

**Effective Response to Large-Scale Disasters:
The Need for High-reliability Preparedness Networks**

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A continuing preparedness challenge concerns leading, managing, and coordinating multi-agency disaster prevention and response efforts. Effective disaster prevention and response requires a network of preparedness agencies and organizations that functions as a single, high-reliability organization (HRO). High-reliability organizations have been studied extensively; however, the lessons learned in managing HROs have not been systematically applied to the management and operations of multi-agency and private sector organization networks required to respond to large-scale disasters. This paper develops and recommends a leadership and management

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model for creating and leading high-reliability preparedness networks (HRPNs). The paper demonstrates that the HRPN is key to effectively preparing for and responding to rapid onset disasters such as hurricanes, tsunamis, and mass casualty terrorist events as well as evolving disasters such as infectious disease outbreaks, famines, drought, insect infestations, social system failure, and economic depression.

Key Words: High-reliability organizations, preparedness, disasters, terrorism

Introduction

It is clear that the ability to respond effectively to large-scale disasters is beyond the capability of a single organization or institution. Therefore, a continuing challenge concerns leading and managing numerous government and private sector organizations' disaster prevention and response efforts and eliminating multiple chains of command, duplications of effort, and agencies working at cross purposes. The challenge has become even more daunting because of the increased number and consequences of large-scale disasters and the number of agencies and organizations that must be organized, coordinated, and managed. Effective disaster prevention, detection, containment, and response require a network of agencies and organizations that function as a single, high-reliability organization.

High-reliability organizations (HROs) have been studied extensively; however, the lessons learned in managing HROs have not been systematically applied to the management and operations of multiple government and private sector organization networks required in large-scale disasters. This paper addresses the organizational, management, and leadership requirements involved in planning for, preventing, detecting, containing, and responding to large-scale disasters and proposes the development of *high-reliability preparedness networks* (HRPN). The high-reliability preparedness network is the next generation of the HRO and the key, indeed requirement, to prepare effectively for and respond to large-scale rapid onset disasters such as hurricanes, tsunamis, and

mass casualty terrorist events, as well as chronic long-term disasters such as the combined AIDS, tuberculosis, and ethnic wars of the African subcontinent.

Large-scale Disasters

There are no universally accepted definitions of incident, accident, crisis, or disaster (Shaluf, Ahmadun and Said, 2003, Quarantelli, 1998), however, there is agreement that disasters are non-routine in nature, cause social unrest and produce victims in excess of available resources (Kreps and Drabek, 1996, Quarantelli, 1998). Although the scope of social unrest and problems differ among varying forms of crises and disasters; in the disaster, emergency, risk management, and crisis management literature; incidents, accidents, and crises are generally viewed as organization or industry-wide in scope and disasters are viewed as having community, regional, national, or international consequences. Further, this literature generally views incidents, accidents, and crises as human-initiated and disasters as either human- or nature-initiated.

Multi-causal, acute events with a broad scope of devastation are referred to as large-scale disasters, catastrophes, or complex humanitarian disasters. Complex humanitarian disasters are relatively acute situations affecting large populations, caused by a combination of factors, often including civil strife, food shortages and population displacement and typically result in significant mortality (Noji and Toole, 1997, Burkholder and Toole, 1995). In addition, incidents may become accidents, which may progress to crises and ultimately disasters (Shaluf, Ahmadun and Said, 2003).

Definitions are dependent upon the discipline using the terms; however, generally large-scale disasters possess unique characteristics as outlined by the Federal Emergency Management Agency (FEMA). Large-scale disasters create demands that exceed the normal capacities of any one organization or government. Consequently, the number and structure of responding organizations may result in the creation of new organizations or of new tasks that engage participants who are not ordinarily disaster responders. Furthermore, the participation of multiple and possibly new

organizations greatly increase the complexity of communication, coordination, and standardization of disaster planning, leading to the difficulty of understanding “who does what” in disaster response. In addition, organizations inexperienced in disaster response often respond by continuing their independent roles, failing to see how their function fits into the complex, broader response effort.

