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Managing the Vulnerability of Megacities in North America and Europe to Seismic Hazards

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ABSTRACT

The science and technology of seismic hazard mitigation are increasingly being shared among scientists and policy makers around the world. Administrative expertise is also being shared. While there is still tremendous unevenness in technical and administrative capacities and resources, a global community of emergency managers is developing and there is a globalization of expertise. Hazards are better understood, tools for risk assessment are improving, techniques for hazard mitigation are being perfected, and communities and states are implementing more comprehensive disaster preparedness, response, and recovery programs. Priorities are also emerging and hazard mitigation has emerged as the priority of choice in North America and Europe. An increasingly important component of hazard mitigation is resilience, in terms of increased capacities for disaster mitigation and recovery at the community and even individual levels. Each year, more is known about the locations and natures of seismic hazards, although there are still unknown and poorly understood fault lines and limited understanding of related disasters such as tsunamis and landslides. More is known about the impact of earthquakes on the built environment, although nature still provides surprises to confound man's best efforts to reduce risk. More is known about human nature and how people respond to uncertain risk and when confronted by certain catastrophe. However, despite the increased understanding of seismic phenomena and how to protect people and property, there is much that needs to be done to reduce the risk, particularly in major metropolitan areas. The exposure of large concentrations of population to seismic hazards is the most problematic policy dilemma because of the risks posed by large buildings, the potential health hazards when large numbers of people do not have clean water and food and when there are mass casualties, and the loss of critical infrastructure. Indeed, modern societies are more fragile because people are more dependent upon technologies that are vulnerable to disruption. How have local, regional, and central governments responded to seismic risk in the U.S. and Europe? In some cases, the governments have acted no differently than those in developing nations. Hazards remain ill-understood, levels of risk remain uncertain, mitigation policies remain unimplemented, and officials and the public remain ignorant of the need to act. In other cases, the governments have sought to understand the hazards, assess the risk, develop and implement mitigation strategies, and educate the public concerning how to reduce their vulnerability. Lessons from the 1985 Mexico City earthquake increased understanding of structural vulnerabilities, particularly for the kinds of structures proven vulnerable in that earthquake. For example, there is construction in Salt Lake City, Utah, very similar to that damaged in Mexico City. Lessons from the 1989 Loma Prieta earthquake increased understanding of the need to reinforce bridge and highway supports and the program to reinforce supports in southern California greatly reduced the highway damage that might have resulted from the 1994 Northridge earthquake. Much has also been learned from the Northridge and 1995 Kobe earthquakes about liquifaction and structural vulnerabilities and those lessons are being integrated into seismic hazard mitigation practice. The Kobe earthquake also demonstrated the need for better seismic monitoring and for dispersing stockpiles of emergency supplies so that they will be closer to potential disaster areas. The 1999 earthquakes in Turkey, as well as other recent disasters, have demonstrated that failures to implement effective hazard mitigation measures can be costly in terms the loss of lives and property. But, they have also demonstrated that communities can respond better and recover faster when they have the skills and resources to do so within their own communities. While outside assistance is still needed, communities can survive until help arrives when they have the capacities to meet immediate critical needs. Recovery is also speeded when outside assistance is tailored to local needs, rather than determined by donors who may not understand local conditions. In North America and Europe, greater investment is being paid in local capacity-building to reduce the costs of disaster and to facilitate hazard mitigation.

Keywords: Seismic hazards, Mitigationstrategy, Response, Recovery program

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1. Introducton

As the new millennium gets underway, fundamental change is taking place in how governments deal with natural and technological hazards. Hazard reduction has become a major policy focus in an increasing number of nations and, as a result, there is increased investment in the capacities of governments to manage hazards and deal with disasters. The impetus for change has been the rising costs of disaster. Social costs are increasing as populations grow. More people are at risk. The economic costs of disaster are also increasing. Regional and even national economies can be devastated in major disasters and it may take decades to recover. Some economies may never recover. There may be cultural costs, as well. Historic sites, including those not yet discovered, and cultural treasures may be forever lost. As social, economic, and cultural costs rise, so do the potential political costs. When officials fail to reduce hazards when possible, respond to disasters reasonably, and recover from disasters as quickly as possible, they may be held accountable by their constituents. When officials fail, even though circumstances may be beyond their control, or when they appear to fail, they lose public trust. Therefore, officials can ill-afford to ignore the potential for catastrophe.

