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INFRASTRUCTURE RECOVERY

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This month's issue of *The CIP Report* focuses on Infrastructure Recovery. Seen time and again, both natural and manmade disasters have lasting impacts on critical infrastructure. The recovery process requires coordination across governments, private, and nonprofit sectors. In our first article, the United States Geological Survey provides an overview of the 2011 Virginia Earthquake, revealing a need for greater public awareness of geological processes and emergency procedures to ensure safety. Then, the Director of the Disaster Risk Reduction Program at the Virginia Tech Research Institute analyzes efforts to assess vulnerability and risk to infrastructure systems at the regional level. The Queensland University of Technology then discusses the significance of community participation and cultural understanding in post-disaster reconstruction. Finally, Professor Daniel Aldrich stresses the importance of social capital in infrastructure recovery, extrapolating from his new book, *Building Resilience*.

This month's *Legal Insights* examines the National Disaster Recovery Framework released by the Federal Emergency Management Agency (FEMA) in September of 2011.

We would like to take this opportunity to thank the contributors of this month's issue. We truly appreciate your valuable insight.

We hope you enjoy this issue of *The CIP Report* and find it useful and informative. Thank you for your support and feedback.

Mick Kicklighter
Director, CIP/HS
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One Year Anniversary: Magnitude 5.8 Virginia Earthquake

by The United States Geological Survey (USGS)

This article was originally published on the USGS website. To read the original article, please click **here**.

On August 23, 2011, tens of millions of people in the eastern United States and southeastern Canada were startled by sudden ground shaking from a rare, magnitude **5.8 earthquake** in central Virginia. Several small earthquakes occur every month in the eastern United States, but this earthquake was among the largest to occur in this region in the last century. It is estimated that approximately one third of the U.S. population could have felt this earthquake, more than any other earthquake in U.S. history. Around **148,000 people reported** their ground-shaking experiences caused by the earthquake on the USGS "Did You Feel It"? website. Shaking reports came from southeastern Canada to Florida and westward to locations near the Mississippi River.

Start with Science

There is much still unknown about the earthquake, including details of the fault that produced it and possible relationships to older faults and other geologic features. Although it was a rare event for the east coast, the earthquake was not a surprise, in that it occurred within the Central Virginia seismic zone. This zone has been identified on USGS seismic hazard maps for decades as an area of elevated earthquake risk. However, it is the largest known earthquake to have occurred in that zone. "Every large earthquake is a learning experience, but it is particularly the case for this Virginia earthquake because of the rarity of such events in the eastern U.S.," said USGS Director Marcia McNutt. "For example, what are we doing so right that a record setting number of east coast residents know the value to science of submitting their experiences on "Did You Feel It"? and yet not enough appropriately responded with 'duck and cover' during the seconds of most intense ground shaking?" Further studies to better understand this earthquake will help ensure public safety in Virginia and other areas of the eastern United States. The USGS is actively involved in studying last year's earthquake in Virginia, as well as earthquake hazards worldwide. The President's requested FY13 budget includes a proposed increase in funding to expand USGS efforts to assess eastern U.S. earthquake hazards. **USGS expertise** includes earthquake monitoring and notification, earthquake impact and hazard assessments, geologic mapping, and targeted research on earthquake causes and effects. So what have scientists been up to? Take a glimpse below at some new insights and projects currently underway.

Rapid Response to Record Aftershocks

Since the earthquake, more than 450 aftershocks have been recorded. These events were calculated based on analysis by the **USGS National Earthquake Information Center (NEIC)** using data from portable seismographs that were deployed by several organizations immediately after the earthquake. "The speed with which the USGS and our state and university partners got networks of seismometers into the field to capture the aftershock sequence from this earthquake defined the causative fault at depth, a first for a major eastern U.S. earthquake," said McNutt. "Unlike the typical situation in the western U.S., faults in this part of the country do not have a surface expression, making it far more difficult to estimate the maximum possible magnitude of earthquake that the fault can generate or the expected repeat time of the earthquakes." This careful effort has produced the best recorded aftershock sequence in the eastern United States. A complete catalog of the number, size, and timing of all the aftershocks is being compiled.

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VA Earthquake *(Cont. from 2)*

Aftershock monitoring is valuable for locating and characterizing the dimensions of the causative fault, recording data useful for ground-motion investigations, and characterizing the aftershock-sequence.

Damage Assessments and Impacts

The Virginia Department of Mines, Minerals and Energy is **leading an effort** to map associated property damage from last year's earthquake to inform community preparedness plans for future earthquakes in the region. Fortunately, the event last year was centered in a rural area and did not cause widespread severe damage or serious injuries, but that would not be the case in future events if they occur close to urban centers like Richmond or Charlottesville.

The earthquake was far enough (about 40 miles) from the densely populated Richmond, Virginia, area that there was no loss of life or serious property damage despite the presence of a large number of old, unreinforced masonry buildings. However, **moderately heavy damage did occur** to schools, businesses, and **homes in rural Louisa County** southwest of Mineral, Virginia. Widespread light-to-moderate damage occurred in the area from central Virginia to southern Maryland. In the Nation's capital, there was damage to several landmarks, including the Washington Monument and Washington National Cathedral. The North Anna nuclear power station, located about 12 miles from the main shock epicenter, was shut down as a result of strong shaking from the earthquake.

USGS scientists also **recorded changes** to groundwater levels within minutes to 24 hours after the earthquake, as far away as 350 miles from the epicenter. Changes in groundwater levels have been observed from other earthquakes around the world and are a reminder of the wide-ranging impacts of an earthquake.

