



## Resilience Research Workshop Summary Report

July 14, 2009

Hosted by the  
Natural Hazards Center, University of Colorado and  
the Community and Regional Resilience Institute

**Summary Report  
Resilience Research Workshop  
July 14, 2009  
Broomfield, Colorado**

In collaboration with the National Hazards Center (NHC) at the University of Colorado, the Community and Regional Resilience Institute (CARRI) co-hosted the Resilience Research Workshop in Broomfield, Colorado, on July 14, 2009. Leading resilience researchers from across North America came together to share reports on their research and discuss priorities for the future.

This one-day workshop was organized by a steering group that consisted of Susan Cutter, University of South Carolina; Margaret Davidson, National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center; Fran Norris, Dartmouth Medical School and National Center for Disaster Mental Health and the START Center of Excellence; Walt Peacock, Texas A&M; Adam Rose, University of Southern California and the CREATE Department of Homeland Security (DHS) Center of Excellence; and Gavin Smith, University of North Carolina and the Center for Natural Hazards, Coastal Infrastructure, and Emergency Management. Kathleen Tierney, Natural Hazards Center, and Tom Wilbanks of Oak Ridge National Laboratory (ORNL) served as co-coordinators. To maximize participation of subject matter experts in the field, the workshop was scheduled on the day before the annual Natural Hazards Research and Applications Workshop, which attracts more than 400 scholars and practitioners to Broomfield each July.

The workshop combined informal presentations in a panel format with active discussion and information sharing among panelists and the audience; Section 2 of this report lists the workshop attendees. This nationally recognized assembly included more than 40 leaders from different research communities and included extensive discussions on how resilience is studied in a range of topical communities:

1. natural environment and ecosystems
2. built environment and infrastructures
3. health and mental health; firms, markets, and regional economies
4. populations and civil society
5. methods and measurement in the study of resilience; applications and evaluation

Cutting across these areas of concern were varying approaches to measuring resilience, including indicators, observations, and data collection strategies, and issues related to the evaluation of strategies aimed at enhancing resilience. Summaries from the workshop presentations are found in Section 3 of this report.

Although the presentations revealed the diverse ways resilience is viewed by the various research communities, the attendees shared a belief that resilience is a vitally important objective for disaster preparedness and a strong interest about how to achieve it, document it, and sustain it.

By the end of the day the attendees joined in proposing another resilience research workshop in 2010 – in fact, suggesting the possibility of making it an annual event.

The complete collection of presentations from the July 14 Workshop is available at the CARRI web site and can be found at:

[http://www.resilientus.com/publications/resilience\\_researchworkshop.html](http://www.resilientus.com/publications/resilience_researchworkshop.html)

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## **Section 2 – Resilience Workshop Attendee List**

### **Moderators and Speakers**

Carter Butts, University of California, Irvine  
Craig Colten, Louisiana State University  
Susan Cutter, University of South Carolina  
Margaret Davidson, NOAA Coastal Services Center  
Michael Dunaway, DHS  
Warren Edwards, CARRI/ORNL  
Richard Eisner, Fritz Institute  
Elaine Enarson, Independent Researcher and Scholar  
Ann-Margaret Esnard, Florida Atlantic University  
Duane Gill, Oklahoma State University  
Tim McDaniels, University of British Columbia  
Dennis Mileti, University of Colorado (emeritus)  
Fran Norris, Dartmouth Medical School and National Center for Disaster Mental Health  
Walter Peacock, Texas A&M University  
John Pine, Appalachian State University  
Keith Porter, University of Colorado, Boulder  
John Pyne, Northriversolutions  
Liesel Ritchie, Natural Hazards Center  
Adam Rose, CREATE DHS Center of Excellence, University of Southern California  
Randolph Rowel, Morgan State University  
Monica Schoch-Spana, Biosecurity Center of the University of Pittsburgh Medical Center  
Gavin Smith, Center for Natural Hazards, Coastal Infrastructure, and Emergency  
Management, DHS Center of Excellence, University of North Carolina  
Kathleen Tierney, Natural Hazards Center  
Kenneth Topping, Cal Poly San Luis Obispo  
Tom Wilbanks, CARRI/ORNL  
Brent Woodworth, Los Angeles Emergency Preparedness Foundation

