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Cities at Risk: Hurricane Katrina and the Drowning of New Orleans

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CITIES AT RISK
Hurricane Katrina and the Drowning of New Orleans

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The impact of Hurricane Katrina on New Orleans revealed vulnerabilities caused by the interaction of the city's fragile physical environment, aging infrastructure, and declining economic and social structure. The hurricane constituted a triggering event, but the severe destruction and heavy losses documented the extraordinary costs of inadequate plans and practice, given the city's high exposure to risk. This condition and its sobering consequences are not limited to New Orleans, but constitute a silent threat for other cities in the United States and the world. The challenge for cities is to create a new vision of vital, resilient communities that are able to assess and manage their own risk in order to limit escalating damage from extreme events.

Keywords: *Hurricane Katrina; New Orleans; Federal Emergency Management Agency; FEMA; National Response Plan; resilient cities*

Visual images of New Orleans underwater flashed across television screens around the world on August 29, 2005 and captured a host of policies, plans, and practices that had gone badly awry. The scenes showed people stranded on rooftops, awaiting a rescue helicopter that was slow in coming; breached levees allowing the water from Lake Pontchartrain to flow into streets and neighborhoods that were below sea level; and rescue workers in boats, searching abandoned houses for people left behind. Worse, the images continued with views of more than 25,000 people crowded into the Superdome, without adequate water, food, or security. The television cameras silently documented the fact that most of those left behind in the Superdome, termed the "refuge of last resort," were poor and minority, adding to the perceived inequity and injustice of this event. These powerful images presented a sobering profile of a drowning city.

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It is extremely rare to lose an entire city to disaster, as occurred in New Orleans on August 29, 2005. Even in the San Francisco Earthquake of April 18, 1906, sections of the city remained intact and operational. In the Great Chicago Fire of October 9, 1871, whole neighborhoods remained functional. In contrast, the destruction in New Orleans left the entire city uninhabitable, with no functional services—communications, water, electrical power, sewerage, transportation, gas distribution—for weeks. Mandatory evacuation was the only possible course of action.

What circumstances and conditions led to the near total destruction of the city? The damage to New Orleans in August 2005 is now a matter of record, but could a similar sequence of events threaten other cities in the United States and abroad? Was the damage in New Orleans due to Hurricane Katrina, or was it some combination of human and technical factors that failed under the stress of the hurricane? The size, cost, and consequences of this catastrophe compel a re-examination of the conditions, policies, and practices that led to this sorry outcome and, in particular, the cumulative decision processes in public organizations that failed to take timely action to prevent danger.

Initial Conditions

The vulnerability of New Orleans to hazards is well known. The city is situated seven feet below sea level on sinking clay soils, with the Mississippi River and Lake Pontchartrain at its borders. The city also endures direct exposure to hurricanes from the Gulf of Mexico, but has struggled to maintain its original location. In the 1920s and 1930s, the U.S. Army Corps of Engineers constructed a complex system of levees and pumps to keep the city dry and operational. Over the years, the city had been sinking slowly farther below sea level, as the levees constructed upriver on the Mississippi prevented the replenishing of soils in the coastal wetlands that gave some protection to the city. Built to withstand Category 3 hurricanes, the levee system on which the city depended had not been adequately maintained, and requests for federal financing to reinforce the levees were repeatedly denied in recent years. When Katrina, a Category 4 hurricane with winds up to 145 miles per hour, made landfall slightly east of New Orleans on August 29, 2005 at 6:10 a.m., inhabitants of the city breathed a collective sigh of relief that the city had escaped a direct hit. But at 2:00 p.m. that afternoon, the 17th Street levee breached, allowing the waters of Lake Pontchartrain to flood the city. The aging infrastructure had given way under the intense pressure of the Category 4 storm.

Hurricane Katrina can legitimately be termed a natural disaster; that is, an event outside of human control. But the second and more serious disaster, the flooding of the city when the levees failed, was regrettably a product of unintended human design. New Orleans, once a thriving port city, had in recent decades lost much of its economic base as the petroleum industry weakened in Louisiana. Unemployment had increased, and approximately 25% of the city's inhabitants were living in poverty. Many of these people did not have transportation or any means of leaving the city, even if they wished. Compounding the disadvantage was the lack of public knowledge regarding the likely consequences of severe hurricanes and credible experience of the public with Category 3 or 4 storms. The racial disparities revealed in the sobering impact of the flooding on the population of New Orleans belied the legal framework of social justice (Young 2002).