Increased Number and Consequences of Disasters

The number and severity of large-scale disasters in the last 100 years has been growing dramatically. Reasons for the increase in nature- and human-initiated large-scale disasters may be attributable directly or due to interaction among a number of factors (Mitchell, 1996, Logue, 1996, Noji, 1997, Mitroff and Alpaslan, 2003). Some of the more important factors include the increase in population, migration of people to urban areas and consequent increase in population density, location of cities in high risk areas, population mobility, erosion of environmental barriers, changes in climate, increase in social unrest, nationalism, fanaticism, tribalism, economic inequity, development of complex and integrated technologies, global interconnectedness, and the increase in old (cholera, yellow fever, diphtheria, malaria, plague) and the emergence of new (HIV, Ebola, Hepatitis C, hantavirus, rotavirus) infectious diseases.

Disaster Life Cycles

Large-scale disasters have a distinct life cycle and over the course of the life cycle often require dozens of agencies and organizations to address community, regional, and sometimes national and international devastation and recovery. A number of disaster life cycles have been proposed (Carr, 1932, Haas, Kates and Bowden, 1977, Stoddard, 1968), however, disaster life cycles generally have three phases of varying length—pre-disaster, response, and recovery.

Disaster phases are, at best, arbitrary and only useful in distinguishing the major functional activities of a period. Emergency activities do not cease suddenly, to be replaced by other types of activities (Haas, Kates and Bowden, 1977). However, the use of

disaster phases has become important in codifying research results (Neal, 1995) and planning disaster network organization and activities. Generally, the pre-disaster phase includes prevention activities, mitigation, and preparedness. Pre-disaster typically includes hazard and vulnerability analysis as well as the establishment of the response network, incident command plans, planning, and a variety of training activities. The response phase includes early warning, emergency, and response. The emphasis in the response phase is on search and rescue, subsistence, shelter, health care, sanitation, infrastructure, and social services. The recovery phase involves clean up, logistics, rehabilitation, reconstruction, and response evaluation.

The agencies and organizations involved in phases one and two of the disaster life cycle will typically remain stable. These agencies and organizations are primarily those involved in emergency response such as hospitals, emergency response units, Federal Emergency Management Agency (FEMA), public health agencies, and local and state police organizations. However, phase three of the disaster life cycle may require new participants. For example, in phase three of the disaster life cycle, first responder organizations such as EMS and fire department roles likely will diminish and clean up and construction organizations will be required.

It is likely that there will continue to be an increase in the number and severity of nature- and human-initiated large-scale disasters. These disasters can be successfully addressed only through the well organized and coordinated interaction of multiple agencies and organizations throughout each phase of the disaster life cycle. Each phase of the disaster life cycle will require a high reliability preparedness network.

An Organization, Management, and Leadership Problem

Preventing, detecting, containing, and responding to a large-scale disaster is not a response agency competency problem but rather an organization, management, and leadership problem of coordinating efforts. Response, relief and recovery agencies usually have highly developed skills in delivering their particular services. For example, fire fighters are highly trained and know what to do when

responding to fires and many have additional expertise in search and rescue and mitigating hazardous chemical spills. Similarly, EMS personnel have also had extensive training and are highly effective in triaging, treating, and transporting the injured or ill. Public health responders have clear roles in monitoring, diagnosing, and investigating outbreaks and health hazards in the community and are capable of supporting individual and community health efforts. The difficulty in large-scale disasters is organizing, managing, and coordinating the many diverse agencies and stakeholders delivering these services. Therefore, effective organization, management, and leadership issues are critical in large-scale disasters.

The United States Government Accountability Office (GAO) February 1, 2006 Statement by Comptroller General David M. Walker on GAO's Preliminary Observations Regarding Preparedness and Response to Hurricanes Katrina and Rita confirmed that organization, management, and leadership issues underpinned many of the challenges encountered in the response to Hurricanes Katrina and Rita. The critical themes cited in the Statement were a lack of: 1) clear and decisive leadership, 2) strong advance planning, training and exercise programs, and 3) capabilities for a catastrophic event.

Clear and Decisive Leadership

The GAO statement indicated that leadership roles, responsibilities, and lines of authority were not clearly delineated prior to the hurricanes. The lack of lines of authority and a single individual responsible for leading the response led to a protracted and disjointed response. The Statement concludes:

“As a result, the federal posture generally was to wait for the affected states to request assistance. At the same time, some federal responders such as the Coast Guard and DOD did ‘lean forward’ in proactive efforts anticipating a major disaster”.

