

# Federalism and Its Impact on Emergency Response to Disasters and Catastrophes

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***CONTENTS***

<b>1. INTRODUCTION.....</b>	<b>1</b>
<b>2. THEORETICAL FRAMEWORK: NETWORKS OF FEDERAL, STATE, AND LOCAL ACTIVITY IN RESPONSE TO AN EMERGENCY .....</b>	<b>4</b>
<b>3. NETWORK ANALYSIS OF THE RESPONSES OF THE STATES OF LOUISIANA AND MISSISSIPPI TO HURRICANE KATRINA .....</b>	<b>9</b>
3.2 INTERORGANIZATIONAL COORDINATION IN AN EXTREME EVENT.....	12
3.3 PATTERNS OF INTERORGANIZATIONAL NETWORKS .....	15
3.3.1 Louisiana Response: During and After Hurricane Katrina .....	15
3.3.2 Louisiana Response to Katrina: Boots on the Ground .....	20
3.3.3 Mississippi Response: During and After Hurricane Katrina.....	22
<b>4. CONCLUSION .....</b>	<b>24</b>
<b>REFERENCES .....</b>	<b>27</b>

## 1. Introduction

Responding effectively to a non-routine emergency, disaster, or catastrophe, whether natural or manmade, is a major, and sometimes overwhelming, challenge. Extreme events require coordinated action among multiple actors across jurisdictions, under conditions of high anxiety and stress, urgent demand, and tight time constraints. Hurricanes Katrina and Rita, the events of 9/11, California wildfires, and Midwestern floods all evoke memories of these challenges and their consequences, while at the same time, it is not terribly difficult to imagine future, similar scenarios, as the likelihood for extreme weather patterns increase and the threats of domestic and international terrorism persist.

In the United States, as with most countries around the world, ultimate responsibility for emergency preparedness and response rests with the government. Yet, no single government agency, big or small, can handle all aspects of an emergency response, except for the smallest, most localized, and routine of emergencies (e.g., building fire). As a result, to properly effect an emergency response, there is mutual reliance among a variety of government agencies (operating horizontally and vertically), nonprofits, and private entities. Adding to the complexity is the fact that policies that guide an emergency response can vary widely in practice across federal, state, and local governmental and nongovernmental entities. (Dynes 1984, Drabek 1985, Mushkatel & Weschler 1985, Waugh & Sylves 1996, Haddock & Bullock 2006, Waugh & Streib 2006, McEntire & Dawson 2007, Sylves 2007, Waugh 2007)

In fact, the American form of federalism itself has been argued to be one of the main challenges to an effective response. For instance, local authorities may be reluctant to turn over responsibilities for dealing with the emergency to state and federal entities; conflicting goals may create tensions between government agencies at different levels; and, rather than acting in unison within a response, there may be varying forms and degrees of collaboration. (Cook & Louscher

2008) In light of this challenge, this paper will examine the following question: *How does the institution of federalism in the United States impact the design and operation of emergency management and more specifically, help or hinder individual disaster responses?*

In 2005, issues associated with federalism surfaced within several contexts, for instance, the REAL ID Act, federal requirements associated with Temporary Aid to Needy Families (TANF) reauthorization, the Terri Schiavo case, state and local government opposition to the No Child Left Behind Act, and Senate confirmation hearings for Chief Justice John Roberts and Justice Samuel Alito. (Dinan & Krane 2006) Most prominently, the delayed and poorly coordinated intergovernmental response to Hurricanes Katrina and Rita also generated considerable debate in Congress, and among academics and the general public, as to the appropriate federal, state, and local roles in responding to emergencies (e.g., Hoover 2005, Nivola 2005, U.S. House 2005, Clovis 2006, Dinan & Krane 2006, Griffin 2006, Kweit & Kweit 2006, Winston et al. 2006, Conlan & Dinan 2007, Cook & Louscher 2007, Gaston 2007, Scavo et al. 2007, Birkland & Waterman 2008, Maestas, et al. 2008, Schneider 2008). In parallel, empirical studies of emergency management networks were produced, primarily in the form of case studies of individual events. Historically, natural hazards have received the most attention, with the events of 9/11 and Hurricanes Katrina and Rita, in particular, inspiring reams of analyses and commentary (e.g., Waugh 2004, Comfort & Kapucu 2006, Fischer et al. 2006, Kiefer & Montjoy 2006, Picou & Martin 2006, Simmons & Sutter 2007, Leonard & Williams 2009, Scott 2009, Varley 2009).

There have also been those rare occasions where issues of federalism have crossed paths in article form with emergency management and response, but since the events of 9/11, these have tended to focus on security concerns rather than emergency management and response. For instance, Kincaid & Cole (2002) explored overall intergovernmental implications of the events of 9/11, as well as the specific implications of federal grants-in-aid and other federal, state, and local initiatives, and the implications for judicial federalism and public trust and confidence. Clovis

(2006) examined the relationship between federalism and homeland security national (federal) preparedness. Gaston (2007), in part, explained how federalism in practice has shifted much of the management and performance of important homeland security activities away from federal authorities.

Interestingly, though implications of network activity can be seen throughout this developing field, only a handful of studies utilizing the techniques of social network analysis (SNA) have been produced. Kapucu (2005) addressed the emergency management interorganizational network in response to an extreme event, specifically analyzing the interactions among public, private, and nonprofit organizations that had evolved in response to the events of 9/11. Choi and Brower (2006) examined the disparity between formal plans and actual networks in practice for emergency services in a local government setting. And, most recently, Kapucu, Augustin, and Garayev (2009) studied the structural elements of a specific mutual aid agreement and partnership that allows states to assist one another in responding to disasters, as it was utilized during Hurricanes Katrina and Rita.

One could easily say that if the research literature associated with emergency management, network analysis, and related issues of federalism could be visualized collectively as Swiss cheese, there would be by far more air than cheese, with little coverage or continuity. This study contributes to the understanding of (primarily) intergovernmental relations in emergency management and response within the framework of American federalism. The study examines the federal, state, and local “coordinated” emergency response to Hurricane Katrina in the States of Mississippi and Louisiana through the lens of SNA, thereby contributing to a greater understanding of public management in extreme environments as well as further understanding of certain SNA principles as they apply to organizational actors within an institutional setting.

To this end, Section 2 of this paper provides background information on the general concepts and rationale of the study, and the theoretical underpinnings from which the research question, general assumptions, and hypotheses are derived. Section 3 lists the assumptions and hypotheses specific to this study; discusses the data and methodology utilized; and provides an initial analysis of the results. Section 4 summarizes the evaluation and implications of the research; discusses the challenges and limitations associated with the data and methodology of the study; and its implications for theory development and future research.

## **2. Theoretical Framework: Networks of Federal, State, and Local Activity in Response to an Emergency**

Simply put, from a structuralist perspective, networks consist of “a finite set or sets of actors and the relation or relations defined on them” (Wasserman and Faust 1994, 20). Within the context of policy analysis and public administration, a network may also be defined as a “policy making and administrative structure involving multiple nodes (agencies and organizations) with multiple linkages” (McGuire 2002, 599), with “regular communication and frequent exchange of information leading to the establishment of stable relationships between actors and to the coordination of mutual interests” (Adam and Kriesi, 129).

Emergency management networks are further defined by the level of interorganizational dependence, and the variety of actors and goals (Kapucu et al. 2009). Emergency management networks can be viewed as important policy instruments, addressing natural and manmade disasters. In the context of emergency management, interorganizational networks will coalesce as a result of the directives in plans and procedures and emerge when a mix of citizens, practitioners, and organizational actors, linked through formal and informal relations, converge on the scene of an incident to support emergency functions (e.g., Drabek 1981, Perry 1982, Drabek 1986, Dynes and Tierney 1994, ICMA 2006, Brunnsma et al. 2007). Partnerships of public, private, and nonprofit

entities permit collaboration and coordination to create an emergency response. (Kamark 2004, Kamensky et al. 2004, Waugh 2004, Mitchell 2006, McEntire and Dawson 2007)

The American federalist system itself, with a separation of functions and shared authority among federal, state, and local “levels” of government, implies a need for collaboration, coordination, interaction, and bridge building. Under the U.S. system, a degree of sovereignty is assumed at state and local levels of government, resulting in local governments having most of the discretion and responsibility for emergency management functions (namely, mitigation, preparedness, response, recovery), while federal agencies are intended to provide a great deal of the support and resources. States often act as intermediaries, facilitating the implementation of federal policies at the local level, training communities in best practices, funneling federal grant monies, and coordinating response efforts with other states. Unlike other federal government systems, in the United States, states can develop relationships and connections without the express approval of the federal government. (McEntire and Dawson 2007, Kapucu et al. 2009)

More than two decades ago, Thomas Drabek (1985) examined six disasters over a two-year period and found four primary characteristics of the American emergency management system: localism, lack of standardization, unit diversity, and fragmentation. *Localism* refers to the fact that municipalities and counties have the initial and primary responsibility for emergency management, contrary to other governments with state-centric programs. *Lack of standardization* refers to the how emergency management is organized and undertaken; no two localities or states have identical policies or organizational arrangements. *Unit diversity* refers to the fact that entities of different sizes and types commonly respond to emergencies. The first three characteristics combine to produce the fourth: *fragmentation*. Vertical fracture results when federal, state, and local government approaches to emergency management diverge; horizontal fracture results when entities view emergency management from their own frames of reference, leading to conflicts across peer organizations and between neighboring jurisdictions. In the intervening years, genuine

attempts have been made to resolve differences among programs and cultures, and issues associated with fragmentation, but significant disparities continue to exist. (Drabek 2003, McEntire and Dawson 2007)