The Role of Government in Disaster

Given the current state of knowledge regarding the vulnerabilities of New Orleans, what policies and procedures were in place to protect the city and its inhabitants from almost certain danger? The quintessential responsibility of government is to protect its citizens from danger.[1] This task is more complicated in a federal government, with multiple jurisdictions sharing responsibility for mitigation and response to disaster. Although policies and procedures have been developed over a 50-year period to facilitate this process, coordination within and between jurisdictions is difficult to achieve in practice. Ironically, comprehensive policies had been enacted and extensive planning had been done after the terrorist attacks of September 11, 2001 to improve coordination in governmental practice for hazard reduction and response. Formally, governmental policies are organized in an all-hazards approach that includes reduction of threats from natural, technological, or deliberate causes. Yet, in practice, the national priorities had shifted significantly from that goal. Given the trauma of the 9/11 attacks, the Bush Administration identified terrorism as the primary threat to the nation and focused its efforts on the prevention of further terrorist attacks within the all-hazards approach.[2]

The two major policies governing the public response to major threats, including hurricanes, are the National Response Plan and the National Incident Management System. Both policies had undergone extensive review and had been accepted as part of the major reorganization of emergency management and security functions into the newly created Department of Homeland Security in January 2004. The National Response Plan (FEMA 2004) was an adaptation of the former Federal Response Plan (FEMA 2000) that identified the roles and responsibilities of the 28 federal agencies in mobilizing response to an actual disaster. The intent of the National Response Plan was to extend the design of interagency collaboration to state, county, and municipal levels of authority in response to a disaster. It was formally adopted in November 2004 in a major effort to improve coordination among levels of governmental jurisdiction in disaster response. The National Incident Management Plan (NIMS), adapted from the earlier Incident Command System initially developed by the U.S. Forest Service in response to recurring wildland fires in Southern California, created a common terminology and set of standards for disaster operations that would be recognized and followed at each jurisdictional level. The intent was to develop a common method of training and practice that would allow the rapid mobilization of a response system from different organizations and jurisdictions in disaster operations for a specific incident.

Earlier executive orders, such as the U.S. Intergovernmental Counterterrorism Concept of Operations Plan issued in January 2002, have also been part of the major effort to redefine governmental responsibilities to reduce the threat of disaster. This executive order first redefined the role of the Federal Emergency Management Agency (FEMA), making it the lead agency for Consequence Management, but assigning the role of Crisis Management to the Department of Justice and agencies responsible for managing security threats. This distinction of crisis from consequence management separated the major function of disaster mitigation that FEMA had developed under the leadership of James Lee Witt in the 1990s from the disaster relief-and-recovery functions that had been its traditional role (Comfort 2003). Both functions were incorporated into the Department of Homeland Security when it was established in January 2004.

Hurricane Katrina provided the first major test of national policies and procedures for disaster management since the establishment of the Department of Homeland Security. Disaster relentlessly reveals the flaws in policy and practice, and the actions taken prior to, and following, Hurricane Katrina exposed the weaknesses of the current priorities and practices at all four jurisdictional levels. A brief time line of actions taken by governmental actors documents the remarkable series of delays and omissions that characterized the preparedness and response actions for Hurricane Katrina.

The Evolution of Disaster

The abbreviated time line listed below documents the approaching hurricane and its changing status as well as formal actions taken by governmental actors at municipal/parish, state, and federal levels of jurisdiction, over an

11-day period. Importantly, it shows primary actions taken—and not taken—as the storm advanced over the city. The time line documents only the 11 days of the actual storm. Missing is the chain of decisions prior to the disaster that reflects the more complex interaction among the physical environment of the city, its complicated infrastructure system, and the organizational systems that respond to emergencies. A careful delineation of that set of interactions is beyond the scope of this study, but central to systematic analysis of this problem.

August 23, 2005

U.S. National Hurricane Center (NHC) reported the formation of Tropical Depression Twelve over the southeastern Bahamas in the Caribbean Region.