Because the costs of disaster may be so dear, governments are investing more in emergency management. As a consequence, fundamental change is taking place in how we deal with hazards because of (1) increased knowledge about hazards and the vulnerabilities of communities, (2) the application of new technologies to monitor threats to life and property and to assist in decisionmaking, and (2) the global sharing of information and expertise in disaster management. The change is particularly evident in how nations on the Pacific Rim are expanding scientific knowledge about the risks posed by meteorological and geophysical hazards, how they are adopting new technologies such as geographic information systems and remote sensing to facilitate decisionmaking, and how they are sharing information on common hazards and how to reduce them. This article examines emergency management at the beginning of the new millennium in terms of the state of knowledge about the hazards we face and societal vulnerabilities, the state-of-the-art of emergency management, and the sharing of information and expertise between and among nations. The focus is on the nations on the Pacific Rim, but the thesis is true for other nations and other regions facing common hazards.

Phenomena such as global warming, El NiZo and La NiZa, and the patterns of seismic and volcanic activity along the "Ring of Fire" are still not fully understood by scientists and, as a consequence, still pose somewhat ill-defined risks for communities and uncertain problems for policymakers and emergency managers. Nonetheless, while scientists are still trying to determine the impact of global warming on sea levels and climate, understand the weather cycles that seem to be causing unusually severe climatic conditions, and gauge the cycles of seismic and volcanic activity to anticipate potentially catastrophic events, scientific knowledge about such hazards continues to grow and continues to provide answers for at least some of the questions about how to protect people and their property from natural hazards. Similarly, understanding of technological hazards, from acid rain to pesticide runoff to radiological accidents, is increasing. While the long-term impacts of some hazards are not fully understood, there is considerable information on the nature of the hazards and how to mitigate their effects. In short, policymakers are being provided more of the information that they need to make effective decisions concerning how to address old hazards and how to identify and assess new hazards. Scientific knowledge is being translated into more effective hazard reduction policies and improved disaster response and recovery programs, although much still needs to be learned for those policies and programs to be as effective as they might be.

While emergency management is organized quite differently from nation to nation and even within nations, there are common issues. The expansion of local and regional response capabilities is one of the more common concerns as nations try to create

highly capable national emergency management systems. National debates are also common on such issues as the role of the military in disaster operations, the development of "disaster resistant" communities that are less vulnerable, the development of more resilient communities that can recover quickly, the logistics of delivering emergency assistance to distant regions and communities within a reasonable time, the integration of sustainable development into hazard mitigation and recovery programs, and the integration of nongovernmental organizations and individual volunteers into disaster operations, as well as other issues. Indeed, the very role of government as the guarantor of public safety and public health is being debated among policymakers in some nations.

At the same time, the profession and practice of emergency management are being transformed. While there are still major differences among nations in how they structure their emergency management systems and some differences in their use of technology, there are growing similarities. Most obvious perhaps is the technological revolution that is taking place. Old technologies are being adapted to emergency management. New technologies, particularly military technologies, are being adapted for use in managing hazards and responding to disastsers. As a result, new tools are being made available to disaster managers in emergency operations centers and to disaster workers in the field and new decision support systems are making more and better information available to policymakers. Also, the lessons of past disasters are being shared within an increasingly professional international emergency management community. A common emergency management language is developing. Common models are being adapted to the needs of communities and nations. Information is being shared with colleagues in other nations. The globalization of emergency management is helping expand the capacities of emergency managers at all levels. Nonetheless, applying the new knowledge and techniques is still difficult without a full understanding of the hazards and the vulnerabilities of society.

Applied research is helping distill disaster experience into generalizable lessons. As a result, emergency managers have greater access to usable information. Indeed, information sources can be accessed during disasters to inform policy and operational decisionmaking. While prior disaster experience provides a basis for most decisions, the testing of common wisdow can reduce the tendency to analogize inappropriately and the synthesis ofpast experience can make it more useful. The volume of applied research is also encouraging more theoretical research to provide conceptual frameworks and models to explain disaster experience. In essence, there is a growing common body of knowledge for the profession of emergency management and a gowing need for professional education beyond the technical training of emergency responders.

