Net-Centric Crisis Response
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The chapter by Andreas Olligschlaeger makes a compelling argument about shifting disaster response from hierarchical to networked structures. This chapter will explore the current elements of the National Incident Management System (NIMS), its Incident Command System (ICS), and how these systems represent hierarchical structure. Further analysis will explore which, if any, elements of the current NIMS could potentially translate into a networked environment.

One of the early agendas of the Department of Homeland Security (DHS), formed in the post-9/11 federal response, was to standardize America's public safety and first responder entities in emergency preparedness and management. DHS adopted their version of the Incident Command System (ICS) long practiced by the fire service and branded it the National Incident Management System (NIMS). NIMS/ICS presents a flexible but hierarchical manner in which to structure all elements of responding to wide-scale critical incidents. National confidence in DHS and one of its legacy agencies, FEMA, was rapidly eroded in the hours and days following the brunt force of Hurricane Katrina in the Gulf Coast region. NIMS and the ICS model were not in evidence in the days that followed Katrina's blast. Even with the strong leadership of the military eventually taking over, processes like ICS were likely to breakdown given the magnitude and unthinkable outcomes of the storm. Taking the best of the NIMS/ICS and transforming it into a net-centric model may present a more reliable and effective strategy for future emergency preparedness.

Current thinking may hold that critical incident management warrants the traditional “chain of command” structure that can control scenarios with military precision, while typical “day to day” problem solving is more likely to use more flexible, adaptive structures (Birzer, 1996). As technology evolves and information is increasingly available widespread and real-time, hierarchical structures hold less relevance in transferring critical information (Myers, 2006).

It appeared that during Katrina, the traditional command and control (C&C) within the pyramidal hierarchy of federal-state-local emergency management collapsed early in the disaster. Unanticipated conditions such as widespread lawlessness, radio system failure, and first responder grief and abandonment all contributed to disorder rather than order (see Gardner’s chapter in this volume). Significant numbers of first responders were completely disconnected with the centralized C&C, illustrating that “cutting off the head” of the central node in a hierarchical structure kills or disables the system (Myers, 2006).

NIMS, its Origins, and Hierarchical Design

NIMS was developed by the Department of Homeland Security in March of 2004. At the heart of NIMS is the Incident Command System (ICS), whose origins date back over 30 years. ICS began to take shape within the fire service in the early 1970s as a response to deadly wildfires in California. California and federal officials developed a model of ICS called FIRESCOPE, even as Phoenix, AZ fire officials were developing a Fireground Command System. Work continued throughout the 1980s to blend these systems into what is now recognized as a consistent ICS process with universal terminology and tactics (FEMA,"NIMS and the Incident Command System", n.d.).

FEMA publication 501-8 (2006) provides a further overview of how ICS ought to operate. The ICS is a very hierarchical structure. ICS involves the establishment of an Incident Commander who has overall command and control of the incident through a well defined Command Staff (Safety Officer, Public Information Officer, and Liaison Officer) and General Staff (the Section Chiefs overseeing the major fundamental elements of ICS). The major elements of the General Staff include:

- Operations Section
- Planning Section
- Logistics Section
- Finance/Administration Section
- Intelligence Section (if needed/appropriate)

The Incident Commander (IC) and their section chiefs comprise the Basic Functional Structure in ICS. Growth of this structure is designed to follow a modular extension, whereby the structure grows as needed and diminishes as the need declines.

Section Chiefs further delegate authority as needed and may also add Branches (in the Operations Section) and Units (in all other Sections) as needed. Branches are added if there are too many Groups or Divisions, if the incident demands a Functional Branch, or if it is a multijurisdictional incident. Branches are for further delegation when the Operations Section Chief is getting too large a span of control. Under the Section Chief, and Branch Director if present, fall Groups and Divisions. Groups are always functional assignments; Divisions are always geographic assignments. Supervisors within the Operational Section lead Groups and Divisions.

In all other Sections, Units are the elements that fall under the Section Chief and are led by Unit Leaders. The Planning Section contains the following Units:

- Resources
- Situation
- Documentation
- Demobilization
- Technical Specialists (as needed)

The Logistics Section contains the follow Units, which may fall under one or two Branches:

- Supply Unit
- Ground Support Unit
- Facilities Unit
- Food Unit
- Communication Unit
- Medical Unit

The Finance/Administration Section contains the following Units:

- Compensation/Claims Unit
- Cost Unit
- Time Unit
- Procurement Unit

Each of these defined Units within Sections has clear, defined missions. Often, there is a strong interconnectivity between Units towards the accomplishment of a specific need, (e.g. Food Unit works with Ground Support Unit and Supply Unit to make sure food resources are obtained, transported, and made available).