At the time that Hurricane Katrina made landfall, the National Response Plan (NRP) (DHS 2004) provided the framework and direction for federal response to emergencies. It outlined ways in which the federal response supported and coordinated with state and local response. The NRP replaced the Federal Response Plan (FEMA 1999), which was in effect during the events of 9/11. Like the FRP, the NRP assigned primary and support responsibilities among nearly 30 federal agencies and the American Red Cross. Unlike the FRP, after 9/11 and the creation of DHS, the NRP was an attempt to move toward a federalization of emergency response and to proscribe a consistent program of responding to large-scale disasters and catastrophes across states and localities. The NRP was controversial in many ways, not the least of which was its proscription of state and local behavior. Initially, it also provided many unfunded mandates and due to the general haste in its preparation, provided little in the way of a comment period for the public and state and local officials prior to its implementation. And, though DHS maintained that it represented natural and manmade emergencies equally, the slant toward terrorism became evident. Its first full-scale activation occurred during Hurricane Katrina. At the time of Katrina, many of its incident annexes, including the one devoted to catastrophic events, were still in draft form or incomplete. (Waugh and Sylves 2002, Waugh 2003, DHS 2004, Harrald 2007, McEntire and Dawson 2007 )

Regardless, the basic concept of emergency operations is simple. Routine emergencies in the United States are handled locally, if at all possible. Routine emergencies are defined as those emergencies that occur frequently and can be handled with the involvement of one, two, or perhaps three emergency response organizations (e.g., building fire). Fire and police departments, hospitals and emergency medical teams are assumed to know the likely manmade and natural hazards specific to their area, prepare and train in the same environment, and can be on the scene within

minutes. Non-routine emergencies may temporarily overwhelm in-house resources of a local government (e.g., hazardous materials fire, derailed tanker car containing hazardous materials). Note that in one part of the country an emergency may be routine, whereas in other parts of the country, the same emergency would be considered non-routine (e.g., snow emergency). (Haddow and Bullock 2006)

If events escalate to the point that local resources are insufficient, the state intervenes. Depending on the state, states may be free to interject themselves; in others, local governments may have more self-determination. Regardless, the state efforts are primarily oriented to support the efforts of local officials, and as such, the state can draw upon their own resources as well as the resources and support of other states within their region. By definition, disasters operate on a much larger scale than an emergency and are events which overwhelm the resources of the local jurisdiction(s) for an extended period of time (Winslow 1996, Scott 2009). If the event exceeds the capabilities of both the state and locality, the Governor may then ask the President for an official emergency declaration, and request federal resources and support by invoking the Stafford Act. (Note that the terms *emergency* and *disaster* are frequently used interchangeably, as in emergency/disaster management, emergency/disaster response. For the purposes of this paper, when referring to emergencies, disasters, or catastrophes generically, the term “emergency” will be used. When referring specifically to a type of emergency event, the appropriate categorization will be used.) (Haddow and Bullock 2006)

Even when federal support is requested, control and coordination of the event is typically provided by the state and localities involved. Only at the request of the state or in the instance of state or local incapacitation (e.g., nuclear attack) does the federal government assume responsibility for coordination, and in extreme events, the reins of overall command and control. Since the events of 9/11 and with the advent of a national security category referred to as an Incident of National Significance (INS) encompassing both manmade and natural threats, the appropriate timing of

federal support and intervention, and the form that this intervention takes, has become an increasingly fuzzy area open to interpretation. There have also been instances of delayed requests for federal support by a state(s), which subsequently undermined the quality of response and arguably resulted in loss of life. These instances have prompted DHS, and specifically FEMA, to consider instances where it might be appropriate to preemptively intervene in such a catastrophic incident. A *catastrophic incident*, as evidenced by Hurricane Katrina, is “any incident, resulting in extraordinary levels of mass casualties, damage, or disruption which severely affects the population, infrastructure, environment, economy, national morale, or government functions” (DHS, 2004, Catastrophic Incident Annex, p. CAT-1). Multiple incidents may occur simultaneously or sequentially in contiguous and/or noncontiguous areas. Preemptive intervention on the part of the federal government, except in the most extreme of examples, is highly controversial in that it seemingly violates commonly held precepts of the American federalist system. (DHS 2004, McLoughlin 1985, McEntire 2002, Comfort and Kapucu 2006)

Realizing that no one individual or organization can respond effectively to an emergency, the social network perspective has proved to be of increasing interest to disaster researchers (e.g., Stallings 2002, Kapucu 2006b, 2009). The few published network analyses of emergency management networks have used a variety of theoretical frameworks, from a systems approach (e.g., Uhr et al. 2008) to complex adaptive theory (e.g., Kapucu et al. 2009). Social network analysis itself is generally not viewed as a theory per se, but a complex set of techniques used to evaluate information and data. SNA tends to take on the characteristics of the discipline or theory with which it is combined. (Wasserman and Faust 1994, Adam and Kriesi 2007)

For purposes of this study, the structuralist approach of social network analysis will be combined with a systems orientation, with the added context provided by a collection of case studies. The systems perspective incorporates the view that to understand an incident or

phenomenon various elements of the system and interactions between them (and the environment) need to be understood. (Comfort and Kapucu 2006, Uhr et al. 2008)

### **3. Network Analysis of the Responses of the States of Louisiana and Mississippi to Hurricane Katrina**

There are a variety of hypotheses that can be drawn from the research question: *How does the institution of federalism in the United States impact the design and operation of emergency management and more specifically, help or hinder individual disaster responses?* For purposes of this study, one has been selected:

H1. When there is demonstrated arrested (or delayed) development and transfer from local to local, state, and federal involvement in a disaster, challenges associated with the emergency response (beyond that of the hazard itself) will be observed, and in the extreme event of a catastrophe, the response itself is likely to break down altogether.

This hypothesis rests on certain assumptions that can be drawn from information provided in Sections 1 and 2 of this paper:

- A1. Resource, communication, and coordination requirements of a disaster or catastrophe are far greater than the capacities of any single locale, state, or region.
- A2. An effective response to extreme events leads to a greater density of communication among organizations and less centralized networks. Thus, weak links (Granovetter 1974) tend to become stronger and additional connections are forged.
- A3. The locus of control and coordination for *routine* emergencies generally resides with local governmental entity(ies). There it remains throughout the duration of the routine emergency and any post-emergency, recovery operations.

- A4. As a routine emergency evolves into a disaster, and then into a catastrophe, the “center of gravity”, the locus of control and coordination, tends to shift from local and state control and coordination to federal control.

### **3.1 Data and Methodology**

Data were gathered to support the review of activities and interactions of the States of Louisiana and Mississippi in the days leading up to the physical impact of Hurricane Katrina on the coasts of Louisiana, Mississippi, and Alabama, and the days subsequent (August 20 – September 30, 2005). The experiences of the States of Mississippi and Louisiana are considered as two separate cases in that the two emergency responses represent two distinct outcomes in terms of perceived quality of response.

Data were collected as a result of content analyses of post-emergency FEMA situation reports, University of Colorado Disaster Research Center (DSC) Rapid Response Reports, case studies (e.g., Scott 2009), GAO reports, and media accounts (e.g., NY Times, Washington Post, local newspapers). Review of these documents provided an inventory of organizations involved and information on their relationships, descriptive statistics, qualitative context, and the data from which depictions of the networks were constructed. With the initial inventory of organizational actors gathered, the National Response Plan, and Louisiana and Mississippi State and local plans (current, as of September 2005) were reviewed to confirm the roles and responsibilities of non-emergent organizational actors and to fill in the gaps of knowledge left by academic, governmental, and press accounts.

In evaluating network participation and identifying network participants, appropriate boundaries must be drawn. Networks with a large number of actors tend to have “fuzzy”, or ill-defined, boundaries in that it is difficult on the periphery to determine the level and type of involvement of certain actors, when organizational and collective behavior become increasingly

blurred (Comfort 1999). Are interactions incidental, or directly related to the response? Bounded networks were created for this study which were comprised of organizational actors that performed functions directly related to the emergency at hand. “Actors” excluded from network membership included informal, emerging groups and those organizations having only marginal involvement in the emergency response.

There were also instances when individuals and organizations were aggregated into one organizational actor. For example, VOAD (National Voluntary Organizations Active in Disasters) coordinates the efforts of many volunteer organizations; county organizations include all individuals, groups, and organizations employed by the county and involved in the emergency response; the Mississippi EOC (Emergency Operations Center) includes the Governor and his staff; and, the NO (New Orleans) EOC is synonymous with the Mayor of New Orleans and his staff.

Data were originally coded to support a directed and valued network representation. Upon review, this approach was discarded because the documentation gathered, while consistent in terms of the nature of the contacts made (in terms of action and communication), did not consistently document the number of contacts made or the direction of actions and communications. Thus, data were recorded to support an undirected network, signifying a connection, but not valuing or directing that connection.

Social network analysis using UCINET software (Borgatti et al. 2002) was employed to depict the relationships between organizational actors that responded to this emergency. UCINET contains several analytic routines and general statistical and multivariate analysis tools. This paper uses network centrality measures of degree and betweenness, and measured cliques to determine subgroup structure (Freeman 1978/79, Wasserman and Faust 1994, Everett and Borgatti 1999, Borgatti 2005). Specific measures and methodology used build on those utilized by Kapucu (2005) in analyzing the response to the events of 9/11.

### **3.2 Interorganizational Coordination in an Extreme Event**

In the early morning hours of August 29, 2009, Hurricane Katrina made landfall on the coasts of Louisiana, Mississippi and Alabama. Registering as a Category 5 hurricane in the Gulf, it hit as a strong Category 3 – much to the relief of coastal residents and authorities. Though hurricanes are not unknown in the area, Hurricane Katrina was far from “routine”, and registered as a catastrophic hurricane.

Prior to its making landfall, the perceived magnitude of potential destruction to life and property resulted in preparations being made at the federal, state, and local levels of government. These preparations were guided by state and federal law; memoranda of understanding and other agreements supporting mutual aid and support among organizational actors at the local, state, regional, and federal levels; knowledge and experience gained through exercises and drills with multi-organizational participation; and, pre-established local, state and federal plans and procedures.