It is within the context of these changes that emergency managers are trying to create effective policies and programs to deal with the hazards that their communities and nations face. It is also within this context that they are building an international community of emergency management professionals and linkages between and among policymakers responsible for reducing natural and technological hazards.

2. The State of Knowledge About Hazards

New hazards are being identified and assessed and familiar hazards are becoming better understood. Meteorological phenomena, El NiZo and La NiZa, are causing cycles of flood and drought from South America to Southeast Asia and the South Pacific.[1] Record droughts are now being experienced from North America to the Korean peninsula and from Australia to Mongolia and there are growing concerns about the availability of water for industry and agriculture, as well as for drinking. Dry conditions are also making many areas vulnerable to fire. Wildfires are also threatening areas from southern and eastern Europe to Africa, but the connection between meteorological phenomena and the cycles of flood and drought may be most clear along the Pacific Rim where the effects of El NiZo and La NiZa

may be most direct. Wildfires have been ravaging large tracts from Argentina to Canada and from the Korean peninsula to Australia. Fires in Thailand and Indonesia have interfered with civil aviation and have caused respiratory problems for many.[2] During the summer of 2000, the U.S. experienced the worst wildfire season in its history. Similarly, recent massive flooding in South America, China, and elsewhere have left thousands homeless and devastated regional economies. Cycles of El NiZo and La NiZa have been identified as the principal reasons for the severe weather. Global warming may be contributing to the meteorological unrest, but it is still an ill-defined threat because scientists are not agreed upon its impacts on weather, sea levels, and climate.

Seismic tremors and increased volcanic activity in Central America and East Asia have recently caused damage and death, as well. The Hanshin earthquake in 1995 is still having an impact on economies inside and outside of Japan, particularly in terms of the quakes effect on Japans shipping industry. More recent major earthquakes in Japan, Taiwan, and elsewhere in Asia are serving as reminders of the potential for catastrophic loss of life and property. Volcanic activity is threatening communities in Japan, the Philippines, Mexico, Ecuador, Peru, and other nations and volcanologists are anticipating new activity in such places as Mt. Rainier in Washington State. Fifteen volcanoes were identified as needing more research by the International Association of Volcanology and Chemistry of the Earths Interior as part of IDNDR and ten are located on the Pacific Rim.

While some natural and technological hazards are poorly understood and some cause-effect relationships have not yet been defined adequately to permit effective action to reduce their threat, there are increasing areas of common interest and common response. For example, scientific knowledge about the El NiZo and La NiZa phenomena now provides clues concerning their onset and greater understanding of their effects. Cycles of drought and flood are all too familiar, but their causes have been elusive. There is also growing evidence of cycles of earthquakes and tsunamis that have had catastrophic effects on the environment and human life along the Rim. In some cases, the geography of the region has been significantly altered. For example, coastal erosion due to the last cycle of El NiZo revealed buried forests along the northwest coast of North America. Tsunamis generated by seismic activity in the Cascadia subduction zone have altered the coastline significantly over the centuries. As a consequence, the State of Oregon has developed a tsunami warning system like that in Hawaii in anticipation of the next great waves.[3] The seismic cycles may run hundreds to thousands of years or even longer and, as a consequence, few historical records may exist to document their power and effect. Longitudinal data is necessary to identify the cycles and scientists are slowly piecing together the historical evidence to determine the frequency and intensity of such events. Historical evidence is typically used to assess hazards, but is not always synthesized to provide a comprehensive analysis of the level of risk and used to inform policymaking.[4]

To be sure, new hazards are also being created. Increased reliance on fragile technologies makes societies more vulnerable. Transportation systems, communication networks, power grids, and other infrastructure are vulnerable to disruption due to mechanical and structural failure, human error, and human design. Terrorists can disrupt computer systems and they can loosen biological, chemical, and radiological agents upon communities and even entire nations. "Rogue states" may choose to use weapons of war against other states and even their own citizens. The potential for manmade catastrophe has few limits. Identifying all the current and potential manmade hazards is extremely difficult. The list would include everything from pesticide runoff to acid rain to terrorism.