Mapping Underground Faults

Scientists are mapping faults and other geologic features to help refine their knowledge of the Central Virginia seismic zone. This will help determine the potential sizes of future earthquakes in the region and the likelihood of their occurring. As part of this effort, USGS scientists **conducted airborne geophysical surveys** across parts of Louisa, Goochland, and Fluvanna Counties from July 15 – 25, 2012. These data will be used to help develop 3D imagery of underground faults responsible for the earthquake. The instruments in **the airplane** took magnetic, gravity, and radiometric readings across the region. Subtle changes in the Earth's magnetic and gravity fields can help scientists map contrasts in rock types and thus underground faults.

The Next East Coast Earthquake: Are You Ready?

On October 18, 2012, at 10:18 a.m., schools, businesses, organizations, government agencies, communities, and households across Georgia, South Carolina, North Carolina, Virginia, Maryland, and the District of Columbia all participated in one of the biggest earthquake drills in history. Termed, The Great Southeast Shake Out, participants learned to drop, cover and hold on. These types of drills offer chances to practice what to do before an earthquake happens in your community, and help you prepare for a quick recovery ❖

More Information

Read a recent article by USGS scientists in the *American Geophysical Union* newspaper EOS titled, **"The 2011 Virginia Earthquake: What are Scientists Learning"?**

Additional multimedia resources, such as interviews and maps, may be found at the following links:

Interviews:
A Year After the 2011 Virginia Earthquake: What More Do We Know? **http://gallery.usgs.gov/audios/444.**

A Year After the 2011 Virginia Earthquake: Will Shaking Continue? **http://gallery.usgs.gov/audios/445**.

Living Near the Epicenter: **http://gallery.usgs.gov/videos/566#.UDZBBIl5mc0.**

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Assessment and Management of Resilience for Regional Infrastructure

by Frederick Krimgold, Director, Disaster Risk Reduction Program, Advanced Research Institute, Virginia Tech

The Disaster Risk Reduction (DRR) Program of the Virginia Tech Advanced Research Institute (VTARI) has been active in the assessment of vulnerability and risk to critical infrastructure systems at the regional scale over the past ten years. Coming from a background in earthquake hazard reduction that focused primarily on evaluation and strengthening of individual buildings, the DRR program expanded its focus to address issues of critical infrastructure vulnerability in the aftermath of the events of September 11, 2001.

National Capital Region

Initial research was done on the review of vulnerability assessments that had been carried out for the primary infrastructure systems of the energy, transportation, communications, and water/wastewater sectors of the National Capital Region (NCR). Among the most important findings of this study was the fact that while individual systems were relatively well informed on their own internal vulnerabilities, they were typically unaware of their up-stream and down-stream dependencies. The technical, administrative, financial, and regulatory environments of key infrastructure systems were largely internally focused and unprepared to deal with loss of necessary system inputs or aware of consequences of their own failure for dependent systems. In some cases, the condition of interdependency threatened to inhibit recovery where systems exhibited co-dependency.

Danville, Virginia

Following the initial project work on the NCR that was carried out in conjunction with the Metropolitan Washington Council of Governments, the DRR program conducted a regional resilience assessment for the City of Danville, Virginia. As a city of approximately 50,000 people, Danville provided a more tractable object of study. The city owned the municipal electric utility, surface transportation system, water and sanitation systems, and had a municipal communications network. All of these systems were coordinated under a unified public administrative authority. The scale and transparency of administration in Danville offered a laboratory-like setting for the analysis of multiple system interactions and interdependencies.

In the Danville study, it was possible to trace paths of dependency across infrastructure systems without the barriers of corporate financial and liability concerns. For example, it was possible to track the consequences of power failure to pumps in the water system and to track the consequences of water system failure for sanitation, firefighting, and cooling. It became clear that inter-system dependencies had a major role in extending and amplifying the consequences of initial point failures. Induced failures in dependent systems had the effect of dramatically expanding the geography of impact and the scale of affected populations. A critical finding from this work was the fact that consequences of failure could not be adequately captured by the individual system that suffered the initial failure.

The important implication of this finding is that it is very difficult to motivate mitigation investment on the basis of a cost/benefit analysis carried out at the single system level. This is particularly true where the costs of mitigation are born by a single private sector infrastructure owner and the consequences of failure are born by a much broader public.

Central Florida Hurricanes

In 2004, central Florida was struck by a series of four major hurricanes. In the aftermath of these devastating events, it was recognized that the City of Orlando and Orange County provided an excellent opportunity for the empirical analysis of the consequences of

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Regional Infrastructure *(Cont. from 4)*

critical infrastructure failure and for the tracking of paths of dependency across systems. The DRR Program, in conjunction with the American Lifeline Alliance of the National Institute of Building Sciences, was able to carry out a detailed post-event assessment. Beyond the direct damage inflicted by wind, rain, and flooding, the region suffered significantly from failures of dependent systems that were not directly affected by the hurricanes. For example, failure of the power distribution system led to failure of the cellular telephone system which, in turn, impeded the emergency response system. Similarly, failure of the power system led to failure of the rail road signaling system which stopped rail transport of coal and chlorine to South Florida and threatened power generation and water supply for millions of people who had otherwise been unaffected by the hurricanes.

Hampton Roads

The Virginia Governor's Office of Commonwealth Preparedness supported a comprehensive regional resilience analysis in the Hampton Roads Planning District that was led by the Virginia Tech Disaster Risk Reduction Program with assistance from the University of Virginia and Old Dominion University. Based on lessons learned from Danville and Orlando, the regional analysis was intended to identify priorities for specific investments in regional resilience. Hampton Roads is a region made up of 16 independent jurisdictions, a complex geography, and a major presence of military installations. The complexity of distributed authority and the inaccessibility of key information needed for comprehensive regional modeling led to a three-tiered approach to analysis of system vulnerability, dependency, and resilience.