The result of a lack of clear and decisive leadership was that “... multiple chains of command, a myriad of approaches and process...” emerged to deal with the escalating problems. Clearly, activities of community based disaster management organizations must be coordinated with efforts of state and federal disaster organizations.

Strong Advance Planning, Training, and Exercise Programs

Based on experience of Hurricanes Katrina and Rita, the GAO Statement advocates strong advance planning both within and among community, state and federal responder organizations. In addition, what is needed is consistent and robust training and periodic exercise programs to test the plans, improve communication channels, and predict and identify potential impacts. Such plans and exercises should include multiple agencies at all levels including first responders, the DOD (National Guard), and contractors. The reasons why plans were not adequate are partly due to lack of central leadership and coordination and participation of the leadership in the training and exercises at all levels of response.

Capabilities for a Catastrophic Event

Identification and rapid restoration of response and recovery capabilities such as communications, continuity of essential services, and logistics and distribution systems were inadequate in the Katrina and Rita response. A “big picture” assessment of the scope of the devastation and of how much and what types of assistance were needed were beyond the capabilities of local officials and inadequate at the federal level. When the scope of devastation was finally determined, logistical systems were often overwhelmed with critical resources not available. The GAO Statement indicated that resources and capabilities should be better managed in such areas as evacuation; mass care (sheltering, feeding, and related services); managing, integrating, and deploying volunteers and unsolicited donations; and initiating and sustaining community and economic recovery.

Similar to the responses to Hurricanes Katrina and Rita, a lack of appropriate capabilities was apparent as severe acute respiratory syndrome (SARS) spread rapidly in more than 25 countries in 2003 (Liang and Xue, 2004). Devadoss, Pan, and Singh (2005) note that the health care information system in Singapore was simply insufficient for managing the information flow involved in the outbreak (Devadoss, Pan and Singh, 2005). Fortunately, the problems were recognized quickly and the major issues were resolved in a couple

of weeks. In Toronto, however, the information system problems were not resolved during the outbreak and Canadian officials were required to rely on an antiquated *post-it notes* paper system for managing contact tracing operations.

New organizational arrangements, public and private cooperation, joint planning and sharing of resources, more training and generally more leadership, management and broader thinking in dealing with large-scale disasters were called for as early as 1998 (Rubin, 1998). Yet, communities and regions have not initiated and maintained integrated, reliable disaster response networks because there has been no relevant model to guide their development.

Clear and decisive leadership, strong advance planning, training and exercise programs, coordination of community based assets with state and federal resources, and capabilities for a catastrophic event appear to be the critical missing elements of large-scale disaster response. The themes regarding Hurricanes Katrina and Rita cited in the GAO Statement and the themes derived from the experience of other types of disasters are the same themes focused on by high-reliability organizations (HROs). Much can be learned from organizations that constantly must deal with potential disaster and have been successful in preventing, detecting, containing, and responding to disasters.

High-reliability Organizations

Organizations that operate under very dangerous conditions and yet manage to have fewer than their fair share of accidents are referred to collectively as *high-reliability organizations* (Roberts, 1990a, Roberts and Weick, 1993). These organizations include power grid dispatching centers, air traffic control systems, nuclear aircraft carriers, nuclear power generating plants, fire fighting incident command systems, US Army combat maneuver groups, high density theme parks, commercial petroleum organizations, prison inmate transport operations, and hospital emergency departments. The best of these organizations rarely fail even though they encounter numerous unexpected, non-routine events (Weick and Sutcliffe, 2001). As Weick and Sutcliffe (2001, p. 3) explain it in terms of managing the “unexpected:”

“They organize themselves in such a way that they are better able to notice the unexpected in the making and halt its development. If they have difficulty halting the development of the unexpected, they focus on containing it. And if some of the unexpected breaks through the containment, they focus on resilience and swift restoration of system functioning.” (Weick and Sutcliffe, 2001)

In organizations that continuously operate in high-risk, high-velocity environments, small problems can cascade into accidents if they are not stopped by pre-planned organizational, technical, or procedural defenses (Roberts, Bea and Bartles, 2001). HROs are especially adept at detecting small system failures and fixing them before they escalate into larger disasters. Given the dangerous nature of the work, the complexity of operations, and the significant consequences of failure, these organizations should probably fail often but do not.