In Louisiana, the Emergency Assistance and Disaster Act of 1993 outlined the roles and responsibilities of state and local (parish) officials. Under this Act, the Governor was authorized to declare a state of emergency; “direct or compel the evacuation of all or part of the population from any stricken or threatened area”; “commandeer or utilize any private property”; and “[p]rescribe routes, modes of transportation, and destination in connection with evacuation.” State law gave most of the same emergency powers, including the authority to declare emergencies and order evacuations, to parish presidents and chief executives of municipalities. (Scott 2009)

In accordance with the Act, the Louisiana Office of Homeland Security and Emergency Preparedness (LOHSEP) is responsible for preparing and implementing the state emergency operations plan (“Emergency Plan”). The Act also requires each parish president to establish an office of homeland security and emergency preparedness, which works with LOHSEP to develop and update local emergency plans. Louisiana’s Emergency Plan (2005) specifically notes that its

contents, guidance, and requirements does not “replace or supersede any local plans” or “usurp the authority of any local governing body.” As with the state, the emergency plan for New Orleans has an annex devoted to hurricane response. Management of evacuations is the responsibility of the mayor, to whom state law delegates the authority to order evacuations.

In the event that local resources are inadequate to respond effectively to a disaster, the State’s Emergency Plan advises parishes (counties) to turn next to “mutual aid agreements with volunteer groups, the private sector, and neighboring parishes.” (White House, 2006, Chapter 2: 6) In addition, the State can draw upon the resources of other states through a regional agreement, the Emergency Management Assistance Compact (EMAC). EMAC was originally created by Florida and sixteen other states as a result of challenges associated with state and federal response to Hurricane Andrew in 1992. Under EMAC, a state can request assistance from other states from a virtual menu for a variety of support (e.g., coordination assistance, aircraft, helicopters, temporary shelters, National Guard troops). (House Select Committee 2006, Rosegrant 2009)

The federal government also had its own emergency response plan (the National Response Plan) to turn to when first responders, and state and local governments, had exhausted their resources and requested assistance. In the instance that an emergency overwhelmed the capabilities of state and local governments, or in some cases when it even threatened to occur, the governor of the affected state could invoke the Stafford Act, and request that the President declare a state of emergency or make a major disaster declaration. This effectively readies “the cavalry” of organizations and resources available to the federal government, who then await a specific request. Led by FEMA, who does not directly respond, but who manages the emergency response, relief and recovery efforts of the federal government by assigning individual tasks to supporting agencies and departments and coordinating their work (White House, 2006). FEMA can also draw upon other state and local governments, private contractors, volunteers, and the National Guard to supply equipment and workers in its response efforts (Kirkpatrick and Shane, 2005). (DHS 2004)

The National Response Plan (NRP) was created after the events of 9/11 in response to the directives of the 2002 Homeland Security Act, and introduced the concept of an Incident of National Significance (INS), which was defined as “an actual or potential high-impact event that requires a coordinated and effective response by [an] appropriate combination of Federal, State, local, tribal, nongovernmental, and/or private sector entities in order to save lives and minimize damage, and provide a basis for long-term recovery and mitigation activities.” Unfortunately, the NRP was not clear as to how or when an INS was to be declared. But, once declared it set in motion activities led by a number of coordinating organizational entities. At the federal level, the DHS Homeland Security Operations Center (HSOC) and the FEMA National Response Coordination Center (NRCC) were responsible for coordinating information, communications, operational planning, and deployment of federal resources. The Interagency Incident Management Group (IIMG), composed of senior federal officials, was expected to provide strategic incident management planning and coordination, and to act as an advisory body to the DHS secretary. At the local level, the Joint Field Office (JFO), which was intended to be set up near the incident, was responsible for coordinating federal assistance. The actual delivery of federal resources and assistance was organized into fifteen (15) Emergency Support Functions (ESFs), each headed by one or more primary federal departments or agencies (or, in one instance, the American Red Cross), and with other agencies designated to play a supportive role. In the event of an INS, ESF agency representatives sit in at national and regional coordination centers and the JFO. (DHS 2004)

Appended to the NRP were incident annexes dealing with specific events, e.g., biological, nuclear/radiological, catastrophic. The latter dealt with natural or manmade incidents resulting from “extraordinary levels of mass casualties, damage, or disruption severely affecting the population, infrastructure, environment, economy, national morale, and/or government functions.” (White House, 2006, Ch 2: 7) The process of obtaining federal assistance for most cases was often described as a *pull system*, in which a state or local government whose resources had been

overwhelmed by a disaster asked the President to send help. By contrast, the catastrophic annex was characterized as a *push system*, in which the federal government would take the initiative in the face of circumstances so devastating that state and local governments became “victims themselves, prohibiting their ability to identify, request, receive, or deliver assistance.” (White House, 2006, Ch 2: 7)

At the time of Katrina, no attempt to resolve potential discrepancies from competing annexes had been undertaken (e.g, a biological event that is a catastrophe, an event that is both a biological and radiological incident). There was no strategic plan approved to implement the catastrophic incident annex, in particular. And, Katrina was the first major test of the NRP. It is safe to say that not everyone viewed the NRP, or the newly created DHS, as a helpful addition to the federal government’s response arsenal. (Schneider 2005, Ink 2006, Scott 2009)

### **3.3 Patterns of Interorganizational Networks**

#### **3.3.1 Louisiana Response: During and After Hurricane Katrina**

At the local level, prior to landfall, action varied from parish to parish. The Governor had declared a state of emergency in Louisiana, clearing the way for evacuation and other emergency procedures, and had requested and received a Presidential declaration of a state of emergency, from which she could make specific requests as the needs of the State became apparent. State agencies began stockpiling supplies and equipment; pre-positioned small boats to support search and rescue in the wake of the storm; and, mobilized the Louisiana National Guard. Some parishes issued mandatory evacuation notices; others recommended voluntary evacuations. In New Orleans, the mayor did a bit of both by initially recommending a voluntary evacuation, and then issuing a mandatory evacuation order. He and the Governor, providing a united front, held a joint new conference, warning of the impending hurricane and discussing actions that should be taken on the part of individuals in anticipation. The day before landfall, LOHSEP activated the State EOC in Baton

Rouge. FEMA had prepositioned supplies and search and rescue teams; were conducting periodic videoconferences with Louisiana, Mississippi, and Alabama state officials from the NRCC. (Scott 2009)

At the time of landfall and in the immediate aftermath, interactions between organizational actors, as depicted on Figure 1A<sup>1</sup>, were for the most part as anticipated, with some notable exceptions. (1) FEMA, which had been subsumed within DHS, was not actively consulting with DHS at either the Director or staff level, cutting DHS out of the loop with most other federal agencies and the State. At the same time, DHS was interacting frequently with the White House, and not regularly reporting the subject of such communications back to FEMA. (2) The Coast Guard had also been subsumed within DHS, but took a different tactic. Informing DHS of their activities and not waiting for approval from FEMA or the State, they fulfilled their day-to-day mission of patrolling and maintaining the safety of waterways and oceangoing vessels, thereby not violating any rules attached to an emergency response, and in the process saved hundreds of lives of individuals that otherwise might have been washed out to sea or drowned in the flooding. (3) Though the Governor had three distinct points of contact with the White House in the days prior to landfall, she had trouble making contact and raising a response in the 24 hours immediately after landfall. (4) NHC primarily provided hurricane-related information, linking individuals and organizations together through the information shared and the process of sharing it. (5) State requests for outside support (e.g., via EMAC) were so minimal as to not be significant enough to register in the coding of data supporting the network analysis of this paper. (Walters 2005, Takeda and Helms 2006, U.S. Senate 2006, Tierney 2007)

Within 72 hours of landfall, Figure 1B<sup>1</sup>, intuitively speaking, tells a different story. Additional organizational support had been requested primarily through EMAC and was either in

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<sup>1</sup> Note that acronyms used on all figures in this paper are listed along with their full names in Appendix A.

place or en route. But, the destruction from the hurricane coupled with the breach of levees had created a physical catastrophe of historic proportions. (1) FEMA was directly interacting with DHS on a regular basis only because the DHS Secretary used his prerogative to assign the FEMA Director as his representative on the ground. (2) Multiple entities had joined the Coast Guard in search and rescue operations, but were not necessarily coordinating with them and vice versa. (3) In those first few critical days, the JFO, which was later established in Baton Rouge, did not exist. (4) The mayor took an increasingly active and vocal coordination role. (5) The Governor had re-established contact with the White House, but communications were in the form of conflict and resistance. (Walters 2005, Townsend 2006, U.S. Senate 2006, Tierney 2007, Scott 2009)

The size of the network is critical to the structure of organizational interactions because of the limited resources and capacities that each organization has for building and maintaining networks. As the size of the network increases (as evidenced in the number of organizational actors, or nodes), the range of possible social structures increases exponentially with size, and logically so does the complexity of the network. As the size of the network increases, the complexity of relationships also increases. (Monge and Contractor 2003, Kapucu 2005)

Using UCINET, descriptive statistics associated with two measures of centrality: degree and betweenness, were calculated from the data representing Louisiana emergency response network relationships at the time of landfall and shortly thereafter. Results are provided in Tables 1A and 1B. Degree centrality measures network activity, “where the action is” (Wasserman and Faust, 1994, 179). The actor with the highest degree of centrality interacts directly or is adjacent to the greatest number of organizational actors within the network. Those with low degree of centrality are peripheral to the network. Normalized centrality eliminates the effect of variation in network size found in degree centrality, and makes it easier to compare with other, similar networks. (Wasserman and Faust, 1994; Freeman, 2005; Knoke and Yang, 2008)

Table 1B reports that at the time of landfall and again within 72 hours after landfall, FEMA had the most number of ties with other organizational actors in the network, followed by the State of Louisiana and the New Orleans EOCs. FEMA's primary placement at the time of landfall no doubt reflects the widely held assumption that Hurricane Katrina, even without the breached levees, was going to have catastrophic consequences that would quickly overwhelm state and local resources. (Such preparation is not unusual in the case of hurricanes, which of all natural disasters, produces the longest lead time.) Both FEMA and the New Orleans EOC's "popularity" increased in the short intervening period of time, reflecting increased activity and interaction in a much expanded emergency response network. The summary measure of centralization for the network is significantly lower for the second period of time at 14.22 percent, which means that the power of the individual actors in the second instance does not vary much across the network, which is an indicator of a loosely coupled network.