At a micro level, critical facilities for response and recovery were identified and their dependencies on critical infrastructure services were tracked. Where feasible, alternative service strategies were developed to maintain continuity of function through an emergency. At a second, mezzo level, sub-regional communities were identified in which infrastructure system vulnerability and dependency could be assessed in a less complex organizational and administrative context. Finally, these sub-regional elements could be reassembled to provide a comprehensive overview of regional resilience and support the prioritization of specific investments in risk reduction and recovery enhancement.

Nashville/Davidson County

Recognizing the difficulties posed by complex, multi-jurisdictional regions like the NCR and the Hampton Roads Region, the next application of regional resilience analysis was conducted in the metropolitan jurisdiction of Nashville and Davidson County, Tennessee. This study was carried out in conjunction with the American Society of Mechanical Engineers Innovative Technology Institute. The existence of a metropolitan government significantly simplified the process of resiliency analysis. In the study of Nashville/Davidson County, the risk analysis and management for critical asset protection, or RAMCAP, methodology was used for the assessment of individual systems with exposure to a standard set of threats. System assessments were completed for the emergency services sector, the transportation sector, the electric power sector, and the communications sector. Since the primary systems in each of these sectors were related in some way to the metropolitan budget process, it became evident that the Office of Management and Budget could play a major role in the management of cross-cutting issues of inter-system dependency and cross system prioritization of investment in regional resiliency.

Current Focus

Considerable effort has been expended on efforts to model the complexity of highly interdependent regional infrastructure systems. There are various approaches to providing useful support for investment decisions related to regional resilience. However, fundamental issues of governance and the balance of public and private responsibility for the collective safety and welfare of the public remain unaddressed. While it may be possible to accomplish the task of modeling the complexity of regional infrastructure, it is not clear that we have the organizational skill or institutional sophistication to agree on priorities. ❖

Rebuilding Housing after a Disaster: Factors for Failure

by Zabihullah Sadiqi "Wardak,"* Vaughan Coffey,* and Bambang Trigunarsyah,*
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This article was originally published in the Proceeding to the 8th Annual International Conference of the International Institute for Infrastructure Renewal and Reconstruction (IIIRR) in Kumamoto, Japan, August 24-26, 2012. For more information about this event, please click **here**.

Unlike most normal construction projects, post-disaster housing projects are diverse in nature, have unique socio-cultural and economical requirements, and are extremely dynamic and thus necessitate a meaningful and dynamic response.[1] Post-disaster reconstruction practices that lack a strategy compatible with the severity of disaster, community culture, socio-economic requirements, environmental condition, government legislations, and technical and technological situations, often fail to operate and respond effectively to the needs of the wider affected population.[2] Factors that frequently pose real threats to the eventual success of reconstruction projects are rarely given appropriate consideration when designing such projects. Research into past reconstruction practices has shown that ignoring these factors altogether or failing to give them meaningful consideration can affect housing reconstruction projects. In other words, they either miss their targets altogether or undergo serious modifications after their occupancy, subsequently resulting in an overall loss of project resources. This article touches upon the common factors that negatively impact the outcome of such projects.

Lack of Community Participation

Case studies of past post-disaster reconstruction projects indicate that projects without a local component or active community involvement stand a greater chance of falling flat and destroying community cohesion.[3] For example, a case study of a flood rehabilitation project in Bangladesh revealed that a latrine built adjacent to neighboring dwellings without prior community consultation caused severe tension among the neighbors. [4]

In the aftermath of the Indian Ocean Tsunami in Aceh-Indonesia in 2004, many non-governmental organizations outsourced and tendered out what initially was to be a purely community driven effort to large construction companies. The companies were non-participatory and did not pay any attention to the needs of the affected beneficiaries. The houses built by these companies were ultimately found to be structurally defective, culturally inappropriate, and failed to meet the required budgetary requirements, thus building further tension and anger within the affected Acehnese communities. The lack of permitted community involvement subsequently led many families to refuse to live in the houses.[5] A study by Dikmen[6] also revealed that hasty decisions made by government authorities, without a thorough analysis of the needs of the affected beneficiaries, led to great

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[1] Colin H. Davidson, "Multi-Actor Arrangements and Project Management," *In Rebuilding After Disasters: From Emergency to Sustainability*, (eds) Gonzalo Lizarralde, Cassidy Johnson, and Colin H. Davidson, (New York: Spon Press, 2010).
[2] A. Kaklauskas, D. Amaratunga, and R. Haigh, "Knowledge Model for Post-Disaster Management," *International Journal of Strategic Property Management*,13 (2), (2009).
[3] K. Alam, "Bangladesh: Can Large Actors Overcome the Absence of State Will"? In *Building Back Better: Delivering People-Centred Housing Reconstruction at Scale*, (eds) Michal Lyons, Theo Schilderman, and Camillo Boano, (2010), 241, available **here**.
[4] Ibid.
[5] Lisa Smirl, "Building the Other, Constructing Ourselves: Spatial Dimensions of International Humanitarian Response," *International Political Sociology*, 2 (3), (2008), 236-253.
[6] Nese Dikmen, "A Provision Model and Design Guidelines for Permanent Post-Disaster Housing in Rural Areas of Turkey Based on an Analysis of Reconstruction Projects in Cankiri," A Thesis Submitted to the Graduate School of Natural and Applied Science, Middle East Technical Univeristy, (2000), available **here**.

Rebuilding Housing *(Cont. from 6)*

dissatisfaction with a post-disaster housing reconstruction project in Cankiri, Turkey.