### **Other Attendees**

Terri Adams, Howard University  
Lauren Alexander Augustine, The National Academies  
Christine Bevc, Natural Hazards Center  
Linda Bourque, University of California, Los Angeles  
Arrietta Chakos, Harvard Kennedy School  
Ann Farrar, CARRI/ORNL  
Andy Felts, College of Charleston  
Jennifer Foley, DHS  
June Gin, Fritz Institute  
Shubharoop Ghosh, ImageCat, Inc.  
Gerald Iwan West Virginia University  
Susan Kammereaad-Campbell, College of Charleston

Lynne Kidder, Business Executives for National Security  
Richard Krajewski, University of New Orleans  
Susie Kuliasha, CARRI/ORNL  
Jane Kushma, Jacksonville State University  
Shirley Laska, University of New Orleans  
Ward Lyles, University of North Carolina at Chapel Hill  
Benjamin Mayala, the National Institute for Medical Research (Tanzania)  
Alex McLellan, Homeland Security Studies and Analysis Institute  
Mike Matthews, DHS  
Susanne Moser, Susanne Moser Research and Consulting  
Ines Pearce, Pearce Global Partners  
Kristina Peterson, University of New Orleans  
Roger Pulwarty, NOAA ESRL  
Lisa Reshaur, PricewaterhouseCoopers  
Jeannette Sutton, Natural Hazards Center  
Deborah Thomas, University of Colorado, Denver  
William Travis, University of Colorado, Boulder  
William A. (Al) Wallace, Rensselaer Polytechnic University  
Anne Wein, U.S. Geological Survey  
Robin White, Meridian Institute  
Heidi Whiteree, DHS  
Sherry Wright, CARRI/ORNL

## **Section 3 – Presentation Summaries**

### **The Natural Environment and Ecosystems; the Built Environment and Infrastructure**

*Coastal Community Resilience Index* (Presented by John Pine, Appalachian State University)

In 1973, C.S. Holling examined natural systems and their exposure to many external threats, stressing the role of adaptation in resilience. The concepts of vulnerability, resilience, and sustainability are interrelated. A research project with the National Oceanic and Atmospheric Association (NOAA) has tried to model and understand how the natural environment, economics, and social systems play a part in recovery; the focus was to look at the recovery process as it relates to resiliency. Three cities – Charlotte, NC; Boston, MA; and Seattle, WA – have developed a comprehensive set of indicators that attempt to quantify resilience. Among the federal organizations that have shown an interest in resilience are NOAA, Forest Service, Federal Emergency Management Agency (FEMA), and the U.S. Department of Homeland Security (DHS).

Ecological indicators include water quality, air quality, biodiversity, water consumption, recycling, solid waste disposal, household energy use, and wetlands. Data might not be available for all areas as there are few environmental sensors deployed in rural areas. The absence of data and sensors leads to a need to identify proxies that would yield a larger scale. While spatial scale should be consistent it does come from diverse sources; some environmental data comes annually at best. There is a need for indicators that are interdependent with the natural environment. The impacts of climate change must be built into resilience as many gaps now exist.

*Building Resilience in Regional Infrastructure Systems* (Presented by Tim McDaniels, University of British Columbia)

Resilience is a significant concept to many fields including psychology, materials science, economics, and environmental studies. According to the Resilience Alliance, resilience can be characterized as, “The amount of change the system can undergo and still retain the same controls on function and structure.” Cross-sectoral planning for infrastructure resilience faces at least three notable challenges: (1) incomplete incentives, (2) partial information, and (3) few opportunities for learning. The University of British Columbia has selected an approach to address these challenges through structured data-gathering and information-sharing; the goal is to facilitate a cross-sectoral consensus on actions that promote resiliency in a multi-stakeholder region. Among project results is confirmation that sectors are highly interconnected with one another; in addition, there is increased understanding of infrastructure interdependencies and their potential outcomes in disaster. Project results have led to the identification of strategic areas of focus which include fuel supply, water supply, and road mobility.