Betweenness is a measure of the extent to which an actor lies in the direct path of communication between two other actors. Betweenness centrality measures coordination and control, as opposed to simple contact and popularity. An actor central as a measure of betweenness has the power to withhold or distort communication; has the potential of being responsible for group processes within the network; may indicate that other actors are dependent on the central actor to communicate with others; and, may ultimately be a coordinator of the network itself. (Wasserman and Faust 1994, Freeman 2005, Kapucu 2005, Knoke and Yang 2008)

Also, to underscore the conservative nature of the data used, there is the possibility that the bounded networks in this study undercounts actors on the local, state, and regional levels, due to the aggregation of related actors. If this is the case, measurement of degree centrality (actual counts of ties/connections), while interesting, does not reflect the true relationship between actors in this evolving emergency network as well as the betweenness centrality measure. Thus, in an emergency management network, rather than popularity, the important focus should be on issues of control,

coordination, and information “management”. These qualities lend themselves to making betweenness the most effective and informative measure of centrality in an emergency response network. Thus, Figures 1A and 1B are depicted using measures for betweenness centrality.

At the time of landfall, Figure 1A shows a limited number of actors (58), clustered around four organizational actors who provided a coordination function in the form of information, resources, and/or activity: FEMA, the Louisiana EOC, the New Orleans EOC, and the National Hurricane Center (NHC). There appear to be some differences among the actors in how connected they are, e.g., the American Red Cross (ARC) v. the National Voluntary Organizations Active in Disasters (VOAD). Most interactions, though, are limited, and occur primarily between organizations of similar type (distinguished by the color of the node), with federal organizations primarily interacting with federal organizations, and local organizations primarily interacting with local organizations. As the number of actors increase, the depiction can provide an overall intuitive sense of network properties, but the descriptions of what is seen become increasingly imprecise. For instance, within 72 hours of landfall, the emergency response network had increased from 58 to 410 actors. Certainly, one can discern the clustering effect again around certain organizational actors: FEMA, New Orleans EOC, Louisiana EOC, and Louisiana National Guard. Actors appear to be not well integrated, with on average few numbers of ties to a given actor, competing loci of control, and pairs of actors isolated from the network as a whole.

Table 1A provides more detail, and reveals that FEMA, as in the measure for degree centrality, had the highest betweenness score at the time of landfall, indicating their initial high degree of relevance to the preparation and coordination process. Within 72 hours after landfall, the New Orleans EOC (which includes the mayor) had become significantly more prominent than FEMA. Perhaps filling a control vacuum, the general movement from federal to local control and coordination as the emergency escalates into catastrophic proportions runs counter to the accepted progression (local to state to federal) of an escalating response, and seems to be indicative of

problems in terms of the quality and effectiveness of the overall emergency response. Incredibly enough, though physically overwhelmed, positioned in a high-rise hotel overlooking downtown New Orleans, and frequently experiencing communications problems, the New Orleans EOC, a local entity, by a significant margin, was found to be providing a central coordination function for a network that included local, state, regional, and federal participants.

### **3.3.2 Louisiana Response to Katrina: Boots on the Ground**

In contrast to National Guard units, the federal military role in domestic disaster response is limited by design, largely because of traditional reliance on local control and federal law which prohibits the military from engaging in law enforcement activities on American soil (House Select Committee report, 67). DOD viewed itself as a “resource of last resort” in matters of “civil support,” usually responding to a disaster only at the request of a “lead federal agency,” most likely FEMA (House Select Committee report, 39-40). And, FEMA normally sought federal forces only at the request of the affected state. (DHS 2004)

In its Hurricane Katrina response efforts, the White House and the DHS Secretary initially stopped short of invoking the NRP’s Catastrophic Incident Annex (the annex which had no strategic plan or approved procedures, but which allowed, upon declaration of an Incident of National Significance, the preemptive assumption of command, control, and coordination responsibilities from state and local control). Instead, they argued for federalization of National Guard troops by invoking the Insurrection Act. Normally, National Guard forces are under the command of the governor, but the Insurrection Act allows the President to place them, along with active-duty forces, under FEMA’s command. Also, under provisions of the Act, National Guard and active-duty troops are allowed to participate in law enforcement missions. Meanwhile, the Governor requested additional National Guard and active-duty troops, but insisted that the latter be under her command. Complicating matters, in those first few days, DOD officials argued against deployed any active-duty troops at all, while the mayor of New Orleans recommended publicly that DOD be put directly

in charge of both National Guard troops and active-duty personnel. The Governor continued to resist federalization at every turn, even when the White House proposed at one point a compromise, joint oversight proposition. In the end, DHS invoked the Catastrophic Incident Annex, and made the DOD commander in charge of all National Guard troops and active-duty personnel; active duty personnel provided law enforcement functions; and placed the commander in direct communication and coordination of all other law enforcement groups and organizations. (Carwile 2005, Scott 2009)

Figure 2 shows the strength of DOD within the network after this shift, and the resulting increase in strength and stability of the emergency response network overall, as represented by the additional, stronger ties (connections). Table 2A, utilizing betweenness centrality, reveals quantitatively that the overall integration of organizational actors increased, as evidenced in higher density and network centralization percentages. Table 2A also lists the actors with the highest betweenness measures, and not surprisingly, DOD is found to be the power player, with the New Orleans EOC and FEMA following in second and third place. Table 2B, using degree centrality, also shows DOD as the actor with the most connections, but with FEMA second, and then the New Orleans EOC. It could be that FEMA has a number of direct connections as the lead agency in the NRP, and is, therefore, more “popular”, but the New Orleans EOC (in particular, the mayor) continued to act as a conduit to others for some actors.

Cliques are cohesive subgroups of a network, and are defined as subsets of three or more actors that are adjacent to one another, with no other actors also adjacent to all members of a given clique. Wasserman and Faust (1994, 254) suggests that a clique be thought of “as a collection of actors all of whom ‘choose’ each other, and there is no other actor in the [network] who also ‘chooses’ and is ‘chosen’ by all of the members of the clique.” While they can indicate a certain ease of operation, efficiency, and stability within the network, a high number of them, relative to the number of actors in a network, can also indicate an inhibition in working with or sharing information and resources with others in the network (Comfort and Haase 2006, Kapucu 2006a,

Kapucu et al. 2009). In Table 1C, the number of cliques identified in the Louisiana networks at the time of landfall and within 72 hours after landfall numbered 20 and 28, respectively. Twenty-eight (28) cliques is greater than 20, and numerically would indicate greater stability, but considering that the number of organizational actors increased by nearly threefold, the “increase” is not impressive, and indicates an actual decrease (relatively speaking) in the overall stability of the network. With the advent of the military command structure, Table 2C shows that the number cliques rose dramatically to 52, suggesting a high degree of stability and a potential increase in the efficiency of operations.

### **3.3.3 Mississippi Response: During and After Hurricane Katrina**

In contrast, the Mississippi emergency response was not quite so fraught with difficulty. Mississippi was hit hard by Hurricane Katrina, with the full force of the storm, and experienced a staggering loss of life and property. But, comparatively, the destruction was not quite as devastating as that experienced in New Orleans who, in addition to the Category 3 hurricane, suffered the consequences of flooding from breached levees. The quality of the State of Mississippi efforts in response to Katrina was generally viewed as positive, drawing little media attention after the first few days following the storm.

A next-door neighbor to the State of Louisiana, Mississippi operates differently culturally, politically, and administratively. Mississippi localities are legally far more dependent on the State for resources, direction and decision-making. Though emergency management professionals are loathe to admit to any political bias or influence in responding to emergencies, the Governor, a past Chair of the Republican National Committee, by all accounts, did not experience any problems in reaching the President or his staff *directly* throughout the preparatory period, the emergency itself, and in the recovery process. In addition to the use of the regional EMAC resources, the Governor took advantage of his close personal relationship with the Governor of the State of Florida, home of the premier state emergency response organization, known for “the Florida method” with regard to

hurricane response, and used their resources liberally, though it was less than a week after Florida itself was hit by Katrina. When the Mississippi Governor and his state organizations realized (and anticipated) that their resources and capabilities would be exceeded, they quickly ceded direct control horizontally, to those more capable, and vertically, to those who had access to far greater resources. (Scott 2009)

As the hurricane made landfall, the “initial” Mississippi emergency response network is represented in Figure 3A. As with Figure 1A, there are a limited number of organizational actors (41), and they are clustered around a handful of actors: FEMA, the Mississippi EOC, Mississippi Governor, the Mississippi Emergency Management Agency (MEMA), the Biloxi, Mississippi EOC, and the NHC. There appear to be some differences among actors as to how connected they are, e.g., the Department of Defense v. the Coast Guard, FEMA v. DHS. Once again, most interactions are limited, and occur primarily between organizations of similar type (distinguished by the color of the node), with federal organizations primarily interacting with federal organizations, and local organizations primarily interacting with local organizations. Table 3A provides more detailed, quantitative information on the organizational actors. As a measure of betweenness centrality, FEMA is by far the most central, having more power in terms of coordination and control, and acting as gatekeepers to information and resources. In anticipation of the catastrophe, FEMA had a distinct presence, and much like the Louisiana network, was most central. The Mississippi EOC was second in measures of betweenness, but far less central than the Louisiana EOC (also second to FEMA) at a similar time in the chronology of events.