A more recent example of the outcomes of disregarding community participation in post-disaster housing reconstruction occurred in the Australian-funded housing project, "The Alice-Ghan," built 30 kilometers north of Kabul, Afghanistan. The intention of this project was to house forcibly deported Afghan refugees back in their home country of Afghanistan.

All major stakeholders, including the United Nations Development Programme (UNDP), CARE International, and the Afghan Government, had their specific roles to play during the early and subsequent stages of the housing project; nonetheless, the most crucial stakeholder, "the recipient community," was excluded. The project outcomes were reported as being unsuccessful, particularly in terms of meeting the socio-economic and cultural needs of the recipient community.[7] Jeremy Kelly further reports, "[l]ike every resident spoken to, Assadullah Mohammed Yacoub, 48, says he is grateful to the Australian government for its assistance but wishes it had asked people what they needed instead of building a Western suburb in the middle of the Hindu Kush."[8]

Problems Associated with Community Participation

Although community participation has been acknowledged as vital for reconstruction projects, it can also have long term negative impacts on community development if the basic principles of community participation are neglected.[9] A contrary view is expressed in a study of community participation by Lizarralde and Massyn,[10] which concluded that in the African cities of Netreg, Freedom Park, and Mfuleni, the community-based approach led to urban fragmentation and limited opportunities for economic growth. El-Masri and Kellett[11] also argue that the overall performance of low-cost housing projects does not necessarily depend on community participation and that some aspects of community participation need revision.

In an effort to reconstruct houses for the community affected by the Indian Ocean Tsunami in December 2004, Foundation of Goodness (FoG), a Sri Lankan local not-for-profit agency, invested substantial time and effort in designing two-story houses. The design was carried out in consultation with the community and a model was produced before the construction work could actually begin. When initially polled, the community supported the building of two story houses, as they believed that the second floor would reduce vulnerability to future tsunami destruction and damage. However, problems started to emerge after the community moved into the houses. They soon found that the kitchen did not allow for bio-fuel cooking, the stairs were too steep (which made it difficult for aged members to access the second floor), and there was a lack of outdoor space. Yetever, that was not the major problem; what could not have been easily predicted by the community during the design and implementation was the excessive heat that made the second floor uninhabitable. In this case, the community had been consulted on a regular basis; however, the lack of technical and environmental knowledge made community participation less effective leading to great dissatisfaction during post-construction occupancy.[12]

In the Maldives, in the aftermath of the Indian Ocean Tsunami in 2004, the government allocated a plot

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[7] Jeremy Kelly, "Afghan Project Failing in a Town Called AliceGhan," *The Australian*, (June 15, 2010), available **here.**
[8] Ibid.
[9] Jonathan K. Mafukidze and Fazella Hoosen, "Housing Shortages in South Africa: A Discussion of the After-Effects of Community Participation in Housing Provision in Diepkloof," *Urban Forum*, 20 (4), (2009), 379-396, available **here**.
[10] Gonzalo Lizarralde and Mark Massyn, "Unexpected Negative Outcomes of Community Participation in Low-Cost Housing Projects in South Africa," *Habitat International*, 32 (1), (2008), 1-14, available **here**.
[11] Souheil El-Masri and Peter Kellett, "Post-War Reconstruction: Participatory Approaches to Rebuilding the Damaged Vllages of Lebanon: A Case Study of al-Burjain, *Habitat International*, 25 (4), (2001), 535-557, available **here**.
[12] J. Shaw and I. Ahmed, "Design and Delivery of Post-Disaster Housing Resettlement Programs: Case Studies from Sri Lanka and India," (2010), available **here**.

Rebuilding Housing *(Cont. from 7)*

of land to build 250 houses for an affected community. The community was invited to participate in the design phase of their houses. However, the government deliberately excluded them from the reconstruction process to avoid an over-reaction and unreasonable interference from owners excessively obsessed with the quality of "their" houses.[13]

Relocation

Planners and developers of post-disaster reconstruction projects have the tendency to relocate and resettle disaster-affected communities. There is often little consideration given to the significance of "place" in the formation of community identity and socio-cultural and economic relations.[14] Research suggests that affected communities do not willingly accept relocation, which can often lead to further deprivation.[15]

A study of housing reconstruction by Dikmen,[16] following the earthquake of June 2000 in Cankiri, Turkey revealed that relocating communities from their original place can be problematic.

The study indicated that houses reconstructed in situ were fully occupied, whereas most of those constructed on new sites that did not consider the lifestyle of the beneficiaries stood empty. As a result of past practice and according to contemporary studies, all agree that community relocation needs thorough analysis and meaningful planning because it involves more than merely relocating a mass of physical bodies. Relocation is a risky endeavor that can result in project failure if it involves any measure less than relocating the entire community life.[17] In 2004, the relocation of fishing communities in Sri Lanka many kilometers inland severely undermined people's ability to access their only livelihood, i.e., the sea. Not only the men, but also the women and children were devastated, as they were no longer able to take up any sort of employment.[18]

Fraud, Corruption, and Waste of Project Funds

Unlike green field construction, post-disaster reconstruction is complex, dynamic, and chaotic in nature[19] and as such, represents many challenges.[20] The task of reconstruction, as indicated by Le Masurier, Rotimi, and Wilkinson[21] and Lloyd-Jones,[22] necessitates a high level of coordination and a rigorous managerial approach. Besides the inherent challenges, such as short and inflexible deadlines, community mobilization, high donor demand, and maintenance of intended housing