While the frequencies and intensities of meteorological and geophysical phenomena may not have increased in real terms in recent years, natural disasters are posing greater danger along the Pacific Rim now than in the past because of the increased vulnerabilities of societies. Population growth and increased population density are putting more people

and more property in danger. In fact, current patterns of social and economic development are increasing the exposure of people and property to hazards. The potential for catastrophe is growing as populations increase along coastlines, near seismic fault lines, near volcanic hazards, near industrial sites where toxic chemicals are used or stored, near pipelines and transportation routes, and in other hazardous areas. The potential for catastrophe is also increasing as civil aviation and ship traffic increase. Crowded skies and waterways increase the risk of accident and mechanical failure. There are also shared risks to health ranging from pesticide contamination to AIDS to influenza. The Spanish flu epidemic of 1918 demonstrated the potential for worldwide health threats, even to those populations less susceptible to ordinary illnesses. International travel and commerce are speeding the spread of pathogens.

3. The State of the Art of Emergency Management

While there is still great variation in national approaches to disaster management, there are increasing commonalties. The list of applicable technologies is expanding rapidly. For example, the communication problems that have been endemic in large disaster operations are finding solution, albeit not always perfect, in the use of wireless telephones and other information technologies. While cellular networks may be overwhelmed during disaster, the technology offers capabilities not found with land-line communication systems. Coordination problems common to most international, intergovernmental, and multiorganizational disaster operations are being lessen through the use of common decision support systems. Similarly, remote sensing, satellite imaging, global positioning systems (GPS), geographic information systems (GIS), and other information technologies are providing more and better information to policymakers, emergency management officials, and disaster workers in the field. There is increasing discussion of the utility of virtual emergency operations centers through which officials can access and share information and can communicate "face-to-face" via the Internet. The impact of technological change is astounding and promises to be even more astounding in the near future.

Indeed, experts predict that integrated administrative systems in the "intelligent city" of the new millennium will permit automated monitoring of hazards and other environmental factors and automatic issuance of alerts to emergency responders and alarms to the threatened public.[5] Mobile wireless and Metropolitan Area Networks (MANs) will facilitate communication among responsible agencies. Networked management information systems will provide more comprehensive and common support for human decisionmaking and intelligent systems will automatically initiate appropriate responses when problems arise. The integration of GIS and GPS capabilities will provide spatial information to guide disaster operations. Even now, in some communities, flood gauges alert officials to the threat of swelling streams and rivers and drought gauges alert officials to increased risk of wildfires and the need to implement conservation measures. Satellite imagery is being used to identify and monitor hazards, guide disaster operations, and facilitate recovery. The list of possibilities is endless. And, such systems are being integrated into many more government functions. There are communities now that are integrating seismic hazard data with land-use and demographic data and, thus, have intelligent systems to alert and guide responders and activate warning systems. Elected officials, zoning officials, building code enforcers, fire service officials, law enforcement officials, and emergency managers are also being linked electronically so that they can share information on hazards and disasters.

While technologies are being shared, there are still substantial differences in national and local policy choices. In some cases, the choices reflect differences in the financial and technical resources available to emergency management officials. In other cases, they reflect differences in the orientations toward technology in general or some specific technologies. In still other cases, they reflect commitments to prior policy choices or simply resistance to change. The controversy over U.S. authorities decision not

to take advantage of the Russian Ilyushin-76TD "waterbomber" aircraft to fight wildfires is one example. But, the major controversy may be the over the building of the monumental Three Gorges dam in central China when the common wisdom seems to be that large dam projects are less effective in flood mitigation than was believed in the 1950s and 1960s when such projects were more common. Problems of silting, seismic risk, and potential effects on climate in the region are major concerns of the international communities of emergency management and environmental officials.

The public administration literature also suggests that the organization and function of government is changing in response to new policy challenges and the need to be more effective and efficient. Increased organizational interdependence is necessitating the development of liaison mechanisms. Church groups, civic organizations, businesses, and other individuals and groups have resources that can be used in disasters and, therefore, they should be integrated into local, regional, and even national emergency management systems. Professional associations of funeral directors, builders, contingency planners, and insurance providers have provided critical resources and manpower in recent U.S. disasters, for example. Environmental groups, professional organizations of planners and administrators, health care organizations, and scientists, for example, can provide essential political support to encourage attention to the risks posed by hazards and the need for disaster preparedness. In the U.S., there are increasingly fuzzy borders between and among public agencies at all levels. Resources, including personnel and equipment, are being shared. There are also fuzzier boundaries between government and the communities they serve. Individuals and volunteer groups that respond to disasters are being enlisted in disaster operations. Emergency managers are anticipating such convergence behavior and making it a part of the overall emergency operations plan. Emergency managers are also having to be more selective in their acceptance of assistance and donations, however. Not everyone who offers to help has appropriate motives.