A few days after landfall, the EMAC A-Team held the most dominant position within the network, with FEMA a very close second, and Florida, bringing much of its own resources and organization, ranked fourth. This is depicted in Figure 3B, with quantitative support provided in Table 3A. As the number of actors increase, the depiction can provide an overall intuitive sense of network properties, but the descriptions of what is seen become increasingly imprecise. For

instance, within 72 hours of landfall, the emergency response network had increased from 41 to 468 actors. Certainly, one can discern the clustering effect again around certain organizational actors: FEMA, the EMAC A-Team, the State of Florida, the Biloxi EOC, the Mississippi EOC, the Pennsylvania National Guard, and Hancock County. Actors appear to be more integrated than the Louisiana emergency response network in a similar timeframe, with a higher density and zero pairs of actors isolated from the rest of the network.

Considering its vulnerable circumstance, the State did not have any apparent problem, nor did it exhibit any resistance, to sharing power or delegating responsibility for certain actions, including coordination functions, to known and “trusted” others. Measures of degree centrality presented in Table 3B tell much the same story, only in terms of popularity and actual numbers of individual connections.

Clique formation, represented in Table 3C, shows that, much like Louisiana in the early stages of the emergency response, nineteen (19) cliques were identified. A few days later, the number of actors increased substantially, and the number of cliques had increased as well to thirty-seven (37). The increase provided needed stability to the Mississippi emergency response network. The cohesion and coordination found in the Mississippi emergency response network is intuitively evident in Figure 3B, especially as compared to Louisiana’s network at a similar time in the event chronology.

#### **4. Conclusion**

There is preliminary evidence, supported in this paper by network analysis and anecdotal evidence, to reach the conclusion that the general reluctance of the Mayor of New Orleans and the Governor of Louisiana to relinquish control, based on their perceived role within the American federalist system, led to further chaos and confusion, complicating even further the emergency response to a devastating hurricane and its consequences. The institution of federalism, so important in the

American political system, and which supports in essence local and state response without federal interference to routine and smaller emergencies, can be one of the critical challenges to an effective response to a major disaster or catastrophe. Local and state authorities, literally and figuratively, in the eye of the storm, may be reluctant to turn over responsibilities for dealing with an emergency to federal entities, thus “federalizing” the response.

The evidence is “preliminary” in that the information upon which the network analysis and case descriptions emerged could be much improved and expanded. The documentation used could be supplemented with interviews of individuals, representing each organizational actor, to confirm connections between other organizational actors, and to establish relative weight and direction of ties (connections). With that additional information, more sophisticated network analysis operations could be run which could speak to each State’s response with more specificity and authority, and could directly compare responses (networks) with one another and to an ideal form (e.g., plans and procedures in place at the time) (Wasserman and Robins 2005, Wasserman et al. 2007). The latter is useful in determining the amount of deviation from planned actions, and if it is determined that the response network performed its functions to the letter and the response was still “challenged”, it would indicate that the plan and procedures need to be reviewed in light of the response experience and revised.

Network analysis not only allows for examination of relationships based on quantitative data and methods, but as organizations and networks become more and more complex, for visual and intuitive examination and comparison as well. But, except in the narrowest of examples, network analysis alone does not provide a holistic picture of that which is being studied. Case studies, paired with social network analysis, provide the context and richness necessary for such a view. Placed within the context of a systems approach, a basic analytical method could be devised based on the following: content analysis of documents directly related to the emergency, interviews with individual actors involved in the response, and the application of social network analysis.

Using this approach, any number of related phenomena could be studied, including emergent phenomena in emergency response operations, the identification and study of the role and influence of boundary spanners, and the effect of trust and political influence on emergency response systems within the context of an actual response.

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**Table 1A: Louisiana Emergency Response Network – Betweenness Centrality*****Louisiana at the Time of Landfall***

Density: 0.0545  
 No. of Actors: 58  
 No. of Ties: 174

***Louisiana within 72 Hours after Landfall***

Density: 0.0096  
 No. of Actors: 148  
 No. of Ties: 410

***Betweenness Centrality***

	<b>Betweenness</b>	<b>nBetweenness</b>		<b>Betweenness</b>	<b>nBetweenness</b>
<b>Mean</b>	52.298	3.396	<b>Mean</b>	148.275	0.702
<b>Std Dev</b>	171.538	11.139	<b>Std Dev</b>	495.27	2.346
<b>Sum</b>	2981.000	193.571	<b>Sum</b>	30693.000	145.361
<b>Variance</b>	29425.455	124.074	<b>Variance</b>	245292.547	5.502
<b>SSQ</b>	1833152.000	7729.601	<b>SSQ</b>	55326572.000	1240.942
<b>MCSSQ</b>	1677250.875	7072.234	<b>MCSSQ</b>	50775556.000	1138.866
<b>Euc Norm</b>	1353.939	87.918	<b>Euc Norm</b>	7438.184	35.227
<b>Minimum</b>	0.000	0.000	<b>Minimum</b>	0.000	0.000
<b>Maximum</b>	929.333	60.346	<b>Maximum</b>	4631.036	21.932
Network Centralization Index = 57.97%			Network Centralization Index = 21.33 %		

***Organizations that have the highest betweenness centrality in Louisiana's response to Hurricane Katrina***

	<b>Betweenness</b>	<b>nBetweenness</b>		<b>Betweenness</b>	<b>nBetweenness</b>
<b>FEMA</b>	929.333	60.346	<b>NO EOC</b>	4631.036	21.932
<b>LA EOC</b>	659.333	42.814	<b>FEMA</b>	3190.980	15.112
<b>NHC</b>	481.167	31.245	<b>LA National Guard</b>	2446.624	11.587
<b>NO EOC</b>	467.000	30.325	<b>NO EMT</b>	1789.490	8.475
<b>ARC</b>	279.500	18.149	<b>LEST</b>	1453.000	6.881
<b>DHS</b>	74.333	4.827	<b>LA EOC</b>	1216.635	5.762
<b>Coast Guard</b>	32.500	2.110	<b>NHC</b>	1156.210	5.476
<b>FBI</b>	10.500	0.682	<b>NYPD</b>	1084.000	5.134
<b>DOD</b>	10.500	0.682	<b>LA Governor</b>	961.676	4.554
<b>FAA</b>	10.500	0.682	<b>ARC</b>	951.861	4.508

Note: nBetweenness = normed measure; SSQ = Sum of Squares; MCSSQ = Mean Centered Sum of Squares; Euc Norm = Euclidean Norm.

**Table 1B: Louisiana Emergency Response Network – Degree Centrality*****Louisiana at the Time of Landfall******Louisiana within 72 Hours after Landfall******Degree Centrality***

	<b>Degree</b>	<b>nDegree</b>	<b>Share</b>		<b>Degree</b>	<b>nDegree</b>	<b>Share</b>
<b>Mean</b>	3.053	5.451	0.018	<b>Mean</b>	1.981	0.961	0.005
<b>Std Dev</b>	4.474	7.989	0.026	<b>Std Dev</b>	3.524	1.710	0.009
<b>Sum</b>	174.000	310.714	1.000	<b>Sum</b>	410.000	199.029	1.000
<b>Variance</b>	20.015	63.823	0.001	<b>Variance</b>	12.415	2.926	0.000
<b>SSQ</b>	1672.000	5331.632	0.055	<b>SSQ</b>	3382.000	796.965	0.020
<b>MCSSQ</b>	1140.842	3637.889	0.038	<b>MCSSQ</b>	2569.923	605.600	0.015
<b>Euc Norm</b>	40.890	73.018	0.235	<b>Euc Norm</b>	58.155	28.231	0.142
<b>Minimum</b>	1.000	1.786	0.006	<b>Minimum</b>	0.000	0.000	0.000
<b>Maximum</b>	26.000	46.429	0.149	<b>Maximum</b>	31.000	15.049	0.076
Network Centralization Index = 42.47%				Network Centralization Index = 14.22%			
Heterogeneity = 5.52%				Heterogeneity = 2.01%			
Normalized = 3.84%				Normalized = 1.54%			

***Organizations that have the highest degree centrality in Louisiana's response to Hurricane Katrina***

	<b>Degree</b>	<b>nDegree</b>	<b>Share</b>		<b>Degree</b>	<b>nDegree</b>	<b>Share</b>
<b>FEMA</b>	26.000	46.429	0.149	<b>FEMA</b>	31.000	15.049	0.076
<b>LA EOC</b>	19.000	33.929	0.109	<b>NO EOC</b>	23.000	11.165	0.056
<b>NO EOC</b>	14.000	25.000	0.080	<b>LA EOC</b>	15.000	7.282	0.037
<b>NHC</b>	10.000	17.857	0.057	<b>LA National Guard</b>	13.000	6.311	0.032
<b>DHS</b>	7.000	12.500	0.040	<b>LEST</b>	13.000	6.311	0.032
<b>St. Bernard Parish</b>	7.000	12.500	0.040	<b>HAZMAT</b>	11.000	5.340	0.027
<b>St. Charles Parish</b>	6.000	10.714	0.034	<b>NYPD</b>	10.000	4.854	0.024
<b>St. James Parish</b>	5.000	8.929	0.029	<b>EMAC A-Team</b>	10.000	4.854	0.024

Note: nDegree = normed degree; SSQ = Sum of Squares; MCSSQ = Mean Centered Sum of Squares; Euc Norm = Euclidean Norm.

**Table 1C: Louisiana Emergency Response Network – Cliques****Louisiana at the Time of Landfall**

Twenty (20) cliques were found.