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[13] P. Lawther, "Community Involvement in Post-Disaster Re-Construction: Case Study of the British Red Cross Maldives Recovery Program," *International Journal of Strategic Property Management* 13 (2), (June 2009).
[14] Anthony Oliver-Smith, "Anthropological Research on Hazards and Disasters,"*Annual Review of Anthropology*, 25 (1), (1996), 303, available here; Ronald W. Perry and Michael K. Lindell, "Principles for Managing Community Relocation as a Hazard Mitigation Measure," *Journal of Contingencies and Crisis Management*, 5 (1), (March 1997), 49-59; and Camillo Boano, "Housing Anxiety and Multiple Geographies in Post-Tsunami Sri Lanka, Disasters, 33 (4), (October 2009), 762-785.
[15] Theo Schilderman, "Putting People at the Centre of Reconstruction," In *Building Back Better: Delivering People-Centred Housing Reconstruction at Scale*, (eds) Michal Lyons, Theo Schilderman, and Camillo Boano, (2010), 7.
[16] Dikmen, (2000), available **here**.
[17] T. Lloyd-Jones, "Mind the Gap! Post-Disaster Reconstruction and the Transition from Humanitarian Relief," University of West Minister, (June 2006), available here; and T. Ophiyandri, D. Amaratunga, and C. Pathirage, "Community Based Post-Disaster Housing Reconstruction: Indonesian Perspective," (2010), available **here**.
[18] Michal Lyons, "Building Back Better: The Large-Scale Impact of Small-Scale Approaches to Reconstruction," *World Development*, 37 (2), (2009), 385-398.
[19] Colin H. Davidson, "Multi-Actor Arrangements and Project Management," In *Rebuilding After Disasters: From Emergency to Sustainability*, (eds) Gonzalo Lizarralde, Cassidy Johnson, and Colin H. Davidson, (New York: Spon Press, 2010).
[20] R. Roseberry, *A Balancing Act: An Assessment of the Environmental Sustainability of Permanent Housing Constructed by International Community in Post-Disaster Aceh*, 4th International i-Rec Conference: Building Resilience: Achieving Effective Post-Disaster Reconstruction, (2008), available **here**.
[21] Jason Le Masurier, James O.B. Rotimi, and Suzanne Wilkinson, "A Comparison Between Routine Construction and Post-Disaster Reconstruction with Case Studies from New Zealand," Presented at the 22nd ARCOM Conference on Current Advances in Construction Management Research, (September 4-6, 2006).
[22] Lloyd-Jones, (June 2006), available **here**.

Rebuilding Housing *(Cont. from 8)*

quality,[23] reconstruction projects can also fall prey to fraud and corruption, resulting in huge losses of project funding.[24] A substantial amount of project resources can also be wasted on managing and alleviating tension with the host governments. This is evident from a case study conducted in the aftermath of the Indian Ocean Tsunami in Sri Lanka, where NGOs had to divert a considerable amount of their resources towards negotiating and restoring relationships with the government of Sri Lanka after they had become frayed due to the slow progress of post-disaster housing reconstruction.[25]

In post-disaster operations in both Sri Lanka and in Aceh-Indonesia, many community leaders were perceived as constituting a major obstacle to community consultations when they failed to pass on, or distorted, important information. The Acehnese community also related concerns about their local leaders being corrupt and abusive in their leadership roles. In both countries, the lack of transparency and the corrupt nature of community leadership led to many concerns related to inequitable distribution of housing.[26] An examination of 23 recent case studies of post-disaster settlements revealed that a 1999 transitional settlement and shelter program in post-conflict Ingushetia, Russia, faced numerous fairness and equity challenges.[27] The program was intended to provide cash grants to host families to shelter displaced families in private houses. The program suffered when individual community members fraudulently falsified documents in order to meet eligibility criteria for the program.

In the aftermath of large disasters, governments as well as NGO employees, can become particularly susceptible to fraud and corruption when hasty disbursement of large sums of recovery funding and distribution of aid assistance is ill-coordinated and incompetently monitored.[28] In Sri Lanka, after the effects of the tsunami in 2004, the buffer-zone policy that had already caused much anxiety to affected communities led to anger and aggravation when incidences of unfairness and corruption in relation to land allocation became public. Even after the government's rising of buffer-zone limits, people's right to access their affected land and to reconstruct their houses remained at the discretion of the Sri Lankan government; ultimately, this caused grave confusion amongst many international NGOs over whom to assist. As of August 2007 (nearly three years after the tsunami), due to the slow progress, more than 30 families who could not make it back to their previous land were still waiting for their new houses to be built.[29]

Ignoring Local Needs/Culture

Evidence suggests that affected communities do have the ability to overcome disasters and also have the most extensive knowledge of their own needs. However, reconstruction is often delivered in such a way that at best responds to the requirements of its implementers rather than to those of the affected population[30] and as a result, these projects often suffer when community needs are eclipsed by the implementers' greater interests, such as project

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[23] Roseberry, (2008), available **here**; and Robert Olshansky, "Planning after Hurricane Katrina," *Journal of the American Planning Association* 72 (2), (2006), 147-153.

[24] Michal Lyons, "Building Back Better: The Large-Scale Impact of Small-Scale Approaches to Reconstruction," *World Development*, 37 (2), (2009), 385-398; and, "Comments on the Project Proposal Regarding the Bujagali Hydropower Project" (Uganda), (2002), available **here**.

[25] Shaw and Ahmed, (2010), available **here.**

[26] I. Christoplos, *Links between Relief, Rehabilitation and Development in the Tsunami Response: A Synthesis of Initial Findings, Joint Evaluation* 2006:5, (2006), available **here**.

[27] Leon Esteban, Ilan Kelman, James Kennedy, and Joseph Ashmore, "Capacity Building Lessons from a Decade of Transitional Settlement and Shelter," *International Journal of Strategic Property Management* 13 (3), (2009), 247.

[28] Lawther, 13 (2), (June 2009).