*Natural Environments and Human Resilience* (Presented by Craig E. Colten, Louisiana State University)

When considering resources and societies it is evident that settlements were located where resources existed to support the human life. Over time, societies that live in vulnerable locations adapt to their natural environments and develop resilient practices. As new technologies drive resource dependent activities into new environments or enable exhaustion of existing resources, societies may move beyond resilient practices and damage the environment. Or if they move into more environmentally precarious environments they may rely on rigid structural protection systems that are not resilient to mitigate natural hazards. Human use of natural resources has grown in scale and has created dramatic impacts on the environment far from the source of resources use. Examples of these impacts that reduce resilience include destruction of coastal wetlands, hypoxic dead zones in coastal waters, carbon loading of the atmosphere, and contamination of water bodies. There are benefits to resiliency to be derived from protecting the natural environment. Wildlife protection enhances biodiversity and the maintenance of forests and wetlands offers flood protection and climatic benefits. Conversely, the outlay of maintaining altered natural systems is costly and undermines resilience.

### **Health and Mental Health; Firms, Markets, and Regional Economies**

*Mental Health and Resilience* (Presented by Fran H. Norris, Dartmouth Medical School and National Center for Disaster Mental Health Research)

Mental health is an important criterion for evaluating community or societal resilience. Focus may be on systems, preparedness, response capabilities, etc., but ultimately success should translate into a healthy population. Distress is a highly sensitive indicator of environmental stress, including both trauma and adversity. Within limits, post-disaster distress is normal but when highly prevalent, severe, or persistent, this points to systemic needs and/or problems. While most individuals show resilience, approximately one fifth to a quarter of survivors may experience persistent, chronic distress. When considering the adaptive capacities that promote psychological resilience there are five essential elements of mass trauma intervention: sense of safety, calm, self-efficacy, connectedness, and hope. Mental health matters, it is the *sine qua non* of community and societal resilience to disasters.

*Resilience Research and Public Health Preparedness* (Presented by Monica Schoch-Spana, Center for Biosecurity, University of Pittsburgh Medical Center)

Public health emergency preparedness, as a self-conscious set of principles and practices, is a very young field driven by events and a perceived urgency for action. The research has yet to catch up. An explicit, consensus-driven “resilience” concept does not currently exist in the field of PHEP. In fact, health authorities have only recently come to a common understanding of the PHEP concept itself. When looking into current literature surrounding PHEP, one finds more reviews and commentary, rather than primary research, with the focus primarily on preparedness and response. There is little emphasis on recovery and mitigation. What research exists closely follows federal program funding streams and policy initiatives. In January 2008, an Institute of Medicine Letter Report was issued setting forth PHEP research priorities to conduct research that identifies and develops: 1) best practices for the design and implementation of training; 2) communications that encourage effective exchange of vital and accurate information in a timely manner with diverse audiences; 3) sustainable systems and infrastructure that facilitate a community’s ability to manage health emergencies; 4) criteria for evaluating PHEP, response and recovery, and metrics for measuring their efficiency and effectiveness. PHEP needs a comprehensive framework for resilience – a framework beyond the organizational and inter-organizational level that is represented in the majority of PHEP literature and one that is beyond a default understanding of resilience as the “public’s state of mind.” Yet to be developed is an understanding of “systems” resilience and “community” resilience.

*Economic Resilience* (Presented by Adam Rose, Center for Risk and Economic Analysis of Terrorism Events, University of Southern California)

Economic resilience is an important factor when considering that community resilience contributes to the recovery of local and regional economies following terrorist attacks and natural disasters. A static definition of economic resilience is “the ability of a system to maintain function when shocked; this would include the efficient use of remaining resources at a given point in time.” A dynamic definition of economic resilience is “the speed of a system to recover from a shock” and includes the efficient use of resources over time for investment in repair and reconstruction. Examples of resilience include actions by individual businesses and households (conservation, input substitution, relocation), markets (price signals of scarcity), and regional economies (import substitution, information clearinghouses). Economic resilience is consistent with a paradigm shift; all attacks can’t be prevented but losses can be reduced after attacks occur. Motivation for resilience comes from the motivation of individuals and also from business survival. Business interruption losses can be as great as property damage; they begin immediately after an attack and continue through recovery. Because of need and profit, a new industry is emerging surrounding “business continuity.” Many recognize the interdependencies that exist among communities, infrastructure, and businesses with regard to economic resilience.

Investment, information dissemination, and planning can lead to significant enhancement of economic resilience at a relatively low cost.

*ResiliencyPlus* (Presented by Jack Pyne, ResiliencyPlus, LLC, North River Solutions, Inc.)