Perhaps the best known HRO is the nuclear aircraft carrier. The HRO characteristics of nuclear aircraft carriers have been studied extensively (Roberts and Weick, 1993). Personnel aboard nuclear aircraft carriers understand the inherent dangers of nuclear ships in general and air operations in particular. As Weick and Sutcliffe (2001) explain:

“People who work on carriers spend much of their time on a flat deck that has been called ‘the most dangerous four and one-half acres in the world.’ This ‘acreage’ is filled with up to eighty jet aircraft, some of which at any one time are being fueled with their engines running, or having armed lethal weapons attached to their wings, or being launched off the front of the ship by two million horsepower catapults that accelerate the 65,000 pound plane to 150 miles per hour in three seconds, or are being recovered simultaneously at the back end of the ship by what amounts to a ‘controlled crash.’ ...the deck is often slippery with a mixture of sea water and oil, blasts from jet engines and afterburners leave few safe places to stand, vocal communication is difficult, and the people who run these operations are nineteen and twenty-year old kids....” (Weick and Sutcliffe, 2001: 25-26)

At the same time air operations are being conducted, carriers have 6,000 people working in tight spaces with jet aircraft, jet fuel, nuclear reactors, nuclear weapons, an onboard air traffic control system, refueling and re-supply from adjacent ships while maneuvering through fog, high seas, or unpredictable water (Weick and Sutcliffe, 2001).

Operations aboard nuclear aircraft carriers are incredibly complex and the potential for disasters cannot be over emphasized and yet disasters rarely occur. What can be learned from HROs and can the lessons learned be applied to organizing and managing a network of independent agencies and organizations working to prevent and contain and ultimately recover from a large-scale disaster?

Lessons Learned by High Reliability Organizations

Over the past 20 years there has been considerable research on high-reliability organizations and the strategies they pursue in avoiding accidents and cascading events resulting in disaster (Perrow, 1984, Roberts, 1990a, Roberts, 1990b, Roberts, Stout and Halpern, 1994, Roberts, Bea and Bartles, 2001, La Porte and Consolini, 1998, Klein, Bigley and Roberts, 1995, Bigley and Roberts, 2001, Bierly and Spender, 1995). Roberts and Bea (2001) aggregated these lessons into three major categories: (Roberts, Bea and Bartles, 2001)

1. HROs aggressively seek to know what they do not know. More specifically HROs train people to look for anomalies unusual events, decouple systems when problems are discovered to minimize the harm caused by the initial incident, delegate decision making down to the lowest organizational level possible and empower people to act, create cultures where people feel comfortable reporting failure, design redundancies in systems to ensure multiple ways to detect problems, and accept input from diverse perspectives to cross-train and redesign systems.
2. HROs design their reward and incentive systems to recognize costs of failure as well as benefits of reliability. In doing so, HROs balance rewarding efficiency and reliability and ensure that organizational goals align with public goals.

3. HROs consistently communicate the big picture of what the organization seeks to do, and try to get everyone to communicate with each other about how they fit into the big picture. As a result, HROs develop a culture supportive of open communication, establish a command and control systems that fits all participants and consider the complexities and details of systems.

High-reliability Preparedness Networks

The increase in the number, complexity and consequences of nature- and human-initiated large-scale disasters has created the need for a new type of organization—the high-reliability preparedness network (HRPN). The magnitude of the impact of large-scale disasters requires the management and coordination of many community, state, and federal autonomous agencies and organizations focusing on an emergency situation. This network of dozens of agencies and organizations must be highly organized and flexible, have well defined incident command protocols, engage in extensive training, and be highly reliable without any real assurance that the network will ever be activated. In addition, an acknowledgement of a disaster life cycle and the organization and management of the agencies and institutions that must function successfully throughout the cycle is pre-condition for a reliable network. Disaster response organizations must develop HRPNs by applying the lessons learned through the success of HROs and previous large-scale disasters such as Hurricanes Katrina and Rita. These lessons focus on the network organization, management, and leadership.

Network Organization

Effective responses to community, regional, and national nature- and human-initiated large-scale disasters will require much more in terms of an organization and the creation of a reliability culture than has been established thus far in developing response networks—far beyond a group of loosely coupled autonomous agencies and organizations. High-reliability organizations are *designed* for reliability and have

well-defined and practiced roles for all participants. These roles, supported by extensive training, allow decision making to be pushed to the lowest level possible for accurate and quick decision making, making prevention and response most effective. Further, decision making at the lowest level keeps small problems from cascading to large ones. Network leadership must have confidence that responders in the field have a sense of the big picture, are adequately trained, and have the latest and most relevant information.