The Planning Section assists the IC in developing an Incident Action Plan (IAP). Significant planning throughout the event requires adapting the IAP, communicating the IAP's major objectives to the varying Sections, and measuring its outcomes. Finally, in major, multijurisdictional events, a Unified Command (UC) can take the place of IC. Rather than an individual IC, a team of commanders from each major governmental agency or discipline jointly develops the objectives, plans, and priorities for the incident (FEMA, "NIMS Basic" 501-8, 2006).

One readily apparent challenge of the ICS as defined within NIMS is the complexity of terms and the specific areas of responsibility. Despite federal mandates that all first responders must be trained in NIMS, if a police officer does not work with ICS every day, keeping the nomenclature and responsibilities straight is a daunting task. Assuming any police agency is well grounded in ICS, which is a most optimistic assumption, introducing a Unified Command and thrusting in additional commanders who may not enjoy any level of prior relationship with the police IC poses yet another challenge. At times, when observing the unfolding Katrina response, the command structure looked anything *but* unified. Even when all levels of government were working together (presumably in a UC structure), the "unity" was missing in the reporting out of activities and was replaced by finger-pointing.

With a strong, centralized C&C under the ICS plan, it is clear that the IC is the central node of the hierarchical network. Section Chiefs form major nodes immediately under the central node, Branch Directors and/or Unit Leaders slightly less major nodes under them, and so on. With this "top down" approach, as in the historic bureaucratic business model that dominated American culture, responsibility decreases as one travels outward in the organizational structure with information more difficult to manage and rigidity stifling adaptability (Barabasi, 2002, p 201).

ICS in the Katrina Environment

Countless panels, organizations, and governmental entities have and will continue to dissect the overall response to Hurricane Katrina in August and September of 2005. Most observers who watched on television news saw reported delays of federal assets and local authorities that appeared cut off from all C&C functions through loss of communications. As a panel of the National Sheriffs Association indicated in their white paper, federal agencies require a mobilization time measured in days rather than hours (National Sheriffs Association, n.d.). While FEMA provides for national resources through Emergency Mutual Aid Compact (EMAC), in the Katrina response, EMAC teams from some states arrived only to find local agencies ill prepared to use the distant resources. Some states or regions simply sent teams of responders, circumventing the EMAC protocols that are supposed to ensure a planned response and deployment.

Even when EMAC or other major national deployments occur, "there is no substitute for local knowledge when it is time for a decision to be made" (National Sheriffs Association n.d., p3). The heavy, cumbersome bureaucracy that the federal government brings with it required paperwork processing and approvals from beyond even the reaches of local command posts, all the way to Washington, DC. The sheriffs' panel concluded that such delays detracted from the Katrina response. The sheriffs also identified multilayered communication systems that hampered effective coordination. In one example, the New Orleans Police Department radio network crashed because its backup generators went down with the flooding and State Police kept the radio technicians at bay outside of the flooded area (Fordahl and Meyerson, 2005).

Clearly there were more issues at play with the breakdown of C&C during Katrina than only failed radio systems. While not approaching the initially reported 500 officers, many police officers left the community, either to attend to family crises, or simply to flee the storm and its resulting chaos (Johnson, 2006). The reliance on a highly bureaucratic hierarchical structure such as NIMS in an extended time disaster with no jurisdictional boundaries, such as a potential Avian Flu pandemic, will likely see a similar outcome due to the absence of timely decision making and burdensome process.

Contrasting Net-Centric with Pyramidal Hierarchy

Unlike the top-down structure of the ICS, net-centric structures rely on mesh-like linkages that survive on the basis of many nodes, all interconnected, and able to adapt to interruptions within the network. Networks are more stable than pyramidal organizational structures because of their distributed nature; no one node in the network will stop communication if it goes down for whatever reason. While networks rely on small numbers of large hubs that have many links, and larger numbers of smaller nodes with fewer links, as long as each node averages one link minimally, there will be communication (Barabasi, 2002, pp. 18, 63). Because of the interconnectivity of networks, it would require attacks on many major hubs simultaneously to cause a cascading failure to take down the network (Barabasi, 2002, pp. 119-120).