The net effect will be far more integrated emergency management systems that tie together the mitigation, preparedness, response, and recovery functions for which emergency management agencies are now responsible with the efforts of law enforcement agencies, public health departments, public works departments, land-use planning and zoning departments, building code enforcement offices, and public utilities (especially water, power, and communications). The systems will also involve nongovernmental organizations and private individuals who are responsible for essential emergency services and/or are participants in decision processes before, during, or after disasters. Better use will be made of the available human and material resources when communities address the hazards they face and/or when they suffer disaster.

The responsibilities of government are changing. There is likely to be increasing

- Information of a more general nature is also being shared. reliance on regional and local preparedness and mitigation,
- focus on multi-hazard approaches,
- reliance on nonstructural mitigation,
- linkage of government, nonprofit sector, and private agencies,
- linkage of disaster management to other essential programs, and
- professionalization of disaster management agencies in all sectors.[6]

In the U.S., the Federal Emergency Management Agency's (FEMA) Project Impact is attempting to develop "disaster resistant" communities that can better manage hazards and respond to disasters. FEMA's Project Blue Sky is attempting to enlist the construction industry in the effort to build more "disaster resistant" structures by educating builders about effective hazard mitigation techniques. The development of partnerships is viewed as a more effective way to encourage hazard reduction than traditional government regulation.

Formal partnerships is only a beginning, however. Bilateral arrangements need to become multilateral arrangements and even international conventions.

Formal relationships need to be reinforced with informal, working relationships that are not dependent upon narrowly defined legal agreements. In short, the development of interdependent networks is necessary to assure that the emergency management systems are seamless. In the U.S., recommendations to permit state governors to use National Guard units from other states during times of disaster will increase resources considerably in major disasters. The recruitment of firefighters from Canada, Australia, Mexico, and New Zealand to help fight wildfires in the U.S. during the summer of2000 and the assistance provided by U.S. firefighters to Malaysia earlier in that year are illustrative of the expanding network of emergency responders that increase the available resources to deal with disasters and, with a sharing of expertise, are expanding the capabilities of all the participants.

While building "disaster resistant" communities is far better than focusing on effective responses to disasters that have already occurred, the better course may be to encourage the development of "disaster resilient" communities. Communities that have the resources to address hazards on their own and that use social and economic development processes to reduce risk will have fewer disasters and will need much less assistance from regional and central authorities. Local agencies are typically the first responders and often have to deal with disasters for hours or days before help arrives. Building local capacities improves disaster response, but, more importantly, it can facilitate and speed recovery because local needs are more clearly met. It also makes it easier to link emergency management programs to local land-use and to social and economic development. "Resilience" is the focus of the new national emergency management system in New Zealand[7] and has been recommended as a focus in Japan[8] and elsewhere.[9] The development of community emergency response teams (CERT) in the U.S. is a step in the right direction in terms of community involvement and capacity-building, but a more comprehensive approach would be more effective in terms of encouraging resilence.

Perhaps more important than having capable emergency management personnel and programs in-place is the willingness to permit them to do their work. There is a strong temptation in the midst of calamity to engage in *ad hoc* crisis management, rather than to trust those who are responsible for disaster management. The experiences in Peru, Bolivia, and Ecuador during the 1997-1998 El NiZo Southern Oscillation (ENSO) are examples of that tendency. Government officials in all three nations created new structures to respond to the disasters and thereby "marginalized" their traditional national emergency management systems, i.e., the civil defense organizations. Confused responsibilities and duplication of effort resulted.[10] Similarly, U.S. authorities have created new structures to deal with the disasters resulting from acts of terrorism involving "weapons of mass destruction" despite having a well developed national system to deal with catastrophic disasters of all sorts.[11] Investment in capacity-building and trust in the institutions responsible for response (until they prove untrustworthy) are essential if the structures to deal with disasters are to be effective. Disaster responses usually are intensely political in nature, but the costs failure recommend a much more pragmatic and professional approach.