As organizations strategize and look for ways to increase efficiencies and prosper they too have serious concerns about their operational resiliency and preparedness. ResiliencyPlus™ is a company that offers a series of self assessments, some free, aimed at those very concerns. There is a growing interest in operational resilience and business continuity due to supply chain concerns and dependencies, concerns over liability, governance and compliance issues, and valuation implications. [www.Resiliency1.com](http://www.Resiliency1.com) assessments have twelve areas of focus within its assessments, which range from emergency management to business chain logistics to risk management and control. Resilience is a worthy second line of defense; it is effective, low cost, and self-motivated. Resilience applies to both producers and consumers and is yet another way that we can contribute to reducing the threat of terrorism. Go to [www.ResiliencyPlus.com](http://www.ResiliencyPlus.com) for more information.

### **Populations: Sociodemographic Issues and Vulnerability; Civil Society and Social Capital Issues**

*Resiliency Through the Lens of Displacement Vulnerability and Long-Term Recovery* (Presented by Ann-Margaret Esnard, Florida Atlantic University)

A more complete understanding of recovery is an important factor in fully defining and measuring resilience. Additional studies are needed in the area where groups suffer the lingering or late-blooming effects of a disaster, such as those displaced populations created by Katrina. Displacement can be considered as both an outcome and a cause of vulnerability. It is an outcome in socially vulnerable households, where levels of income, education, and other factors, are most at risk of long-term displacement. Displacement can cause vulnerability where, for example, loss of jobs makes groups, which were “OK,” shift into a vulnerable status as a result of the late-blooming effects for the disaster that hamper the ability to access assets and tap into social capital.

*Disaster Resilience - Seeing, Measuring, and Promoting* (Presented by Elaine Enarson, independent scholar and consulting sociologist)

Dominant approaches to population-based social vulnerability research have focused on “Who,” “What,” “How,” and “Why.” These approaches do not capture all the important dimensions of resilience and cannot address key questions at different levels of analysis, from the individual, group, household and organization, to local neighborhoods, broader communities and regional levels. More “Rs” are needed. In addition to systems that are robust, rapid, resourced, and redundant, our approaches must be respectful of local knowledge and power.

*Disaster Resilient Organizations, Bay Area Preparedness Initiative* (Presented by Richard Eisner, FRITZ Institute)

Organizational Resilience has been defined as being able to rebound from disruption and resume a limited set of critical services to clients. It will be driven by the resilience of individuals, organizations, peer organizations, infrastructure, supply chain, and interface with local government and structures. Organizational resilience cannot be differentiated from facility resilience. There is a spectrum of resilience for structures. Immediate occupancy target would be for essential services, such as hospitals, police, and fire departments, which should be available in hours. A second tier, life safety, would be for all new buildings and for a typical retrofit of others. The third target, collapse prevention, refers to a minimum retrofit for existing facilities. Similar time and capacity based criteria can be applied to organization performance and tolerance for disruption. Fritz Institute's BayPrep Initiative concepts of individual, organization and facility resilience to enhance disaster resilience and response capacity to community and faith-based service providing organizations in the San Francisco region. For this sector, resilience was defined by a collaboratively developed standard for preparedness and response capacity. Facilitated technical assistance and capacity building as well as peer and cross-sector network and convenings built capacity of peer organizations and integration of CBO/FBO service providers into local government preparedness and response structures.

*Practice Theory* (Presented by Randolph Rowel, Morgan State University, School of Community Health and Policy)

Social capital can play an important role in the development and implementation of activities designed to create disaster resilient communities, particularly among low-income and racial minority populations. As a working definition, social capital can be defined as an aggregate of social norms, networks, and resources which foster the community collectiveness through the development of individual trust for community members and subsequent development of interpersonal relationships within that community. Although social capital is not always explicitly stated, models designed to engage communities, form partnerships, or create resiliency often include social capital as one of its tenets. Enhancing social capital at the community level to promote cooperation and mutual benefit increases the likelihood of forming partnerships beyond the community. Thus, the use social of capital to increase a community's capacity to prepare, respond and recovery from a disaster has the potential to make them resilient to other community stressors and vice versa.

## **Methods and Measurement in the Study of Resilience**

*Baseline Indicators for Disaster Resilient Communities* (Presented by Susan L. Cutter, Hazards and Vulnerability Research Institute, University of South Carolina)

We all know that social capital is a critical aspect of any community, but how does one quantify the unquantifiable? Efforts to effectively assess the relative resilience of a community depend upon quantifiable data. Tracking whether or not a community is becoming more resilient requires baseline data. Susan Cutter, a leading resilience and vulnerability researcher with the University of South Carolina, has created a model to measure social vulnerability. Through the Social Vulnerability Index (SoVI), a consistent set of measures are used across time and space to assess existing social conditions at the county level to determine what it reveals about a community's vulnerability to disasters.