One of the earliest architects of the Internet illustrated the differences between vulnerable centralized (such as the ICS) and de-centralized (such as Community Oriented/Problem Solving Policing) structures and a distributed structure. Distributed networks are mesh-like with multiple contacts between nodes. The network monitors its own traffic history, modifying path selection to respond to changes in the network. Its efficiency comes from local control without the need for any central (i.e. vulnerable) control (Baran, 1964).

Cowper (2005) describes "net-centric policing" as citizens and police alike, linking electronically to multiple sources of information, used towards achieving mutually understood objectives. He describes two primary purposes of the networks, to provide:

- Organizational intent, mission, goals, and priorities for all to readily understand
- The immediate local context for each individual within the network.

In this fashion, a highly informed human network would coordinate activity absent centralized C&C, using local decision making, but within the organizational intent framework (Cowper, 2005). When contrasted with hierarchies, networks have the advantage of more resilience to breakdowns, less dependence on individual leadership skills in central positions, and less likelihood of, and vulnerability from, ego and turfism.

Whether in the context of natural disaster preparedness or attempting to prevent future man-made disasters through terrorism, the federal government still relies on highly structured hierarchies that move much slower than either the winds of hurricanes or the dispersed cells of terrorists both domestic and international. The FBI's Joint Terrorism Task Forces (JTTF) is a key example of a highly structured and traditional organization, likely hampered with bureaucratic requirements. The FBI has sought ways to more quickly release information that may be classified beyond the normal law-enforcement sensitive releases to local police but has found that the length of time to secure high level clearances is extreme (Casey, 2004) and takes agents away from the higher purposes of actually preventing terrorism. In contrast, looking at a flatter, responsive, and team-oriented structure with a bias towards quick action could result in a decidedly effective approach to combating and preventing terrorism (Levin, 2006), and its net-centric design would make it resilient as well.

ICS in a Net-Centric Environment

Unlike the highly structured hierarchy of the NIMS/ICS, a networked approach would see knowledge and skills sets distributed across wide expanses. While ICS allows for cross training personnel to assume a variety of roles within the ICS structure, a net-centric approach would match individual first responders with other human assets to act as a force multiplier to their particular skill sets. Here is but one example of what a net-centric response to a Katrina-scale event could resemble:

> Multiple rapid response clusters comprised of personnel from local, state and federal agencies, each with their own specialized sub-units, could have immediately deployed to the affected areas, setting up communications and providing instant situational analysis and information flow to all other clusters. Computerized disaster scenario models, derived from previous real-world disasters as well as virtual reality war-games conducted by emergency management authorities, would help guide individual clusters' responses. Personnel from local agencies would provide area-specific expertise to state and federal personnel within their cluster, eliminating the need for redundant efforts.

> Modern algorithms, such as dynamic programming, could then immediately begin allocating resources to clusters or even individual nodes based on local needs, the needs of other clusters, as well as overall inventory. In the case of major communications failure or other breakdown within a cluster or hub, the entire system would still continue to work. And, because the system is dynamic, situation changes in various locations would lead to instant adjustments within the entire system, thus preserving maximum operational efficiency.
> For those nodes or clusters that experience communication failures or are physically cut off form the rest of the network, Neighborhood –Driven Policing principles (see Levin and Myers 2005) could be applied by using local police officers (nodes) with well established community relationships (links) to provide leadership in the absence of outside help. These officers, supported by both the community and other state and federal officers within their cluster, could continue to support the mission and purpose of the effort and collaborate with local residents to survive until contact with the rest of the network is reestablished. (Myers, 2006)

Rather than rely on a flexible but hierarchical structure of ever expanding Branches, Divisions, and Units, a net-centric approach would incorporate the distributed task management and leadership functions in a way that would facilitate more rapid decision-making and quicker deployment of assets where they are needed the most. Nodes in the network would still likely rely on hubs of analysis, resources, and expertise that could not reasonably reside at each and every node. The networked approach would permit this sharing of expertise and resources even if a hub of information was cut off, due to the multiple paths of information available. Radio interoperability will not simply rely on basic radio backbones or even trunked systems. Emerging VoIP technologies and "black box" interconnectors will facilitate seemingly disparate systems to plug in with each other as needed, following the meshed infrastructure of the human networks.