August 24, 2005

NHC upgrades the storm system to Tropical Storm Katrina in the morning.

August 25, 2005

Hurricane Katrina makes landfall in south Florida, north of Miami, as a Category 1 storm.

August 26, 2005

- Hurricane Katrina weakens as it travels over the landmass of Florida, but grows in intensity to a Category 2 storm with winds up to 100 miles per hour as it moves into the Gulf of Mexico. The NHC projected that the storm would strike Mississippi and Louisiana.
- Louisiana Governor Kathleen Blanco issues Proclamation No. 48 KBB 2005, declaring a state of emergency, and directs Louisiana to prepare for Hurricane Katrina.

August 27, 2005

- The NHC upgraded Hurricane Katrina to Category 3 intensity with winds to 140 miles per hour.
- Governor Haley Barbour, Mississippi, issues Executive Order No. 939, which declares a state of emergency for the State of Mississippi.
- Governor Kathleen Blanco, Louisiana, sends a letter to President Bush requesting that he declare a federal emergency for the State of Louisiana due to the threat of Hurricane Katrina.
- Ray Nagin, Mayor of New Orleans, orders a voluntary evacuation of the city.

August 28, 2005

- Hurricane Katrina is upgraded to a Category 4 storm, and intensifies rapidly to a Category 5 storm with maximum sustained winds of 175 miles per hour.
- 10:00 a.m.: Mayor Ray Nagin orders a mandatory evacuation of New Orleans
- President Bush declares a major disaster for the State of Florida and authorizes the use of federal agency resources for disaster assistance to the damaged communities.
- Airlines halt flights from Louis B. Armstrong Airport in New Orleans due to hurricane.

- Mayor Nagin opens the Superdome as a "refuge of last resort," for the roughly 150,000 people who had no means to evacuate.

August 29, 2005

- 6:10 a.m.: Hurricane Katrina makes landfall as a Category 4 hurricane just east of New Orleans as winds reach 175 miles per hour.
- 10:00 a.m.: Katrina makes a third landfall near the Louisiana/Mississippi border as a Category 3 hurricane, with winds at approximately 125 mph.
- 2:00 p.m.: The 17th Street levee breaches in New Orleans, allowing the waters of Lake Pontchartrain to flood into the city.
- Communications fail completely as electrical stations and cell phone base stations are flooded; radio frequencies are overloaded or incompatible for response agencies.
- President Bush declares a state of disaster for Louisiana, Mississippi, and Alabama, and authorizes the use of federal resources and supplies to the afflicted states.
- CNN news shows television footage of water breaching the levees in New Orleans, people stranded on rooftops, cars stalled in water, and tens of thousands of people crowded into the Superdome.

August 30, 2005

- The situation in the Superdome worsens. Food, water, medical care, security are scarce. Reports of violence, looting break out.
- Displaced persons seeking shelter break into the New Orleans Convention Center as a place of refuge. Police also direct evacuees to the Center that was neither officially staffed nor supplied; approximately 20,000 people seek shelter there.
- Emergency services are strained beyond the breaking point in both the Superdome and Convention Center.
- Two more levees fail, leaving the city underwater.
- Evacuees, seeking to leave the city on foot via the Crescent City Convention Bridge, are prevented from doing so at gunpoint by the Gretna, LA sheriffs.
- Katrina moves north across Mississippi and is downgraded to a tropical depression near Clarksville, Tennessee.

August 31, 2005

- Lifeline systems—water, communications, transportation, electrical power, sanitary sewers, gas distribution systems—are inoperable throughout the city.
- The city is declared uninhabitable, and officials seek agreements with neighboring State of Texas Department of Homeland Security and Emergency Management to allow 25,000 evacuees to be transferred to the Houston Astrodome.
- Michael O. Leavitt, Department of Health and Human Services, declares a Public Health Emergency for the States of Alabama, Florida, Louisiana, and Mississippi.
- Tropical Depression Katrina moves to the Great Lakes Region and into Quebec, breaking up over the province of Quebec.