System redundancy is another key to a successful HRO design. Critical systems such as communication, rescue, logistics, distribution, shelter, and medical care must have contingency backup plans in place well before the disaster. As demonstrated after the Katrina and Rita Hurricanes, if one or more of these systems fail without a backup, the domino effect ensues and problems escalate rapidly. Such escalation can result in total system failure.

Some observers were surprised that military units (i.e., Coast Guard, National Guard, Army) were among the most prepared to deal with the conditions created by Hurricane Katrina. However, the military has worked hard to build reliability into its units and their performance demonstrates characteristics that must be adopted in organizing and managing a disaster response network.

As the nature of war has evolved from large-scale conventional force confrontations to limited, dispersed, and fluid encounters the military recognized that the greatest obstacle to an integrated command and control (C²) mechanism for maneuver and strike was the hierarchical organizational structure. Hierarchical C² required careful synchronization of multiple command and control structures and required more time than was available on the modern battle field. Increasingly the military has attempted to “harmonize” the C² in such a way as to provide a design and process that allows the various levels of command to sense, orient, maneuver, and strike at a pace and with the intensity required of modern warfare (Macgregor, 2003).

As a result, the military has increasingly developed C² around concepts more often found in the private sector. Flat organizations in the military as in business corporations are no longer viewed as an option but as required. Everyone has to be able to talk with and work with everyone else to implement the intent of leadership. Data must

be available to everyone not just to a “chosen few” and, conventional rules must be questioned, broken, and sometimes forgotten. The ability to change through perpetual fluidity in response to changing conditions is essential to operational success (Peters, 1992).

Radical recommendations have been made to replace the inherently top-heavy army divisions of 18,000-23,000 troops with combat maneuver groups of approximately 5,000 soldiers. The vertical C² of the division encourages tight and centralized operations. Approximately two-thirds of the division’s strength is dedicated to support and logistical functions. Combat maneuver groups, on the other hand, are capability based forces designed for dispersed, mobile warfare with a joint command, control, communications, computers, intelligence, surveillance, and reconnaissance (C⁴ISR) structure designed to integrate fighting capabilities into larger joint forces (Macgregor, 1997). Clearly, public sector emergency preparedness networks have much to learn from the military’s willingness to question the traditional hierarchical organizational and leadership structures.

Network Management

Management concerns the planning, coordination, and budgeting of operations and training of personnel. HRPNs must be managed in all stages of the disaster life cycle. Management in the pre-event phase primarily involves planning and training. Detailed plans and protocols must be developed that establish a command and control system that fits all stakeholders into a common goal with a common reporting structure. As demonstrated by the Katrina and Rita disasters, clear lines of authority are critical and eliminate parallel approaches and working at cross purposes. In addition, in the pre-disaster phase specific operational, logistical, and financial plans are developed.

In building and maintaining a HRPN, only multi-agency and multi-organization training and simulations that emphasize reliability, decentralized decision making, and big picture communication will be effective. Current approaches of sporadic discipline-specific training and ill-defined, non-disaster-specific incident command systems can be effective for accidents and isolated incidents; however, such a training focus will not work for large-scale disasters. The HRPN must

engage in continuous multi-agency training and disaster simulations that involve all the network stakeholders including the leadership.

Management in phases two and three of the disaster life cycle involves communication and coordination. Management must focus on executing disaster plans and initiating contingency plans when there are signals of pending system failure.

Walt Disney World Resort provides an example of the benefits of advance planning, training, and exercise programs for emergency preparedness that might be applied to the operations of a response network. In 2004, the resort survived four unprecedented hurricanes that ripped across Florida. Even though the four 2004 Florida hurricanes caused \$25 billion in insured losses, Walt Disney World Resort opened immediately after each hurricane passed and did not file a single insurance claim. Disney learned from previous hurricanes and practiced the lessons it learned.