- 1: FEMA DOD NHC
- 2: FEMA FAA NHC
- 3: FEMA NRC NHC
- 4: FEMA ARC NHC
- 5: DHS Coast Guard NHC
- 6: DHS DOD NHC
- 7: DHS FAA NHC
- 8: DHS DHS HSOC NHC
- 9: Coast Guard NHC LA EOC NO EOC
- 10: LA Natl Guard LA Gov LA EOC
- 11: LA Gov LA EOC NO EOC
- 12: LA EOC St. James Parish St. Charles Parish St. Bernard Parish Plaquemines Parish
- 13: LA EOC Tammeny Parish St. Bernard Parish
- 14: LA EOC Tangipahoa Parish St. Bernard Parish
- 15: LA EOC Jefferson Parish St. Bernard Parish
- 16: ARC NHC LA EOC NO EOC
- 17: LA EOC Washington Parish Tangipahoa Parish
- 18: LA EOC Washington Parish St. Charles Parish
- 19: LA EOC St. John Parish St. James Parish St. Charles Parish
- 20: LA EOC Tangipahoa Parish St. John Parish

**Louisiana within 72 Hours after Landfall**

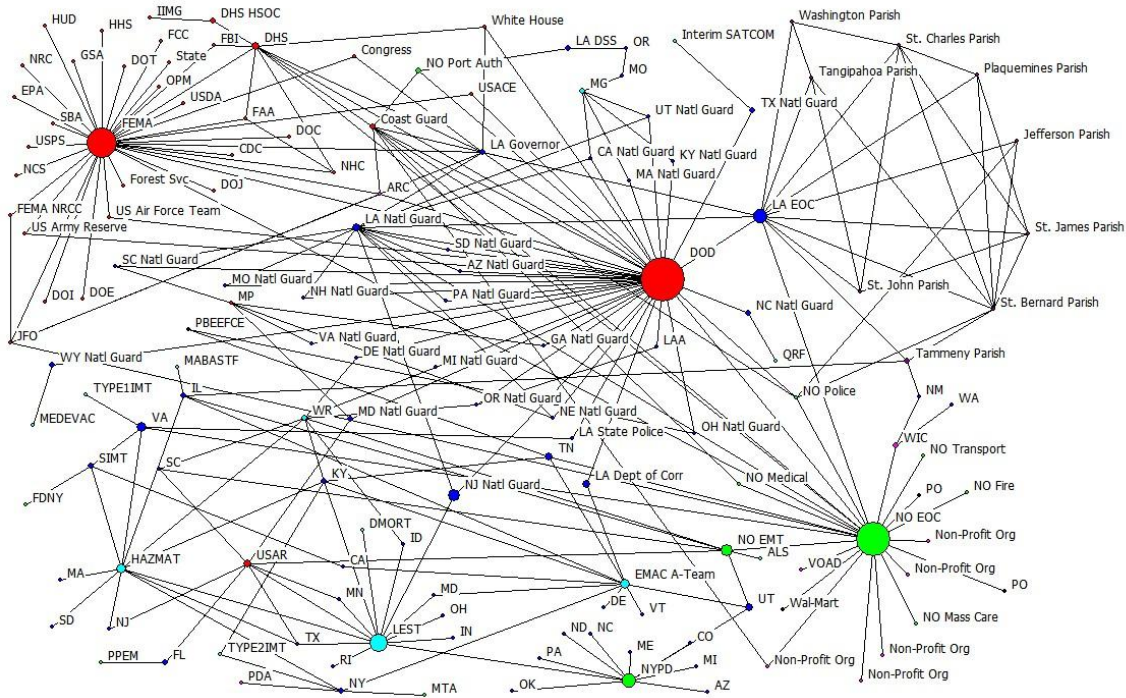
Twenty-eight (28) cliques were found.

- 1: DHS FEMA FAA NHC
- 2: DHS FEMA DOD
- 3: DHS FEMA FBI
- 4: Coast Guard ARC LA EOC NO EOC
- 5: Coast Guard NO EOC NO Police
- 6: Coast Guard NO EOC NO Medical

**Table 1C (continued): Louisiana Emergency Response Network – Cliques****Louisiana within 72 Hours after Landfall (continued)**

- 7: Coast Guard NO EOC Non-Profit Org
- 8: KY HAZMAT LEST
- 9: KY HAZMAT WR
- 10: KY TN EMAC A-Team
- 11: MN LEST USAR
- 12: SC NO EMT USAR
- 13: SC NO EMT WR
- 14: TX HAZMAT LEST
- 15: TX LEST USAR
- 16: VA HAZMAT SIMT
- 17: LA Natl Guard LA Gov LA EOC
- 18: LA Natl Guard LA EOC NO EOC
- 19: LA EOC St. James Parish St. Charles Parish St. Bernard Parish Plaquemines Parish
- 20: LA EOC Tammeny Parish St. Bernard Parish
- 21: LA EOC Tangipahoa Parish St. Bernard Parish
- 22: LA EOC Jefferson Parish St. Bernard Parish
- 23: NHC LA EOC NO EOC
- 24: LA EOC Washington Parish Tangipahoa Parish
- 25: LA EOC Washington Parish St. Charles Parish
- 26: LA EOC St. John Parish St. James Parish St. Charles Parish
- 27: LA EOC Tangipahoa Parish St. John Parish
- 28: Jefferson Parish St. Bernard Parish NO Police

**Figure 2: Louisiana Emergency Response Network after Military Assumption of Command and Control (9/3) – Betweenness Centrality**



Federal-Red; State-Blue; Local-Green;  
County-Purple; Regional-Light Blue;  
Nonprofit-Pink; Private, For-Profit-Black.

**Table 2A: Louisiana Emergency Response Network after Military Assumption of Power – Betweenness Centrality**

Density: 0.0227  
 No. of Actors: 149  
 No. of Ties: 494

*Betweenness Centrality*

	<b>Betweenness</b>	<b>nBetweenness</b>
<b>Mean</b>	183.209	1.707
<b>Std Dev</b>	585.142	5.453
<b>Sum</b>	27115.000	252.679
<b>Variance</b>	34391.188	29.733
<b>SSQ</b>	55641620.000	4831.916
<b>MCSSQ</b>	50673896.000	4400.519
<b>Euc Norm</b>	7459.331	69.512
<b>Minimum</b>	0.000	0.000
<b>Maximum</b>	4713.782	43.927
Network Centralization Index = 42.51%		

*Organizations that have the highest betweenness centrality in Louisiana's response to Hurricane Katrina*

	<b>Betweenness</b>	<b>nBetweenness</b>
<b>DOD</b>	4713.782	43.927
<b>NO EOC</b>	3623.314	33.765
<b>FEMA</b>	3001.786	27.973
<b>LEST</b>	1597.915	14.891
<b>NYPD</b>	1140.000	10.623
<b>LA EOC</b>	1090.845	10.165
<b>NJ</b>		
<b>National Guard</b>	1059.290	9.871
<b>NO EMT</b>	1056.407	9.844
<b>EMAC A-Team</b>	820.536	7.646
<b>HAZMAT</b>	773.559	7.209
<b>VA</b>	687.075	6.403
<b>USAR</b>	588.267	5.482
<b>DHS</b>	498.380	4.644

Note: nBetweenness = normed measure; SSQ = Sum of Squares; MCSSQ = Mean Centered Sum of Squares; Euc Norm = Euclidean Norm.

**Table 2B: Louisiana Emergency Response Network after Military Assumption of Power – Degree Centrality***Degree Centrality*

	<b>Degree</b>	<b>nDegree</b>	<b>Share</b>
<b>Mean</b>	3.338	2.271	0.007
<b>Std Dev</b>	5.003	3.404	0.010
<b>Sum</b>	494.000	336.054	1.000
<b>Variance</b>	25.035	11.585	0.000
<b>SSQ</b>	5354.000	2477.671	0.022
<b>MCSSQ</b>	3705.108	1714.614	0.015
<b>Euc Norm</b>	73.171	49.776	0.148
<b>Minimum</b>	0.000	0.000	0.000
<b>Maximum</b>	39.000	26.531	0.079
Network Centralization Index = 24.59%			
Heterogeneity = 2.19%			
Normalized = 1.53%			

*Organizations that have the highest degree centrality in Louisiana's response to Hurricane Katrina*

	<b>Degree</b>	<b>nDegree</b>	<b>Share</b>
<b>DOD</b>	39.000	26.531	0.079
<b>FEMA</b>	33.000	22.449	0.067
<b>NO EOC</b>	25.000	17.007	0.051
<b>LA National Guard</b>	14.000	9.524	0.028
<b>LA EOC</b>	14.000	9.524	0.028
<b>LEST</b>	13.000	8.844	0.026
<b>HAZMAT</b>	11.000	7.483	0.022
<b>EMAC A-Team</b>	10.000	6.803	0.020
<b>NYPD</b>	10.000	6.803	0.020
<b>DHS</b>	10.000	6.803	0.020
<b>Coast Guard</b>	9.000	6.122	0.018
<b>LA Governor</b>	8.000	5.442	0.016

Note: nDegree = normed degree; SSQ = Sum of Squares; MCSSQ = Mean Centered Sum of Squares; Euc Norm = Euclidean Norm.