This model presents a significant shift from the C&C paradigm of the current ICS structure. Those who took comfort in the eventual assumption of control by experienced and bold military leaders in the Katrina response plan will not embrace a concept of no all-powerful, centralized Incident Commander replaced by micro decision making through a highly distributed network structure. With the introduction of Community Emergency Response Teams (www.citizencorps.gov) actively involving citizen volunteers, it appears that DHS recognizes the need for further engagement of average citizens in taking a higher level of ownership for community preparedness. Further evidence of DHS' recognition of the need to more deeply engage local first responders is the increasing number of NIMS training modules available through the FEMA website, http://training.fema.gov. Perhaps most indicative of providing resources directly available to citizen consumers is www.ready.gov, where DHS has provided preparation materials, brochures, and forms for adults, children, and private businesses. In spite of all these efforts, DHS' critical incident plans place private sector and volunteer/citizen participants on the fringes of the processes rather than at their heart, failing to recognize that the fastest and perhaps most critical initial responses will come from these sectors (Levin, 2006).

Whether within the Neighborhood Driven Policing description (Myers & Levin, 2005) or simply a widespread recognition that government cannot be the sole source of emergency preparedness, a net-centric approach by design draws in citizens as individual nodes in the highly distributed network. Existing Neighborhood Watch groups could take on much wider roles as information dissemination clusters, allowing individual professional first responders to assist and coordinate a group of citizens even if cut off from the broader network, as seen in Katrina. Building on existing relationships (links in the network) and creating new links before critical events can pay high dividends; actually practicing and preparing for the highly unusual critical events could greatly enhance the probability that a Katrina-scale event would be managed in a dynamic and effective manner, even with delays in obtaining direct assistance from the state and federal resources. Well organized and prepared neighbors going door-to-door to collaboratively protect the neighborhood is a low technology network communication that can withstand almost any level of systems failure.

An Illustration of Net-Centric Response

While net-centric holds promise for policing and perhaps overall emergency planning, coordination, and operations, discussion has been primarily theoretical in nature. Implementing model systems within a networked environment might yield useful research-based evidence of the potential of net-centric for preparedness and incident management of Katrina-scale disasters. To better translate the theory of net-centric into an Emergency Preparedness application, Thomas Cowper wrote the following scenario for this chapter. What follows is a futures looking, net-centric model of emergency preparedness and disaster response that illustrates the more adaptive capabilities of disaster response organizations compared to traditional, pyramidal Incident Command that is the current model.

Emergency Management Networks, Elements, and Functions

Elements of a networked approach to Emergency Preparedness include, among others, the following entities:

- Local cops, firefighters and EMS personnel
- Local public works, utility and phone companies, street departments, public schools, hospitals, etc.

- Local citizens and private businesses
- State Police
- State DOT
- State emergency management
- National Guard
- Federal agencies – FEMA, Military, Coast Guard,
- Civilian agencies – Red Cross, bus companies, others

The network facilitates information flow – getting the right information to the right people at the right time and in a way that helps them be more productive. Networks can both push information out to specific individuals or groups of individuals and also include resources, Internet sites, and databases that individuals could be queried as needed. Information exchange would include real-time voice communication; near real-time data communication would include text, graphics, and video. Some of the information being pushed to users would be derived from other users as wearable sensors, cameras, and other data gathering devices collect information and put it on the network for others to see. Some data would come from fixed assets like security cameras, Intelligent Transportation System (ITS) sensors, or Doppler radar. Other data would come from strategic resources such as satellites and aerial photographs. Some of the individuals involved are in the field, actively participating in the rescue/recovery. Others are in a Headquarters (HQ), locally or hundreds of miles away. Some might be at home or in an office.

The Scenario

The event scenario is the explosion of an oil refinery. Before the event occurs, every police officer on patrol is tracked via Global Positioning Satellite (GPS); their automatic personal location information is displayed at the 911 center and on fellow officer's Mobile Data Terminal laptop computers (MDT's). Every employee of the refinery is monitored and tracked via GPS and their location is available for display to 911 center dispatchers. Every local citizen is given a small fob about the size of a quarter. When activated, these devices can transmit the citizen's location over a short distance, less than 100 meters. Cellular phones also have GPS enabled to transmit location information whenever 911 is dialed.