4. Globalization: Science and Public Policy

The globalization of emergency management was stimulated by the efforts of the United Nations through the International Decade for Natural Disaster Reduction (IDNDR) and is now being promoted through its successor, the International Strategy for Disaster Reduction (ISDR). IDNDR's effectiveness in encouraging the sharing of expertise, capacity-building, and cooperation are now being assessed, but it is clear that capabilities have expanded worldwide. The United Nations' Global Program for the Integration of Public Administration and the Science of Disasters (UNGP-IPASD) is also helping to bring together emergency management officials and scientists to improve disaster reduction program.

The international technical expertise and support

provided in firefighting operations noted earlier, as well as expertise shared in other areas, such as counter-terrorism training for the Olympics and other major events, is broadening the global emergency management network and building its capacities. Expertise has been shared by security and emergency management authorities involved in Olympic Games, particularly since the terrorist attack during the 1972 Games in Munich. The Olympic experiences in South Korea, Japan, Spain, Canada, and the U.S. have informed decisionmaking for the 2000 Sydney Olympics. The "lessons learned" in Sydney will be added to the body of knowledge passed on authorities in Salt Lake City and to other future Olympic hosts. Similarly, the experience of Japanese authorities with the sarin attack on the Tokyo subway system by cultists in 1995 has certainly had an impact upon public health and law enforcement authorities worldwide. The Kobe earthquake in 1995 has encouraged Japanese authorities to examine local and regional emergency management capacities[12] and the lessons have been passed on to authorities in other nations. The nuclear accident in a Japanese plant in 1999 added impetus to the effort, as well as encouraging other nations to examine the risk of similar disasters within their own borders.

International conferences, such as the U.S.-Japan Earthquake Policy Symposium,[13] have provided forums for sharing information. ASEAN has created mechanisms for multilaterial cooperation among its members in Asia. The Federal Emergency Management Agency in the U.S. is developing bilateral cooperative agreements to facilitate the sharing of information with international "partners". In May 2000, such an agreement was signed by James Lee Witt, the director of FEMA, and Vice Minister Kim Jae Young of South Korea to facilitate cooperation between the two governments.[14] Similar agreements are being pursued with other Asian governments. The U.S. and China, for example, have established cooperative arrangements between their naval authorities that will, among other things, facilitate search and rescue operations in the Pacific. The U.S. Geological Survey and the Office of Foreign Disaster Assistance, too, have operated the Volcano Disaster Assistance Program since 1986 and have sent mobile response teams to provide assistance in nineteen volcanic crises, including the eruptions of Mt. Pinatubo in the Philippines, Merapi Volcano in Indonesia, and Rabaul Caldera in Papua New Guinea, as well as eruptions in South and Central America.[15] International humanitarian relief efforts have also contributed to the body of knowledge concerning everything from logistics to security in large-scale operations.

Information of a more general nature is also being shared. International research collaboration and the dissemination of research studies are increasingly seeking generalizable findings that can inform policymaking in other nations. The problems of multiorganizational and intergovernmental operations, for example, are universal. While the intergovernmental issues may be less complicated in unitary states, like the Republic of Korea, Japan, the Philippines, Singapore, and New Zealand, than they are in federal states like the U.S., Australia, Mexico, and Canada, intragovernmental conflicts (i.e., "turf" wars) and multiorganizational coordination problems are still common. Geography can complicate the responses of central governments to hazards and disasters, as can ethnic diversity.

As in other aspects of modern culture, international communication and collaboration are expanding the understanding of meteorological and geophysical hazards. Scientific knowledge is shared through international conferences and publications, as well as through exchanges of scientists and students.

Globalization is also affecting the profession of emergency management. The professionalization of the field that is occurring in the developed nations is being mirrored in the developing world. There is an increasing identification of emergency managers with the broader professional community. Korean, Australian, American, Japanese, Chinese, German, British, and Dutch practitioners and scholars, as well as those from other nations, commonly interact. There is also an international sharing of information and techniques through regional disaster centers, the Internet, and professional organizations like the

International Association of Emergency Managers and The International Emergency Management Society. Professional training and education are becoming more international. Distance learning opportunities are increasing. Practitioners can pursue professional certificates and even degrees on-line from institutions half a world away.