**Table 2C: Louisiana Emergency Response Network after Military Assumption of Power – Cliques****Louisiana with DOD at the Helm**

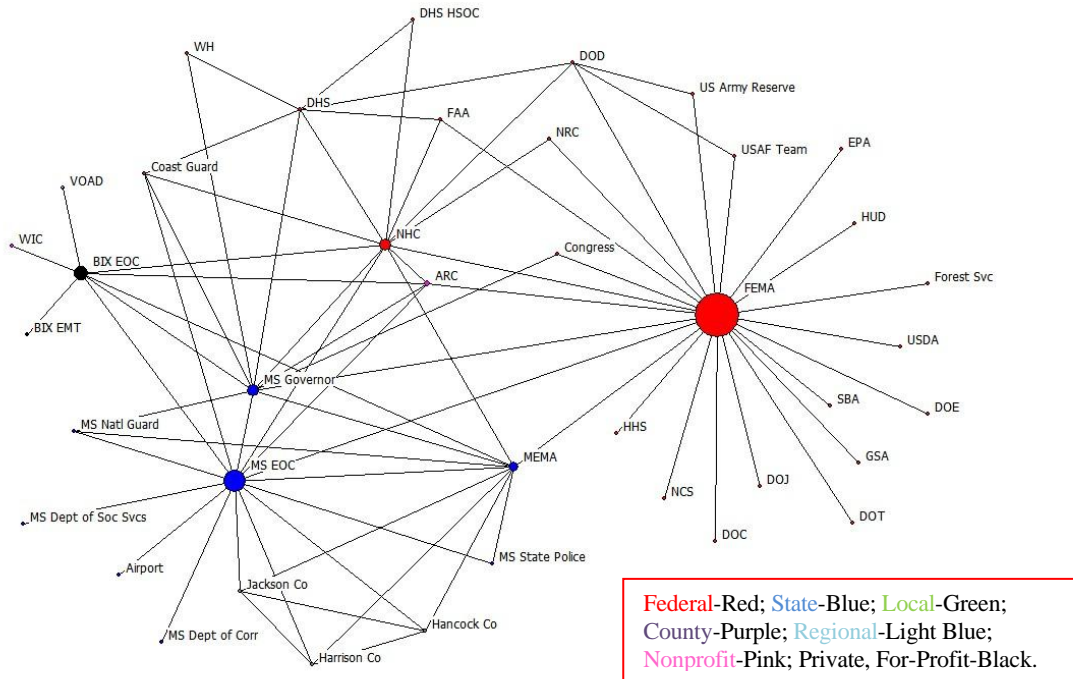
Fifty-two (52) cliques were found.

- 1: DOD LA Natl Guard LA Gov LA EOC
- 2: DOD LA Natl Guard LA EOC NO EOC
- 3: DOD CA Natl Guard LA Natl Guard
- 4: DOD LA Natl Guard MO Natl Guard
- 5: DOD LA Natl Guard NE Natl Guard
- 6: DOD LA Natl Guard NH Natl Guard
- 7: DOD LA Natl Guard NJ Natl Guard
- 8: DOD LA Natl Guard PA Natl Guard
- 9: DOD LA Natl Guard SC Natl Guard
- 10: DOD LA Natl Guard SD Natl Guard
- 11: DOD LA Natl Guard UT Natl Guard
- 12: DOD AZ Natl Guard LA Natl Guard
- 13: DHS FEMA DOD LA Gov
- 14: DHS FEMA DOD NO EOC
- 15: FEMA DOD US Army Reserve
- 16: FEMA DOD USACE
- 17: FEMA DOD ARC
- 18: FEMA DOD US Air Force Team
- 19: DHS Coast Guard DOD NO EOC
- 20: Coast Guard DOD LA EOC NO EOC
- 21: Coast Guard DOD NO EOC NO Police
- 22: Coast Guard DOD ARC
- 23: Coast Guard DOD NO Port Auth
- 24: White House DHS DOD LA Gov
- 25: DOD OR Natl Guard LAA
- 26: Congress FEMA LA Gov
- 27: FEMA FEMA NRCC JFO
- 28: FEMA JFO ARC

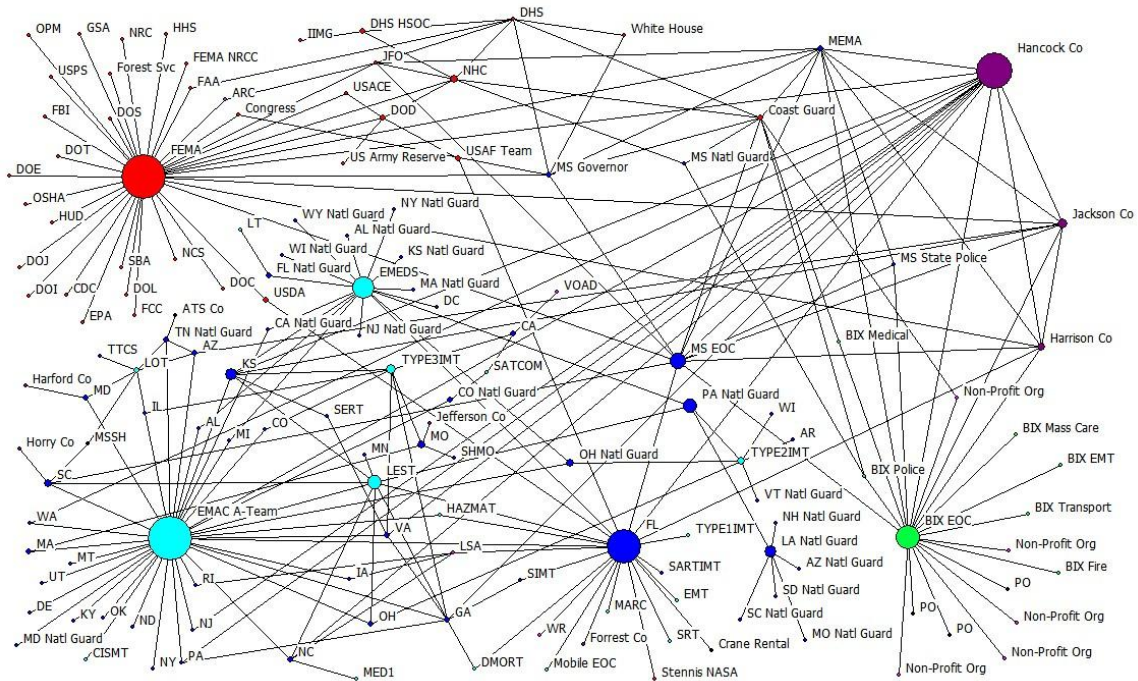
**Table 2C (continued): Louisiana Emergency Response Network after Military Assumption of Power – Cliques****Louisiana with DOD at the Helm (continued)**

- 29: FEMA JFO LA Gov
- 30: FEMA JFO NO EOC
- 31: DHS FEMA FAA NHC
- 32: DHS FEMA FBI
- 33: KY HAZMAT LEST
- 34: KY HAZMAT WR
- 35: KY TN EMAC A-Team
- 36: MN LEST USAR
- 37: SC NO EMT USAR
- 38: SC NO EMT WR
- 39: TX HAZMAT LEST
- 40: TX LEST USAR
- 41: VA HAZMAT SIMT
- 42: LA EOC Jefferson Parish St. Bernard Parish
- 43: Jefferson Parish St. Bernard Parish NO Police
- 44: LA EOC Tammeny Parish St. Bernard Parish
- 45: LA EOC Washington Parish Tangipahoa Parish
- 46: LA EOC Washington Parish St. Charles Parish
- 47: LA EOC Tangipahoa Parish St. John Parish
- 48: LA EOC Tangipahoa Parish St. Bernard Parish
- 49: LA EOC St. John Parish St. James Parish St. Charles Parish
- 50: LA EOC St. James Parish St. Charles Parish St. Bernard Parish Plaquemines Parish
- 51: Coast Guard NO EOC NO Medical
- 52: Coast Guard NO EOC Non-Profit Org

**Figure 3A: Mississippi Emergency Response Network at Landfall (8/29) – Betweenness Centrality**



**Figure 3B: Mississippi Emergency Response Network within 72 Hours after Landfall (9/1) – Betweenness Centrality**



**Table 3A: Mississippi Emergency Response Network – Betweenness Centrality*****Mississippi During Landfall***

Density: 0.0962  
 No. of Actors: 41  
 No. of Ties: 150

***Mississippi After Landfall***

Density: 0.0218  
 No. of Actors: 148  
 No. of Ties: 468

***Betweenness Centrality***

	<b>Betweenness</b>	<b>nBetweenness</b>		<b>Betweenness</b>	<b>nBetweenness</b>
<b>Mean</b>	26.875	3.627	<b>Mean</b>	196.735	1.859
<b>Std Dev</b>	80.600	10.877	<b>Std Dev</b>	602.276	5.690
<b>Sum</b>	1075.000	145.074	<b>Sum</b>	28920.000	273.217
<b>Variance</b>	6496.429	118.315	<b>Variance</b>	362735.969	32.375
<b>SSQ</b>	288747.781	5258.747	<b>SSQ</b>	59011756.000	5266.921
<b>MCSSQ</b>	259857.172	4732.583	<b>MCSSQ</b>	53322188.000	4759.115
<b>Euc Norm</b>	537.353	72.517	<b>Euc Norm</b>	7681.911	72.574
<b>Minimum</b>	0.000	0.000	<b>Minimum</b>	0.000	0.000
<b>Maximum</b>	459.257	61.978	<b>Maximum</b>	3845.535	36.330
Network Centralization Index = 59.85%			Network Centralization Index = 34.71%		

***Organizations that have the highest betweenness centrality in Mississippi's response to Hurricane Katrina***

	<b>Betweenness</b>	<b>nBetweenness</b>		<b>Betweenness</b>	<b>nBetweenness</b>
<b>FEMA</b>	459.257	61.978	<b>EMAC A-Team</b>	3845.535	36.330
<b>MS EOC</b>	206.388	27.853	<b>FEMA</b>	3805.931	35.956
<b>BIX EOC</b>	111.200	15.007	<b>Hancock Co</b>	2982.257	28.174
<b>NHC</b>	96.857	13.071	<b>FL</b>	2836.813	26.800
<b>MS Governor</b>	83.040	11.207	<b>BIX EOC</b>	1855.659	17.531
<b>MEMA</b>	78.655	10.615	<b>EMEDS</b>	1749.824	16.531
<b>ARC</b>	11.733	1.583	<b>MS EOC</b>	1195.920	11.298
<b>DHS</b>	11.269	1.521	<b>PA National Guard</b>	925.303	8.742
<b>DOD</b>	11.217	1.514	<b>LEST</b>	885.097	8.362

Note: nBetweenness = normed measure; SSQ = Sum of Squares; MCSSQ = Mean Centered Sum of Squares; Euc Norm = Euclidean Norm.