All major machinery at the refinery is on the network and its status is continuously monitored. Every vehicle has a GPS device that can be activated at the push of a button to transmit a distress signal to a 911 center; these devices are also programmed to automatically send a message if the vehicle is involved in an accident (airbags deployed) or breaks down. Every house is equipped with an intelligent alarm system that feeds information directly to the 911 center in the event of a problem at the residence. There are security cameras throughout the facility, which are available for viewing to authorized people. There are even some cameras available for viewing by the local public over the Internet. Residences in the vicinity have air quality sensors that gauge toxic gas and particulates, designed to warn people if the air becomes contaminated by releases from the refinery. The information from these sensors is available freely on the Internet. There is a local TV station with access to Doppler radar located at the airport.

In other words, the technology is in place to give everyone a comprehensive picture of their environment and at least some of the people within that domain. The 911 center has graphical displays showing all manner of activity in the area and the status of the refinery, along with real-time video from selected cameras throughout the jurisdiction and particularly around the refinery and other critical areas such as schools or shopping malls. Citizens can voluntarily contribute to this comprehensive picture by turning on various devices in and around their home or their person, and many do.

When the Explosion Takes Place

- Blast damage results in total destruction of the facility and its surroundings. The facility itself is almost completely obliterated by the blast and subsequent fire damage. The fire is still burning throughout the refinery proper and in the adjacent town.
- The surrounding area, a small village of homes and businesses just outside the refinery gates, is severely damaged within a 2-mile radius. Loss of life at the facility is 30 dead and another 50 injured. Some are disabled and still on the grounds. Some are "walking wounded" who are attempting to flee the area. The surrounding area includes another 20 dead and 100 injured within a mile of the site. Residents are fleeing both on foot and in vehicles. Some who are not injured are either helping those in their immediate vicinity or are heading toward the site because relatives were working there.
- The power grid is knocked out within three miles of the site.

- A larger city about five miles away is slightly damaged, with mostly broken windows. While there are some injuries, there is also a toxic smoke plume descending on the area and sickening people in the affected area.
- Local communications are down – a cell phone tower just outside the facility is knocked down. That tower was also a repeater site for the area public safety radio system, leaving a communications “dead spot” in a radius about four miles surrounding the site.
- Some local first responders are among the injured/killed. The local ambulance service building was severely damaged, disabling the nearest ambulances.
- The refinery had a fire fighting station that was destroyed. The nearest fire fighters are responding from the city five miles away.
- Local police from the city are responding. A county deputy was two miles away when the explosion occurred and his car was disabled from the blast, but his radio still works and he can see the site from his location.
- A state trooper was closer to the site when the blast occurred but was sheltered by terrain and is fully functional. She is responding to the site.
- An interstate highway was two miles away. A large number of motorists nearest the refinery are stranded on the highway, some injured. Some are residents of the surrounding village, and those who can are moving toward the area, either in vehicles or on foot. Two people have video cameras.
- The local airport is five miles upwind from the refinery. Two small aircraft were flying in the vicinity when the explosion took place. They are now circling at a safe distance and viewing the scene.

Net-Centric Response

With this rough overview of the situation and the associated conditions, attention shifts to how the network will function. There are two aspects of the network – the technology and the human. Both would spring into action. The autonomous portion of the technology network would react to the event by immediately displaying the outages of the commercial and public safety radio systems, showing the extent of the damage on a graphical display at the network operations centers controlling the systems. Those displays would show an accurate depiction of exactly where the coverage holes were, and that information could be relayed to all first responders and displayed on their MDT's, so they would know when they are in coverage or out. Repair crews would be alerted automatically; they would call up the real-time display and respond with portable transmission nodes or cells that would be able to temporarily fill the coverage gaps in the wireless system. They would be able to analyze their coverage displays and would be trained to know where to go to maximize communications coverage to fill the holes without responding too close to the hazardous site. Multiple temporary nodes would be established within an hour of the event.

Unmanned Aerial Vehicles (UAV's) with video cameras and wireless links could be launched immediately from miles away to autonomously loiter over the site for hours, sending back real-time video footage of the scene along with sensor data for air quality and toxic emissions. On the ground, exploratory robots, programmed to go to certain locations and search for specific objects (i.e. people, damage, fire, heat, toxic or gas) would send back data. Each robot or UAV would be a wireless node, creating an ad hoc communication link that would mesh with existing systems to fill coverage holes. Many injured citizens would turn on their locator fobs that could be picked up by UAV's or robots. The location of the injured would then be incorporated into the displays at the 911 center. The closest first responders could also receive the information, allowing them to proceed directly to the location of the nearest injured to render aid or rescue.