September 1, 2005

- Evacuation of all remaining persons in the city begins, with approximately 60,000 from the Superdome and 20,000 from the Convention Center. They are to be moved to the Houston, Texas Astrodome for shelter until other means of housing can be arranged.

September 2, 2005

- With approximately 229,000 evacuees in the State of Texas, Governor Rick Perry declares a state of emergency in Texas and requests that other states accept evacuees.
- Governor Kathleen Blanco, Louisiana, requests additional federal troops and emergency supplies.

The events listed above constitute the briefest of profiles for this complex, destructive event, but they demonstrate the interaction of vulnerabilities among the physical environment, the engineered systems, and the organizational response system that resulted in catastrophe. Further, the costs of failure in Louisiana spread to other states. The costs are indeed staggering: more than 1,300 dead; 1.5 million people displaced from their homes; 60,000 million homes totally destroyed; an estimated $200 billion in disaster assistance and rebuilding costs in addition to the $52 billion already appropriated by Congress, and a possible long-term negative impact on the U.S. economy, given the damage to the oil refineries and production operations of the Port of New Orleans. This sequence of events and the consequent high costs revealed serious failures in policy, planning, and practice at all four levels of government—municipal, parish, state, and federal—in reference to a city exposed to known hazards. The consequences of Hurricane Katrina and the flooding continue and likely will require years for the reconstruction and rebuilding of the city. The question is whether this type of comprehensive failure of urban infrastructure under stress can be anticipated and large scale catastrophe averted in other cities exposed to recurring risk.

Designing Resilient Cities

Complex metropolitan regions confront a dual hazard. The number and severity of extreme events are increasing, while simultaneously populations are moving into more vulnerable land areas.[3] The problem is exacerbated even further when aging infrastructure is not adequately maintained, as in the City of New Orleans. How can urban managers design, build, and maintain strong, resilient cities that can assess and mitigate risks before extreme events occur? Further, how can such a design be sustained over the flux of time, wear, and degradation on built infrastructures? These critical problems cannot be managed with hierarchical models of control, nor can they be left to chance or serendipity. Rather, a resilient city requires a different model of civic engagement that includes all sectors of its population in a socio-technical framework that enables individual and organizational learning. Such a model is self-organizing and based on a strong information infrastructure that allows rapid and candid feedback among the participants (Comfort 2005). This framework assumes a shared commitment to the goal of disaster risk reduction, and acceptance of responsibility by all participants in the community for achieving that goal. The extensive consequences from Hurricane Katrina demonstrate that the protection of the city can no longer be considered only a function of public organizations. Private and nonprofit organizations, as well as households, have significant roles to play. The process can more accurately be redefined as "governance," (Salamon 2002) in which all entities in a community engage in a conscious, collective effort to reduce disaster risk over time. There are no guarantees, but the likely outcome of a self-organizing design is more constructive, efficient, and sustainable than the current status of ignoring risk or pretending that it occurs only to others or in some future state at least 30 years beyond the present.

Cities are the product of human design, and the communities that societies create reflect the balance of risks and opportunities their leaders are able to recognize at the time. The challenge is to recognize the risks and to create plausible strategies for coping with them in a dynamic environment. One of the major difficulties for practicing managers seeking to develop a coherent strategy for disaster risk reduction is that different groups within the city have different degrees of exposure to risk, different levels of access to resources for mitigating risk, and different rates of change and adaptation to a threatening situation. Understanding what those differences are and identifying practical means of getting these different groups to work together (Bardach 1998) to achieve a coherent strategy of disaster risk reduction is the major task for community policy makers. Developing the capacity for a city to manage its own risk requires a systems approach, one that envisions the city and its surrounding metro region as a vital, interacting set of components that influence one another in both constructive and destructive ways.

Cities as Complex Systems

Cities may be viewed as complex systems that are exposed to risk from physical, engineered, and socioeconomic subsystems (Mileti 1999). Yet, vulnerability to hazards occurs repeatedly at the intersection of these subsystems that function with separate but interdependent dynamics. The challenge to urban policy makers is to "harness" this complexity (Axelrod and Cohen 1999) and guide the separate moving parts in the same direction toward a viable, resilient community that can learn from its mistakes. Understanding the dynamics among the three subsystems, identifying appropriate means for measuring their different rates of change, and integrating these measures into a "common operating picture" for relevant decision makers at municipal, regional, state, and federal levels of jurisdiction are primary responsibilities for urban managers.