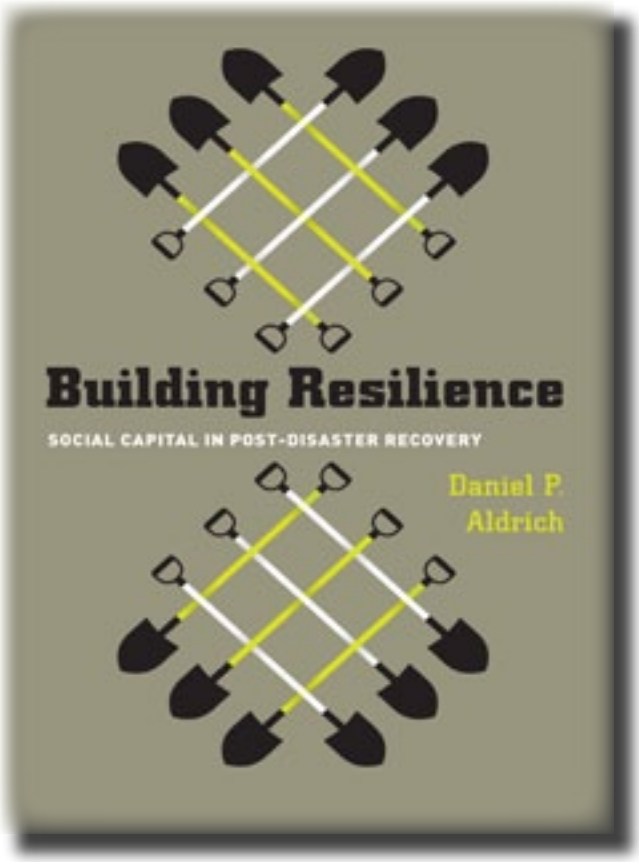
[29] Cathrine Brun and Ragnhild Lund, "Making a Home During Crisis: Post-Tsunami Recovery in a Context of War, Sri Lanka," *Singapore Journal of Tropical Geography,* 29 (3), (November 2008), 274-287, available **here**.

[30] Mpanjilwa Pius Mulwanda, "Active Participants or Passive Observers"? *Urban Studies,* 29 (1), (1992), 89-97; and Shaw and Ahmed, (2010) available **here**.

Building Resilience: Social Capital in Post-Disaster Recovery

by Daniel P. Aldrich*

Whereas some scholarship might be dry, written from a distant position in a detached ivy-covered tower, *Building Resilience* was written "wet" — figuratively and literally. In mid-July 2005, my family moved to New Orleans, where I was to begin an assistant professorship at Tulane University. Only six weeks later, at 4:00 a.m. on Sunday, August 28, my wife and I packed our two small children into our van and drove west to Houston to seek shelter as the rains of Hurricane Katrina began to fall. Heeding the warning of a concerned neighbor who realized we had no experience with the realities of life on the Gulf Coast, we had crammed three days' clothing into a suitcase, snatched up our slow cooker and some photographs, and left behind our rented house filled with new furniture, books, clothes, computers, and records, as well as our second car (a gift from my parents). By noon on Monday, we and other evacuees who were crowded into a motel at the edge of Houston were transfixed by the grainy television images of broken levees. Thereafter, the 11 feet of water that rushed into our New Orleans neighborhood of Lakeview from the nearby Seventeenth Street Canal sat stagnant for almost three weeks, destroying all our possessions and ripping apart the community that had so recently become part of our daily lives.



Although we immediately applied to FEMA for assistance, our initial applications were denied, and we received essentially nothing until our multiple appeals were finally answered in March 2006. Since we had so recently arrived in the Big Easy, we had not had time to activate flood insurance or renters' insurance; hence we had no coverage for our possessions or property. During that period, I had a chance to reflect on the course of recovery — as individuals, as a family, and as a community; I started to read the work of disaster experts to examine their analyses of past crises. There was little agreement on what conditions promote a more effective and efficient recovery. Given this lack of consensus, I concurred with other scholars who argued that it was "extremely important to determine what factors impact the recovery process."

After Hurricane Katrina, I had a chance to see firsthand exactly how individuals, neighborhoods, and cities do — or do not — recover after natural disasters. In my own family's experience, it was friends, friends of friends, acquaintances, and family who did the most for us; subsequently, I have found that disaster survivors around the world tell stories remarkably similar to ours. Then, as I completed the first draft of the book, a tremendous earthquake and tsunami struck northeastern Japan on 11 March 2011, and I heard the same narrative from friends and colleagues in Tokyo and around the country.

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Social Capital *(Cont. from 10)*

A great deal of academic work has focused on disasters; another tremendous body of literature has focused on social capital — the ties that bind people together even in the contentious processes of nonviolent conflict. All of us recognize the role that networks and personal contacts have in our professional and personal lives, but scholarship on disasters and government decision makers has been slow to integrate this concept into its theoretical frameworks. This book brings these two critical concepts together to understand how social resources influence post-disaster recovery. Using extensive studies of four major disasters in the 20th century, it uncovers how social networks and connections form the core engine of recovery after even the most devastating of events.