All of this information would not flood the displays of human operators who would soon be overwhelmed with information overload. Instead, information would be processed by the technology network and depicted graphically in a way that human operators and first responders could immediately make sense of it all and understand the situation as it is unfolding in real time. In a net-centric environment, the goal is to create mutual mental models (MMM's) between everyone involved. MMM's provide everyone with a common framework within which to operate and improve the immediate situational awareness of each individual no matter what they are doing. With MMM's everyone within the network would interactively share his or her knowledge.   People could "drill down" into the information display to gain more detailed information about the strategic situation or their own local vicinity contained within the system. In other words, 911 center operators could be presented with an overview of the whole area, perhaps an area five miles in diameter around the refinery site. By observing this picture, they would immediately see high-level information about holes in the communications and electrical grids, as well as physical destruction such as fires and toxic gas.

As time goes on and more sensors are sent into the area (UAV's, hazmat units, robots, first responders, etc.) the picture becomes more accurate and detailed.   First responders could get a display that shows the area within 100 meters of their position, including the location of other first responders. This would allow them to "self-synchronize" their actions from the bottom up without requiring top-down direction. This is not to say that some top-down direction or guidance might not be warranted. Commanders would have the luxury of more information displayed in a much more robust manner within a controlled atmosphere. They would provide an overall strategy for dealing with the event, high level guidance to help responders be more effective and outline exactly what their priorities should be as they work together to resolve the crisis.

The technology network, then, allows the human network to be more effective. Information would be flowing into 911 centers, news media outlets, police headquarters, fire stations, and all other nodes within the network. Information would be coming by phone as well as radio reports relayed directly from first responders who are within network radio coverage. The civilian aircraft would be talking on aircraft channels, relaying visual information that would be patched to 911 center operators who would put that information into textual and graphical context and send it to all responding units. Leaders at strategic command centers (police, fire, EMS, emergency management, DOT, public works, etc.) would be looking at the unfolding picture using all the in-coming information – voice, data, graphical displays, pictures from the media, UAV's, and robots - and coordinating their planning. As soon as they start to understand a picture of the event, they begin providing guidance to the first responders on the ground. They are not controlling. They are developing a shared understanding of the situation and providing a strategic vision to the responders on the front lines, helping them to self-synchronize from the bottom up. At the same time, the commanders are also coordinating with follow-on aid coming from outside the region (State Emergency Management, National Guard, FEMA, Red Cross, etc.). Those responding agencies are also seeing the picture on the ground and might also be bringing additional information gathering technology to the local and regional network, such as surveillance satellites, aerial recon, and more sophisticated sensors and robots.

Contrasted with NIMS/ICS, no single or group of isolated commanders would be giving a series of direct orders about how to proceed to resolve the situation. Each actor in this scenario, first responder on the ground, citizen on the street, dispatcher in the 911 center, police chief at his HQ, National Guard commander, or Red Cross volunteer 100 miles away, would have a comprehensive picture of the situation tailored to his or her particular needs. Based upon highly networked technology, this information would help responders and commanders create the MMM's that allow people at all levels to self-synchronize their actions to solve the crisis quicker and more effectively than waiting for orders to be passed up and down a structured chain of command. Police, fire, and EMS commanders would self-synchronize as they created a strategic vision to best resolve the crisis. Police, fire, and EMS workers on the scene could self-synchronize their actions in accordance with the strategic vision or guidance from HQ. Those responding from outside the effected area could self-synchronize their follow-on assistance so that it arrives where and when it is most needed without undue delay.

Conclusion

In the absence of an adequate central command, pockets of Katrina first responders and citizens joined together to focus on the highest order tasks at the time. While not consciously intended as such, this was effectively a basic form of ad hoc self-synchronization. Advanced and technologically integrated self-synchronization within a net-centric model is intuitive, quick, and yields a more coordinated response than a hierarchical command structure that simply cannot know everything that everyone else knows. Implementing model systems within a networked environment might yield useful research-based evidence of the potential of net-centric for preparedness and incident management of Katrina-scale disasters.

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