The measurement of risk in metropolitan regions exposed to a range of hazards represents a complex set of the interactions between social and technical systems that requires an integrated research approach (Comfort, Hauskrecht, and Lin 2004). It is essential to evaluate the fragility of an interconnected system of components that includes human organizations, technical infrastructure, changing physical conditions, and computers as informed agents interacting in a complex web of operations that supports economic, social, and cultural life in a wide region. The tasks of research are more complex, measurement issues are more difficult, integration of data from different sources is not trivial, but the goal of identifying the threshold point at which interconnected social and technical systems fail, and using this information to improve performance in managing risk is the same.

The degree of interdependence or dependence among social and technical systems is a major factor that contributes to the vulnerability of these systems in exposure to varying degrees of risk (Perrow 2005). The extent to which one system depends upon another, either for a physical resource or spatial proximity, increases the vulnerability of the second system to the failure of the first. If this dual dependency triggers failure in a third system, a cascade of failure may ripple across all related systems. Consequently, the vulnerability of technical systems that support basic operations in a city cannot be calculated separately, but rather must be based upon careful estimates of the degree of interdependence or dependence across the entire sociotechnical system that provides services to an urban region.

Perrow (2005) distinguishes two types of interdependence from dependence in interacting systems. The first type, in his terms, is reciprocal, in which one system affects the operation of another, but in turn is influenced by the change in performance of the affected system. The two systems, through their interactions, mutually alter the performance of one another. The second type of interdependence is logical, in which one system shares the same structure for operations as the second, enabling the two systems to function in productive exchange and extending the capacity of both. This type, close to the concept of interoperability sought by emergency managers in communications and other functions, is critical to managing technical infrastructure.

Perrow classifies other types of connections among systems as simple dependencies, where there is no interactive influence exchanged among two systems. Rather, he designates two types of dependence, physical and spatial, in which the operation of one system is affected by the performance or lack of same by another system. For example, the pumping stations in the New Orleans system of flood control were physically dependent upon the integrity of the 17th Street levee in holding back the waters of Lake Pontchartrain. When the levee breached, the flood of water from the lake overwhelmed the pumping stations and the electrical generators that drove them. Spatial dependency captures the proximity of technical systems that are located in the same area. For example, if gas mains are located close to underground water and sewer mains, as is often done to achieve economic efficiencies, disruption in one system could seriously affect the performance of the other two systems. Overlapping distribution systems in specific districts of the city create spatial dependencies that may spread disruption from one system to others.

In addition to physical and spatial dependencies, we add temporal dependency, in which the sequence of time is critical to the performance of related systems. For example, continued availability of clean water in hospitals depends upon the performance of electrical pumps to replenish the reservoirs. If the electrical pumps cannot refill the reservoirs in time, the water supply is depleted and the hospital cannot perform critical medical services. Estimating the fragility, or potential failure among the functional systems of a city, is a two-step process. First, it requires identification of the degrees of interdependence and dependence among the six component systems that provided basic services to the City of New Orleans. Second, it requires identification of the same types of interdependence and dependence between the set of technical systems and the emergency response organizations that responded to the increasing demand created by decreasing performance of the technical systems. The city operates as a sociotechnical system, and the measurement of its performance under potential stress needs to reflect that condition.

Communication and Coordination in Disaster

The next critical step in designing a self-organizing, resilient community is building the capacity to coordinate actions among component groups in the system under varying states of urgency. Given the size and complexity of urban regions exposed to risk, this function can most effectively be performed with appropriate uses of information technology. Determining appropriate uses of information technology in disaster management involves a longstanding dilemma. The trauma of disaster requires coordinated action among diverse actors in the affected community. Yet, the disaster event invariably damages the existing technical means of communication. The resulting gaps in communication create further difficulties in transmitting timely, accurate information to participating organizations and groups as a basis for action. For example, the failure of communication systems in the aftermath of Hurricane Katrina exacerbated the difficulties in coordination among agencies and jurisdictions enormously.