For example, in the midst of preparations for an approaching hurricane, a risk manager observed a life guard moving poolside furniture into an indoor storage area. When asked about her actions she explained that the resort was in “stage three” of its emergency plan and securing poolside furniture was her responsibility. A maintenance worker was also observed tying up chandeliers and a manager was stacking sandbags to protect a low lying area from flooding. Moreover, after Hurricane Andrew in 1995, Disney constructed its Florida roofs to withstand 90 mile per hour winds and presently constructs new facilities to even higher standards. The end result of Disney’s preparedness planning and training is thousands of employees who know exactly what to do and what is expected of them. Because of this, the Company “nailed it perfectly” in preparing for Hurricane Frances (Ceniceros, 2005). HRPNs must operate the same way.

Network Leadership

Leadership is about setting direction, building constituencies, and inspiring and motivating. HRPNs will not be established without a champion that pulls together the stakeholders, persuades them that their role in the network is critical, and inspires them to make it work. Once established, HRPN leadership must be clear and leaders

must be quick and decisive.

Network leaders must build constituencies within and outside the network. Leaders must build and reinforce a culture of reliability within the network—reliability of the network to function as designed is the preeminent goal. They must reduce network hierarchy so that channels of authority are as short as possible. Leaders must align participating agencies and organizational goals with public goals and ensure public goals remain at the forefront of network activities. Within the network, leaders must develop a culture of open communication and not let status and hierarchy get in the way. Open communication is the foundation of coordination.

The leadership of the Prisoner Transportation Branch of the Federal Bureau of Prisons has been successful in creating a culture of reliability, something essential to an effective disaster response network. The Bureau transports hundreds of inmates per day and in any year transports more than 50,000 inmates from one prison to another which requires over 1,300 bus trips. In a typical year, approximately 2,000 inmates are transported on medical airlifts and 40,000 inmates are transported for inpatient and outpatient hospital care. Hundreds of thousands of inmates have been transported without a single escape (Babb and Ammons, 1996).

There are a number of reasons for this high reliability of security when prisoners are taken beyond the confines of the razor wire, guard towers and electronic surveillance. Officers are taught to expect the unexpected (traffic jams, medical emergencies, poor weather, etc.) and constantly train through enacting virtually every possible scenario. All scenarios share one thing in common. Unexpected events require quick and decisive action to keep the situation under control and the officers on the scene have to be empowered as leaders to do what is necessary to respond to developing situations.

Dynamic environments require decentralized decision making and in the case of the Prisoner Transport Branch “extraordinary responsibility is assigned to lower level employees.”

By providing the proper training and technological backup these officers on the scene become effective leaders that are critical to the accomplishment of the mission of safe and secure transport of some of society’s most dangerous inmates. Tightly coupled operations

depend on every step in the process being successfully completed and the safe completion of each step is dependent on the coordinated action of a number of personnel knowledgeable about the big picture and empowered for rapid decision making.

Conclusions and Recommendations

HROs have developed cultures that are effective in avoiding disasters, detecting weak signals and containing them when they do occur, and responding as they occur. If HRPNs are to be developed and be effective, they must create a culture and develop similar protocols that make them effective in avoiding disasters (e.g., preventing terrorists attacks and warning and evacuating populations before natural disasters), detecting and containing disasters (e.g., limiting exposure of epidemics and terrorism and providing vaccines), respond quickly and adequately (e.g., providing health care, food, and shelter) and managing recovery (e.g. coordinating clean up, remediation and reconstruction).

It is clear that different HRPNs may be needed for different types of disasters and that there should be many overlapping networks (any one agency may be a member of a number of response networks) depending upon the type of disaster (the agency's primary function would be the same but the other agencies with which it has to interact may be quite different). In addition, there will be different agencies and organizations in phase three of the disaster life cycle than in stages one and two.

At present, current response efforts have not been *designed* for reliability and no one seems clearly responsible for identifying and organizing the required agencies and organizations for large-scale disasters. As a result training has been fragmented and not inclusive of all likely stakeholders. Rather what is needed is broad regional involvement of relevant agencies and organizations. Further *network* training (how the participating agencies work together) and simulations are needed to exercise the entire network.

The mindset of the 20th century was preventing, detecting, containing, and responding to accidents and crises. The mindset of the 21st century must be preventing, detecting, containing and

responding to large scale nature- and human-initiated large-scale disasters. Preventing, detecting, containing, and responding to large-scale disasters is an enormous organization, management, and leadership problem which extends beyond those faced by single organizations or governmental agencies. The development of HRPNs is essential for dealing with the coordination of the agencies and organizations required to deal with large-scale disasters.

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