**Table 3B: Mississippi Emergency Response Network – Degree Centrality***Degree Centrality*

	<b>Degree</b>	<b>nDegree</b>	<b>Share</b>		<b>Degree</b>	<b>nDegree</b>	<b>Share</b>
<b>Mean</b>	3.750	9.615	0.025	<b>Mean</b>	3.184	2.181	0.007
<b>Std Dev</b>	4.603	11.803	0.031	<b>Std Dev</b>	5.099	3.492	0.011
<b>Sum</b>	150.000	384.615	1.000	<b>Sum</b>	468.000	320.548	1.000
<b>Variance</b>	21.188	139.300	0.001	<b>Variance</b>	26.000	12.198	0.000
<b>SSQ</b>	1410.000	9270.217	0.063	<b>SSQ</b>	5312.000	2492.025	0.024
<b>MCSSQ</b>	847.500	5571.992	0.038	<b>MCSSQ</b>	3822.041	1793.038	0.017
<b>Euc Norm</b>	37.550	96.282	0.250	<b>Euc Norm</b>	72.883	49.920	0.156
<b>Minimum</b>	1.000	2.564	0.007	<b>Minimum</b>	1.000	0.685	0.002
<b>Maximum</b>	23.000	58.974	0.153	<b>Maximum</b>	36.000	24.658	0.077
Network Centralization Index = 51.96%				Network Centralization Index = 22.79%			
Heterogeneity = 6.27%				Heterogeneity = 2.43%			
Normalized = 3.86%				Normalized = 1.76%			

*Organizations that have the highest degree centrality in Mississippi's response to Hurricane Katrina*

	<b>Degree</b>	<b>nDegree</b>	<b>Share</b>		<b>Degree</b>	<b>nDegree</b>	<b>Share</b>
<b>FEMA</b>	23.000	58.974	0.153	<b>FEMA</b>	36.000	24.658	0.077
<b>MS EOC</b>	15.000	38.462	0.100	<b>EMAC A-Team</b>	35.000	23.973	0.075
<b>NHC</b>	12.000	30.769	0.080	<b>FL</b>	22.000	15.068	0.047
<b>MS Governor</b>	11.000	28.205	0.073	<b>BIX EOC</b>	20.000	13.699	0.043
<b>MEMA</b>	10.000	25.641	0.067	<b>EMEDS</b>	16.000	10.959	0.034
<b>BIX EOC</b>	8.000	20.513	0.053	<b>Hancock Co</b>	15.000	10.274	0.032
<b>DHS</b>	7.000	17.949	0.047	<b>MS EOC</b>	12.000	8.219	0.026
<b>ARC</b>	5.000	12.821	0.033	<b>MEMA</b>	10.000	6.849	0.021
<b>DOD</b>	5.000	12.821	0.033	<b>LEST</b>	9.000	6.164	0.019

Note: nDegree = normed degree; SSQ = Sum of Squares; MCSSQ = Mean Centered Sum of Squares; Euc Norm = Euclidean Norm.

**Table 3C: Mississippi Emergency Response Network – Cliques****Mississippi at the Time of Landfall**

Nineteen (19) cliques were found.

- 1: FEMA NHC MS Gov MS EOC MEMA
- 2: FEMA NHC MS Gov MS EOC ARC
- 3: FEMA FAA NHC
- 4: FEMA NHC NRC
- 5: FEMA DOD NHC
- 6: Congress FEMA MS Gov
- 7: FEMA DOD US Air Force Team
- 8: FEMA DOD US Army Reserve
- 9: DHS Coast Guard NHC MS Gov
- 10: DHS DOD NHC
- 11: DHS FAA NHC
- 12: DHS DHS HSOC NHC
- 13: White House DHS MS Gov
- 14: Coast Guard NHC MS Gov MS EOC
- 15: MS Natl Guard MS Gov MS EOC MEMA
- 16: NHC MS Gov MS EOC MEMA BIX EOC
- 17: NHC MS Gov MS EOC BIX EOC ARC
- 18: MS EOC MEMA Harrison Co Hancock Co Jackson Co
- 19: MS EOC MEMA MS State Police

**Mississippi within 72 Hours after Landfall**

Thirty-seven (37) cliques were found.

- 1: FEMA MS EOC MEMA Harrison Co Hancock Co Jackson Co
- 2: FEMA JFO MS EOC MEMA
- 3: FEMA MS Gov MS EOC MEMA
- 4: FEMA DOD USACE
- 5: FEMA DOD NHC
- 6: FEMA JFO ARC
- 7: FEMA JFO NHC
- 8: Congress FEMA MS Gov
- 9: DHS JFO NHC

**Table 3C (continued): Mississippi Emergency Response Network – Cliques****Mississippi within 72 Hours after Landfall (continued)**

- 10: DHS Coast Guard NHC
- 11: DHS DHS HSOC NHC
- 12: White House DHS MS Gov
- 13: DHS Coast Guard MS Gov
- 14: Coast Guard NHC MS Natl Guard
- 15: Coast Guard MS Natl Guard BIX Police
- 16: Coast Guard MS Gov MS EOC MEMA
- 17: AZ TN Natl Guard EMAC A-Team
- 18: AZ TN Natl Guard LOT
- 19: FL EMAC A-Team Hancock Co
- 20: FL EMAC A-Team HAZMAT
- 21: FL EMAC A-Team LEST
- 22: FL MS EOC Harrison Co Hancock Co
- 23: GA PA EMAC A-Team Hancock Co
- 24: GA VA EMAC A-Team Hancock Co
- 25: GA EMAC A-Team LEST
- 26: GA VA TYPE3IMT
- 27: KS EMAC A-Team Hancock Co
- 28: KS EMAC A-Team LEST
- 29: KS Hancock Co Jackson Co
- 30: NC EMAC A-Team Hancock Co
- 31: NC EMAC A-Team LEST
- 32: NJ EMAC A-Team Hancock Co
- 33: OH EMAC A-Team LEST
- 34: SC EMAC A-Team LEST
- 35: WA EMAC A-Team Hancock Co
- 36: MS EOC MEMA BIX EOC Harrison Co Hancock Co Jackson Co
- 37: MS EOC MEMA BIX EOC MS State Police

## Appendix A: List of Organizations That Participated in Response Operations

In addition to standard state abbreviations, the following were used to represent organizations that participated in emergency response operations.

ALS	Advance Life Support
ANG	Air National Guard
ARC	American Red Cross
ATS Co	American Tower Systems Corporation
BIX	Biloxi, MS
BIX EMT	BIX Emergency Management Team
BIX EOC	BIX Emergency Operations Center
CDC	Center for Disease Control
CISMT	Critical Incident Stress Management Team
CR	Crane Rental
CRT	Community Relations Team
DHS	Department of Homeland Security
DMORT	Disaster Mortuary Operational Response Team
DOC	Department of Commerce
DOD	Department of Defense
DOE	Department of Energy
DOI	Department of Interior
DOJ	Department of Justice
DOS/State	Department of State
DOT	Department of Transportation
DRC	Disaster Relief Club
EDICS	Emergency Deployable Interoperable Communications System
EMAC A-Team	Emergency Management Assistance Compact A-Team
EMEDS	Expeditionary Medical Support
EMT	Emergency Medical Team
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FBI	Federal Bureau of Investigation
FCC	Federal Communications Commission
FDNY	Fire Department of New York
FEMA	Federal Emergency Management Agency
GSA	General Services Administration
HAZMAT	Hazardous Materials Team
HHS	Department of Health and Human Services
HSOC	Homeland Security Operations Center
HUD	Housing and Urban Development
IIMG	Interagency Incident Management Group
JFO	Joint Field Office
LA Dept of Corr	Louisiana Department of Corrections
LA DSS	Louisiana Department of Social Services
LA EOC	Louisiana Emergency Operations Center
LAA	Louis Armstrong Airport
LADSS	LA Department of Social Services
LAEOC	LA Emergency Operations Center
LEST	Law Enforcement Strike Team
LOT	Law and Order Team
LSA	Lutheran Services of America
LT	Logistics Team
MABASTF	Mutual Aid Box Alarm System Task Force
MARC	Mid America Regional Council
MEDI	Mobile Emergency Department-1 Team

## Appendix A: List of Organizations That Participated in Response Operations (continued)

MEDEVAC	Medical Evacuation
MEMA	Mississippi Emergency Management Agency
MG	Medical Group
MP	Military Police
MS EOC	Mississippi Emergency Operations Center
MSSH	MS State Hospital
MTA	Metropolitan Transportation Authority
NASA	National Aeronautics and Space Administration
NCS	National Communications System
NHC	National Hurricane Center
NO EMT	New Orleans Emergency Management Team
NO EOC	New Orleans Emergency Operations Center
NO Port Auth	New Orleans Port Authority
NRC	Nuclear Regulatory Commission
NRCC	National Response Coordination Center
NU	Nichols University
NYPD	New York Police Department
OPM	Office of Personnel Management
PBEEFCE	Prime Base Engineer Emergency Force Civil Engineering
PDA	Presbyterian Disaster Assistance
PO	Private For-Profit Organization
PPEM	Plaquemines Parish Emergency Management
QRF	Quick Reaction Force
SARTIMT	State Agricultural Response Team Incident Management Team
SATCOMM	Satellite Communications
SBA	Small Business Administration
SERT	State Emergency Response Team
SHMO	State Hazard Mitigation Office
SIMT	State Incident Management Team
SRT	Search and Rescue Team
TTCS	Tennessee Technology Center at Shelbyville
TYPE1IMT	Type I Incident Management Team
TYPE2IMT	Type II Incident Management Team
TYPE3IMT	Type III Incident Management Team
USACE	United States Army Corps of Engineers
USAF Team	United States Air Force Team
USAR	United States Army Reserve
USDA	United States Department of Agriculture
USPS	United States Postal Service
VOAD	Voluntary Organization Active in Disaster
WIC	Women, Infants and Children
WR	Water Rescue