The challenge lies in finding means to increase the communication of core information among key actors, and thereby, coordination of actions in a severely disrupted environment. Increasing timely, valid communication also increases the potential for collective learning among actors in an affected community. This problem can best be understood as a sociotechnical relationship in which the technical means of communication are fundamental to achieving the organizational goal of coordination. Both are vulnerable to disruption in disaster environments, and both require public investment in building a sound technical infrastructure prior to a damaging event in order to support effective organizational performance under stress.

Recent research on the relationship between communication and coordination in complex systems offers fresh insight into this well-known problem. John H. Miller and Scott Moser, researchers at Carnegie Mellon University and the Santa Fe Institute, constructed a series of computational simulations to explore systematically the relationship between communication and coordination in complex systems under different types of conditions and access to information. Briefly, their research found that coordination increases:

— as the number of states of communication allowed to each agent increases;
— as the number of messages allowed to each agent increases; and
— as the payoff for participating agents increases.[4]

Their findings also show a dynamic pattern of interaction among agents. The timing of the communication flow among agents under crisis conditions is episodic. It first increases intensely, then drops. After a period of low intensity, communication again increases rapidly. Although this finding was the product of a computational simulation, it reflects the pattern of evolving action in uncertain environments. The intense flurry of communication represents the search for information, with checking and cross-checking among the actors. The drop in communication flow reflects consensus on action, and an increase in capacity for coordination among the actors. This increase in coordination reflects collective learning among the set of actors, which enables the community to respond more effectively to demands from a damaged environment. After a brief period, new events occur that demand further interaction, and communication increases rapidly again.

Designing communications processes for extreme events represents a major challenge for practicing managers. The requirements for effective communications in extreme events differ from routine practice. Extreme events necessarily require greater flexibility, detailed knowledge of the environment, and access to wider knowledge bases on the part of the organization as well as the user. Communications processes designed for extreme events need to build on a current analysis of organizational capacity, needs, skills, and the community knowledge base.

The actual case of Hurricane Katrina offers a striking contrast to the simulation findings. The technical infrastructure of communication was seriously damaged by the hurricane, but the expected alternative adaptations appeared only in fragmentary instances. As the gaps reported in the preceding time line show, delays in response and misunderstood requests characterized the communications process among jurisdictions. This finding suggests that the existing knowledge base shared among organizations operating at different jurisdictional levels in the Katrina response system had not been adequately developed prior to the disaster. There appeared to be little knowledge shared prior to the disaster or confidence in information exchanged among them.

Silent Threats and Long-Term Policy Planning

The impact of Hurricane Katrina on the City of New Orleans exemplifies a further problem in the process of sustainable disaster risk reduction. Although the deteriorating condition of the levees was well known, and computer models had shown that they would fail under the stress of a Category 3 hurricane, the levees posed a silent threat to the city. The levee system was taken for granted; no specific group of business people, residents, or policy analysts focused attention on the serious consequences for the city if the levees failed. The cost of rebuilding was high; there was no hurricane on the immediate horizon; other issues demanded urgent attention and promised quicker returns. Given the range of problems that the City of New Orleans was facing in the period from 2001 to late August 2005, the repair of the levee system fell in the "too hard" pile of problems, with little thought given to the actual cost to the city, region, and nation if it failed. This inability to recognize the increasing danger from aging infrastructure to U.S. cities represents a major threat to urban regions across the nation.

Maintenance of engineered infrastructure for metropolitan regions is a long-term policy problem (Lempert, Popper, and Bankes 2003), one that does not fit the annual budget cycles that drive most urban agendas. It is also a complex policy problem, as major engineering projects were often financed with federal funding, but once built, states and cities were expected to maintain them. In uneven economic cycles and as the industrial base for the City of New Orleans and state of Louisiana declined in recent decades, infrastructure maintenance was delayed repeatedly. Presumably delayed as a budget-balancing measure, infrastructure maintenance needs to be redefined as a long-term policy problem. The extraordinary costs incurred from the failure of the levee system following Hurricane Katrina discredit any form of justification for delaying maintenance for budgetary reasons.