While many government disaster mitigation and recovery programs are predicated on the idea that the amount of aid provided and the amount of damage caused by the disaster are important, I bring quantitative and qualitative evidence demonstrating that social resources, at least as much as material ones, prove to be the foundation for resilience and recovery. Some scholars have suggested that social resources are important for recovery, but some have called for an investigation that "should verify and extend these concepts, offer more quantitative assessments of social capital as applied to disasters, [and] demonstrate their utility through more rigorous analyses."[1] Others have argued more pointedly that "no empirical studies demonstrate that building social connectedness among community resident results in community resilience."[2]

This new book responds to these challenges, applying cutting-edge methodologies to new data. I show that neighborhoods with higher levels of social capital work together more effectively to guide resources to where they are needed. Individuals who are connected to extralocal organizations and decision-makers prove more resilient because those networks remain robust even after a local crisis. Survivors borrow tools from each other, use their connections to learn about new bureaucratic and requirements procedures, and collaborate to organize community watch organizations. These results have profound implications not only for future research on social capital and disasters, but also for nongovernmental organizations (NGOs), bureaucrats, and politicians in guiding resource allocation.

Today, common approaches to disaster recovery still remain rooted in a 1950s paradigm of physical infrastructure, focusing on the rebuilding of bridges, power lines, homes, roads, and shops. While material-based assistance is important — and certainly saves lives in the short run — alone it will not contribute to long-term resilience in communities subject to past or future crises. Social capital, like other resources, can be nurtured through both local initiatives and foreign interventions. Future disaster mitigation programs will need to better integrate physical infrastructure and social infrastructure.

In reading hundreds of disaster case studies, I noticed that many built their conclusions on a single event; many others had been written without even one visit to the affected community. Determined to avoid these pitfalls, I conducted one year of fieldwork in Japan and India, creating four new data sets describing 225 neighborhoods and hamlets across space and time that were affected (to varying degrees) by a disaster. They include information on 40 neighborhoods in 1920s Tokyo, 9 wards in 1990s Kobe, 60 hamlets and villages, along with an additional 1,600 survey respondents in southeast India in the early 21st century, and 115 zip codes in post-Katrina New Orleans. For some urban sites, I have more than a decade of information on how neighborhoods responded to catastrophe. To gather materials for this

(Continued on Page 15)

1. Howard K. Koh and Rebecca O. Cadigan, "Disaster Preparedness and Social Capital," in Ichiro Kawachi, S.V. Subramanian, and Daniel Kim (eds), *Social Capital and Health*, (Springer: New York, 2008), Chapter 13, 283.
2. Anita Chandra, Joie Acosta, Lisa S. Meredith, Katherine Sanches, Stefanie Stern, Lori Uscher-Pines, Malcolm Williams, and Douglas Yeung, *Understanding Community Resilience in the Context of National Health Security: A Literature Review*, RAND, Prepared for the Office of the Assistant Secretary for Preparedness and Response, U.S. Department of Health and Human Services , (February 2010), 12, available at: **http://www.rand.org/pubs/working_papers/2010/RAND_WR737.pdf.**

Legal Insights

A Look at the National Disaster Recovery Framework

As we know from disasters such as 9/11 or Hurricane Katrina, rebuilding critical infrastructure requires significant coordination and can be quite a messy process. In an effort to clarify the roles and responsibilities regarding infrastructure recovery across governments, nonprofits, and private institutions, in September of 2011, FEMA released the National Disaster Recovery Framework (NDRF).[1] The NDRF builds upon the 2008 National Response Framework (NRF)[2] and emphasizes both pre- and post-disaster planning in order to "restore, redevelop and revitalize the health, social, economic, natural and environmental fabric of the community and build a more resilient Nation."[3]

In so doing, the NDRF provides a leadership structure comprised of a Federal Disaster Recovery Coordinator (FDRC), State or Tribal Disaster Recovery Coordinators (SDRC or TDRC), and Local Disaster Recovery Managers (LDRM). These individuals organize recovery efforts at all levels of government and liaison with key federal agencies to implement what the NDRF terms Recovery Support Functions (RSFs).[4] The NDRF designates coordinating and primary agencies "with significant authorities, roles, resources or capabilities for a particular function within an RSF"[5] to provide assistance when requested by the FDRC or required by the Stafford Act. The RSFs include:

- Community Planning and Capacity Building
- Economic
- Health and Social Services
- Housing
- Infrastructure Systems
- Natural and Cultural Resources

For each RSF, the NDRF outlines a mission, function, pre- and post-disaster objectives, and desired outcomes. For example, the Infrastructure Systems RSF is meant to ensure that "[r]esilience, sustainability and mitigation are incorporated as part of the design for infrastructure systems" and that these systems "are fully recovered in a timely and efficient manner to minimize the impact of service disruptions."[6] The coordinating agency responsible for this RSF is the U.S. Army Core of Engineers, and the primary agencies are DHS' FEMA and National Protection Programs Directorate, as well as the Departments of Energy and Transportation.

FEMA field-tested portions of the NDRF in Alabama, Missouri, and Tennessee in response to the significant damage done in 2011 by tornadoes and flooding. The agency reported positive results, including State alignment with the RSF coordination structure and more streamlined and effective federal participation. Hopefully such results can and will be duplicated on a wider-scale as this new framework takes root and is implemented across the Nation. ❖

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[1] National Disaster Recovery Framework, Federal Emergency Management Agency, (September 2011), available at **http://www.fema.gov/pdf/recoveryframework/ndrf.pdf.**

[2] National Response Framework, Federal Emergency Management Agency, (January 2008), available at **http://www.fema.gov/pdf/emergency/nrf/nrf-core.pdf.**

[3] National Disaster Recovery Framework, at 1.

[4] The NDRF distinguishes RSFs from the Emergency Response Functions (ESFs) listed in the NRF, noting: "There is necessarily some overlap between the ESF and RSF missions, but as the ESF requirements diminish, and the recovery issues take center stage, the RSFs take over the residual ESF activities that are associated with recovery." Ibid., at 38.

[5] Ibid., at 39.

[6] Ibid., at 60.