Some of the major factors influencing social vulnerability are the degree to which members of the community are able to access resources, including information and technology, political power, and social capital, such as social networks. Social vulnerability considers frail and physically limited persons and the type and density of the infrastructure and lifelines. These factors contribute to the overall score, but their significance differs from county to county. As such, the SoVi index can be used as a measure to compare places.

Utilizing a similar approach, baseline indicators of community resilience using six broad categories (social, economic, infrastructure, institutional, ecological, community competence) have been prototyped and tested at the county level for one state. While still preliminary, this presentation shows the usefulness of the instrument in gauging a region's overall resilience by using readily accessible data.

*Advancing Coastal Community Resilience* (Presented by Walter Peacock, Texas A&M University)

The Hazard Reduction and Recovery Center of Texas A&M University is in the process of developing a suite of community disaster resilience indicators for coastal counties along the gulf coast. The indicators being used are broad-based and readily available from secondary data sources, and the results are intended to inform a local community of its relative resilience and vulnerability looking at all phases of a disaster – mitigation, preparedness, response, and recovery. The guiding definition for how the team is structuring its thinking is based on the three elements of community resilience: One to absorb, reflect and resist disaster impacts; two, to bounce back after being impacted; and three, to learn from those experiences and modify behavior and structure to actually help them adapt and reduce potential losses for the future. The project also factors in a community's capital resources along all dimensions – social, economic, physical, and human – using 75 indicators. Results show that the more disaster resilient a community is the lower the number of flood related deaths and the lower the level of total property damage.

## **Applications and Evaluation**

*What Approaches are Currently Being Used to Assess Resilience?* (Presented by Gavin Smith, University of North Carolina at Chapel Hill)

An important question to be answered is how resilience differs from the application of sustainable development principles. Recovery is seen as a differential process of restoring, rebuilding, and reshaping the physical, social, economic, and natural environment through pre-event planning and post-event actions. Institutional resilience is the capacity of an institution to prepare for, withstand, and recover from a major disaster or other circumstances which threaten or disrupt normal operations.

While institutional resilience is an essential building block in disaster recovery, local governments and practitioners are not fully engaged and the issue has not been adequately studied or applied. The overarching sense of entitlement by local communities for outside disaster relief weakens a community's resilience. Smith contends that self-reliance is crucial to building resilient communities. Institutional resilience relies on four principle themes: capacity building, self reliance, accountability and empowerment. Recovery planning is different from normal urban planning in that it takes place under extreme conditions with multi-system failures. The conditions are constraining, but they also invite opportunity. The tendency is for community leaders to try to get back to the way the community was before the disaster. In many cases, restoration perpetuates poor land use or unsustainable practices. Smith emphasized that recovery is not only about speed, but about the quality of the recovery.

*MHDP Scenarios: Stimulus and Probe of Resiliency* (Presented by Keith Porter, University of Colorado, Boulder)

Engaging the full fabric of the community in hazard planning results in loss reduction and improved resiliency. The Multihazard Demonstration Project (MHDP) uses hazards to improve communities' resilience to natural disasters by engaging emergency planners, universities, and government agencies in preparing for natural disasters. Institutional resilience and land use planning are also significant in mitigating the effects of disasters.

Keith Porter, University of Colorado, Boulder, reported on his experience leading the USGS Multi-Hazards Demonstration Project (MHDP) where a series of panels made up of subject matter experts discussed the physical damages that would be likely to occur from a magnitude 7.8 scenario earthquake on the southern San Andreas Fault as well as the impact of secondary hazards such as fires and mudslides. The panels included emergency managers and engineers associated with southern California electrical utilities, dams, and water resources, as well as academics, and scientists. This was the first MHDP workshop. Since then, numerous workshops and training sessions have occurred examining earthquake vulnerabilities related to transportation, mass transit, hospitals, pipelines, railroads, and ports. Of note, the Great Southern

California ShakeOut was the largest disaster preparedness drill in U.S. history involving 5 million people. The MHDP is also creating a statewide catastrophic scenario called ARkStorm, by applying the lessons of ShakeOut to a new set of hazards.