New methods of computational simulation offer a promising alternative for calculating potential risks, their costs and consequences, and exploring policy options (Comfort, Ko, and Zagorecki 2004; Zagorecki, Ko, and Comfort 2005). Although these methods have long been used by engineers, extending their application to guide decision making in actual policy problems represents a method of assessing the complexity of urban environments and developing strategies for long-term policy planning.

Cities as Investments for the Nation

Underlying this inquiry into the impact of Hurricane Katrina on New Orleans is the recognition that cities play an indispensable role in the economy and society of the nation. Cities represent a major investment of not just local funds, but also substantial investments by the region, state, and nation. The contribution of the City of New Orleans in terms of the national transportation of goods from this port city as well as its distinctive culture and history is incalculable. Clearly, the startling costs and consequences of the impact of Hurricane Katrina on this vulnerable city require a different conception of the city in relation to the region and the nation. The hurricanes will return; the Mississippi River and Lake Pontchartrain are continuing constraints; the wetlands in the region could become buffers to damaging storms and erosion, as they once were. But the vision of the city must change, if it is to become a sustainable, resilient community (Comfort 2005).

Toward a new vision of this battered city, I offer five recommendations for the redesign and reconstruction of New Orleans that would lead to sustainable disaster risk reduction in this vulnerable region. These recommendations will not be easy to achieve, as they involve the redesign of existing attitudes, practices, and values. The driving dynamic is the sustainability of what remains in New Orleans after the storm, and the construction of a viable city that is stronger, more resilient, and more successful in managing the continuing risk from its environment.

Strengthen the ecology of the metropolitan region. Frame a vision of New Orleans as the central city in a larger metropolitan region, with both the constraints and possible opportunities that such a vision brings. The hostility between the central city with its increasingly poor population and the newer suburban parishes represent a toxic mix of failed racial, economic, and educational policies.

Rebuild and maintain civil infrastructure on a regional basis. The infrastructure of roads, bridges, electrical power, communications, water, sewer, and gas distribution systems that are essential to the city can offer new opportunities for productive collaboration with the surrounding suburban parishes. To accomplish such change means opening a fresh dialogue with the parishes and identifying ways in which the Delta communities and wetlands can benefit from the knowledge and skills concentrated in the universities, research centers, hospitals, and businesses of New Orleans.

Design scalable investments for organizations with different capacities. Rebuilding the city and region will require continuous effort and investment by public, private, and nonprofit organizations over the long term. Developing a program that will allow mutually beneficial financial participation in economic, social, and cultural development for a range of public, private, and nonprofit organizations will contribute to a stronger sense of identity and commitment to the region.

Invest in a regional information infrastructure. Developing a well-designed, easily accessible information infrastructure and knowledge base for the region that can provide timely, accurate decision support to managers with multiple responsibilities, at multiple levels in the complex system of municipal, state, and federal collaboration is essential for constructive economic, social, and cultural growth.

Shared risk means shared responsibility. Accurate assessment of the risks and vulnerabilities of the metropolitan region means sharing the responsibility for reducing those risks. The New Orleans region faces a long-term policy and planning commitment in sustainable disaster risk reduction. This commitment can likely be met most effectively by adopting a governance approach that engages public, private, and nonprofit organizations in a systematic program of disaster risk reduction.

NOTES

1. The implicit assumption of the Preamble and the powers granted to Congress under Article One, Section 8 of the United States Constitution (Tribe, L., ed. 1988. *American Constitutional Law*, 2nd edition. Mineola, NY: Foundation Press, Inc., xxxiv–xxxv) is that governmental institutions would be established to ensure the safety and liberty of the citizenry.

2. United States Government Interagency Domestic Terrorism Concept of Operations Plan, January 2002 (Washington, DC: February 22, 2001). http://www.fema.gov/rrr/conplan/forword.shtm. This strategy was further developed with the enactment of the Homeland Security Act, January 22, 2002. (H.R. 5005). Federal Register.

3. Munich Re Group Annual Report 2004. Munich, Germany: Munich Re Group, 2005. This annual report provides a global report of disasters that have occurred in the previous year, with the frequency, magnitude, severity, and losses calculated for each type of disaster. http://www.munichre.com/pub.

4. Miller, John H., and Scott Moser. 2003. "Communication and Coordination." Santa Fe, NM: Santa Fe Institute. Research Report. February 25.

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