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VA Earthquake *(Cont. from 3)*

Maps:

Map of Earthquake Hazards in the Central and Eastern U.S.: **http://earthquake.usgs.gov/regional/ceus/.**

Aftershock Map: **http://earthquake.usgs.gov/earthquakes/eqinthenews/2011/se082311a/va_aftershocks_all.jpg.**

Time Lapse Video of the Aftershock Sequence: **http://earthquake.usgs.gov/regional/ceus/se082311a/aftershocks.php.**

"Did You Feel It"? Maps: **http://earthquake.usgs.gov/earthquakes/dyfi/events/se/082311a/us/index.html.**

Map Comparing East and West Coast Earthquakes: **http://earthquake.usgs.gov/earthquakes/eqinthenews/2011/se082311a/felt-comparisons.jpg.**

Photos:

House Damage: **http://gallery.usgs.gov/photos/08_14_2012_rvm8PDb55J_08_14_2012_1.**

Field Investigation: **http://gallery.usgs.gov/photos/02_28_2012_ptk7Nay4MH_02_28_2012_0.**

Mapping Underground Faults: **http://gallery.usgs.gov/photos/07_30_2012_a17Hxl3WWr_07_30_2012_1.**

Rebuilding Housing*(Cont. from 9)*

costs and speed.[31]
A field investigation carried out in 2008-2009 in Chennai, India exposed flaws resulting from developers ignoring community culture. Some newly built apartments had toilet doors fixed next to the kitchens, which was considered an unhealthy arrangement. Another culturally sensitive issue that was largely overlooked was the positioning of internal doors. Most apartments had three interior doors aligned facing each other. Driven by the belief that such positioning would bring bad luck, many families, at their own expense, changed the position of at least one door. This issue could have been avoided if pertinent cultural values had been considered as part of the design.[32]

In a similar situation following the 2004 tsunami in Aceh-Indonesia and Sri Lanka, many construction plans included indoor toilets and kitchens, both of which were considered unhygienic and culturally inappropriate, and thus, in many cases indoor kitchens were transformed into storage facilities. In the case of Chennai, Aceh-Indonesia as well as in Sri Lanka, cultural traditions and norms related to the most acceptable placement of fundamental housing elements, such as walls, doors, and windows, have been ignored.[33]

Concluding Remarks
There are five common factors that often impact the outcomes of post-disaster housing reconstruction projects: community participation, relocation issues, fraudulent use and waste of project funds, and ignoring local needs and culture. In the majority of post-disaster housing reconstruction projects already implemented, failure can be linked-back to lack of, or problems in these areas.

Reconstruction projects that are poorly designed and do not respond to community socio-cultural and economic needs are most likely to either undergo massive modification by the affected recipients, or fail in-part, or even entirely, to meet their objectives. Housing reconstruction is not often the highest immediate priority for disaster-affected communities, and regardless of the effects of the disaster, communities will not accept donations of houses that do not meet their socio-cultural and economic needs.[34] Understanding the complexity and the nature of post-disaster reconstruction projects also necessitates sponsors of these projects to shift their perception from merely seeing housing reconstruction projects as a response to the resultant immediate emergency, to providing assistance that responds to the long-term strategic needs of the affected populations. ❖

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[31] Lloyd-Jones, (June 2006); Cathrine Brun and Ragnhild Lund, "Making a Home during Crisis:Post-Tsunami Recovery in a Context of War, Sri Lanka," *Singapore Journal of Tropical Geography*, 29 (3), (November 2008), 274-287; El-Masri and Kellett, (4), (2001), 535-557; A. Bhattacharjee, C. Fautin, S. Kalonge, J.L. Moore, V. Rawal, and V.M. Walden, "Multi-Agency Evaluation of Tsunami Response: India and Sri Lanka (July 2005), available here; Alam, (2010), 241; and Mulwanda 29 (1), (1992), 89-97.
[32] Shaw and Ahmed, (2010).
[33] Christoplos, 2006:5, (2006), available **here**.
[34] Joel F. Audefroy, "Post-Disaster Emergency and Reconstruction Experiences in Asia and Latin America: An Assessment," *Development in Practice*, 20 (6), (August 2010), 664-677; and Kelly, (June 15, 2010),

Social Capital *(Cont. from 11)*

book, in addition to archival work in libraries in three countries, I interviewed close to 80 people, including survivors, NGO members, neighborhood activists, and civil servants in Japan, India, and the United States, and drew on the transcribed interviews of many more. I visited villages across Tamil Nadu, India, and spent time in disaster-struck neighborhoods of Tokyo, Kobe, and New Orleans.

To analyze data for each chapter in the book, I used a combination of quantitative and qualitative methods, including process tracing, time series, cross-sectional maximum likelihood models, and propensity score matching. Given that no single approach is appropriate for analyzing all types of data, many of the chapters are built on "mixed" or "hybrid" approaches that draw on the strengths of both large-N data analysis and detailed historical research. Further, while many scholars continue to provide extended lists of coefficients marked by asterisks to indicate "significant" findings from their research, here I use confidence intervals and simulations to provide more interpretations of my findings. Each chapter includes graphs and figures that provide predictions based on the empirical findings (although scholars looking for tables of numbers can find them in the appendix). These figures also indicate the degree of uncertainty about the predictions, indicating the 95 percent confidence interval around forecasts.

Finally, scholars have repeatedly stressed the importance of replication and transparency in the provision of data; researchers cannot build on past results unless they themselves can reproduce them independently. Social science follows the scientific tradition in requiring that both the data and the procedures used to analyze it be made public. To meet these standards, all the data analyzed here are available for free download from my website and from such online data storage sites as the Harvard University DataVerse project and the Interuniversity Consortium for Political and Social Research. I hope these data will provide the foundation for future investigations on disaster recovery. ❖

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