical management and repair services.
- Encourage efficient use of resources, including Energy Conservation and more accessible, Location Efficient Development.

Emergency transportation plans should include:

- Communication and support networks that serve the most vulnerable people. This involves a system to identify and contact vulnerable people, provide individualized directions for their care and evacuation, and establish a chain of responsibility for caregivers
- Planning to allow quick deployment of buses, vans and trains. This requires an inventory of such vehicles and their drivers, and clearly established instructions for their use.
- A system to prioritize evacuations based on factors such as geographic location (evacuate the highest risk areas first), and individual need and ability.
- Emergency evacuation information distributed to at-risk populations and all officials, including instructions on pickup locations and what evacuees should bring. This information should be distributed regularly, not just during major emergencies.
- Coordination of fuel, emergency repair and other support services.
- Priority for buses and other high occupancy vehicles where critical resources (road space, ferry capacity, fuel, etc.) are limited.

Automobiles are important for disaster response. Officials can give motorists directions, coordinate vehicle rentals and fuel supplies, provide special services along evacuation routes, use counterflow and highway shoulders as traffic lanes, and apply other traffic management strategies. But automobile transport alone is inadequate because some people lack vehicles and traffic capacity is often limited. Experience indicates that the best way to quickly evacuate a large city is to give buses and perhaps other high occupancy vehicles priority in traffic and fuel access, and then accommodate as many low-occupancy vehicles as resources allow. Individuals can choose between accepting a free and fast bus ride, or driving a private vehicle and facing congestion delays.

Developing communication and support networks that serve vulnerable people requires effective community outreach. Each neighborhood should have an inventory of people who may need assistance, ways to contact them, directions for their evacuation, and a list of their friends and family who can provide emergency support. If possible, social service agency staff or volunteer community leaders should travel with vulnerable evacuees to provide information and reassurance to people who may be frustrated and frightened. Implementing such a system requires that planning professionals work with a broad range of community groups, professionals and social service organizations.

There are often years or even decades between major disasters, so it is important to preserve institutional memory by documenting successes and failures, and updating emergency plans while the experience is still fresh.

Relationships With Other TDM Strategies

Emergency Response Planning is supported by TDM strategies that improve transportation system Resilience and Prioritize use of transportation resources. It involves Planning, Institutional Reforms, TDM Programs, Operations and Basic Access.

Wit and Humor

"Only a mediocre person is always at his best."
- W. Somerset Maugham

"A man may fulfill the object of his existence by asking a question he cannot answer, and attempting a task he cannot achieve."
-Oliver Wendall Holmes

"Ignorance more frequently begets confidence than knowledge."
- Charles Darwin

Examples and Case Studies

Hurricanes Katrina And Rita (Litman, 2005)

Hurricanes Katrina and Rita provided important lessons concerning Emergency Response Transportation Planning. Katrina's evacuation was relatively effective for people with automobiles but failed those who rely on public transit, causing death, suffering and indignity. From a transport planning perspective, the greatest mistake was the failure to deploy buses to evacuate transit-dependent residents without charge. Non-drivers received much better services during Rita's evacuation, but excessive automobile traffic created problems for motorists. Mistakes include failure to implement counterflow lanes as announced, failure to manage fuel distribution, failure to provide basic services (such as washrooms) along the evacuation route, and failure to give buses (and perhaps other HOVs) priority in traffic.

Educated by Rita – Editorial
New York Times (www.nytimes.com), 24 Sept. 2005.

Three weeks after the nation was shocked to realize how little the government knew about emergency management in New Orleans, another hurricane has hit the South and made it clear that the learning curve is still daunting.

There was little danger that Rita would fail to get the authorities' full attention, or that people in the potential path of danger would not heed warnings to evacuate. But when Houston residents were told to leave, they found themselves stranded and sweltering in 90-degree heat in colossal traffic jams.

High-occupancy-vehicle lanes went unused, as did many inbound lanes of highways, because authorities inexplicably waited until late Thursday to open some up. Some motorists discovered, in terror, that they were stuck in what could be the hurricane's path. Tragically, one bus carrying elderly nursing home residents caught fire, killing 24.

If Katrina exposed what happens when many people have no cars to escape danger, Rita seemed to show the other side of the coin. The authorities are going to have to become much more sophisticated about developing evacuation plans that do not put every family on the highway in its own vehicle. But the car-obsessed American public is going to require a lot of education before many will accept the idea that they should flee disaster via mass transit.

> Some Rita-related failures seemed inexplicable. A dearth of federal security screeners at Houston's airports led to long lines for passengers trying get out of the city. The Homeland Security Department should have anticipated that problem. Houston's shortage of emergency shelters and the local officials' apparent reluctance to let the public know where space was available were hard to comprehend.

Transit Emergency Planning (Milligan & Company, 2007)

A U.S. Federal Transit Association study evaluated emergency preparedness activities in 20 metropolitan regions that recently experienced natural or man-made disasters and have relatively high transit-dependent populations. The study found that these agencies have taken very limited steps towards involving populations with specific mobility needs in emergency preparedness planning, identifying the locations of and communicating emergency preparedness instructions to these populations, or coordinating with other agencies to meet the specific needs of these populations in an emergency. While many agencies have conducted important outreach, analysis, and coordinating activities to address the needs of their general population in emergencies, few have targeted these activities to assist their region's most vulnerable people. The report provides resources that should assist officials in these and other metropolitan regions to better incorporate attention to populations with specific mobility needs into their ongoing emergency planning activities.

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Victoria Transport Policy Institute
www.vtpi.org info@vtpi.org
1250 Rudlin Street, Victoria, BC, V8V 3R7, CANADA
Phone & Fax 250-360-1560
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