It is also necessary to understand that nations will find some models of emergency management more appropriate to their circumstances than others. A common language is useful, but common models are only useful to the extent that they fit the sociopolitical context of each nation. Nations differ in terms of the acceptability of command-and-control approaches to disaster management, the levels of local self-reliance, the role of central government, the available human and financial and technological resources, and even how individuals and communities respond to risk and how much risk they may consider acceptable. Moreover, while globalization expands opportunities and resources, it also may complicate the development of organic structures. The models of disaster management common in one nation or several may not be appropriate in others, in other words. Culture also affects community resilience and needs following disaster. International humanitarian and disaster relief organizations are increasingly focusing on the specific needs of communities that have suffered disaster, rather than their presumed needs. Disaster aid can affect everything from local politics to family life. The experience of relief networks being clogged with unneeded and ultimately unused supplies has encouraged greater attention to specific requests from disaster victims and less attention to offers of material and assistance. The experience of communities suffering economic distress because disaster aid supplanted local businesses has encouraged greater attention to kinds and amounts of aid provides. All disaster aid is not assistance, in other words.

5. Conclusions

Clearly, emergency management has professionalized. It is no longer the province of officials unschooled in the application of modern information technologies and it is no longer the province of those inexperienced in natural and technological disaster management. While many communities and some nations still rely upon untrained and inexperienced emergency managers, the costs of that choice are often very high. It is essential to have competent and capable people who understand modern decision support systems, remote sensing, satellite imaging, and other essential technologies. More importantly, it is critical to expand the involvement of elected officials at all levels and the public in disaster management. Centralized decisionmaking is seldom effective in disaster response, political and social support is essential for sustained hazard mitigation efforts, and local and regional capacity-building can make communities more resilient and more capable of responding effectively with minimal outside help.

The globalization of emergency management is also speeding up. Knowledge sharing through international conferences, international training programs, and communication through such media as the Internet are creating a community of practitioners, researchers, and policymakers with common goals and objectives. The goals of IDNDR were to increase knowledge about hazards and how to reduce them and to encourage the sharing of that knowledge across national boundaries. The momentum of IDNDR has not been lost and, indeed, may be self-renewing in terms of the mechanisms for interaction and communication that were created. The development of common tools and techniques and a common language is also increasing the potential effectiveness of international cooperation.

Scientific knowledge is being shared, as well. While some phenomena are still not well understood, such as global warming, knowledge is increasing relative to the more common problems. The lessons of the Mexico City, Loma Prieta and Northridge, Hanshin, Taiwan, Turkey, and other earthquakes are being shared. The differences, as well as the similarities, in those events are being explained and seismic hazard mitigation policies are being adjusted accordingly. Meteorological phenomena, too, are finding explanation. Cyclones, droughts, flooding,

and other weather threats are much better understood than they were even a few short years ago. While there are still significant differences in the approaches to hazard mitigation, a common wisdom is developing. Not the least of the lessons is that the culminative effect of short-term hazard mitigation efforts may be an increased risk of catastrophic disaster. As Denis Mileti and his colleagues suggest, we may be postponing our losses.[16] A long-term perspective is needed.

The sharing of information among practitioners of emergency management and researchers is also helping reduce the risk to human life and property. The connections among science, policy, and administration are being strengthened. However, the connections among policymakers, emergency managers, researchers, and the public also need to be strengthened. The next step is to expand the focus of emergency management. Hazard analyses should be integrated into planning processes. Hazard reduction and sustainability should become central goals in social and economic development. Disaster preparedness should be integrated into public education. Emergency management should include all the tools available to government, from land-use regulation and building standard enforcement to public health screening and immunization programs. Emergency managers should be more proactive and more integrated into other government functions.[17] The goals should be to reduce hazards to the extent possible, expand local and regional capacities to manage hazards and respond to disasters, increase community resilience to facilitate recovery, and broaden the scope of emergency management to provide a more comprehensive and considered approach to risk reduction.

Endnotes

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