

UNIVERSITY OF
DELAWARE

DRC

Disaster Research Center



2011 ANNUAL REPORT

DISASTER RESEARCH CENTER

RESEARCH OFFICE

UNIVERSITY OF DELAWARE

2011 ANNUAL REPORT

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Disaster Research Center (DRC)

Established at Ohio State University in 1963 by Professors E. L. Quarantelli, Russell Dynes, and Eugene Haas, and moved to its current location at the University of Delaware (UD) in 1985, DRC was the first research center in the world devoted to the social scientific study of disasters. Historically, the Center has conducted field interviews and extended research projects on group, organizational, and community preparation for, response to, and recovery from natural and technological disasters and other community-wide crises for both academic and practical development of the field of disaster research and mitigation.

Recognizing the broader research interests in disasters across the campus and the interdisciplinary nature of the research, the Center moved from the Department of Sociology and Criminal Justice to the College of Arts and Sciences in the summer of 2006 and in June 2007 the Center moved again to come under the oversight of the UD Research Office. While much of the research at DRC has been interdisciplinary, UD researchers from disciplines other than Sociology are now actively engaged with the Center. Research at the Center continues to build on the foundation in the social sciences while broadening activities to more explicitly embrace interdisciplinary, multidisciplinary and cross-disciplinary research.

In Fall 2010, the University of Delaware launched a new interdisciplinary graduate program in Disaster Science and Management that is administered through the School of Urban Affairs and Public Policy (renamed the School of Public Policy and Administration). DRC core and affiliated faculty are actively involved in the program as advisors and instructors, as well as in the administration of the program. The program offers Master of Science and Doctor of Philosophy degrees. Graduate researchers from DRC have gone on to careers at leading universities, prominent research centers, key disaster-oriented government agencies, and private sector organizations that deal with disaster and risk issues.

Graduate and undergraduate training has been and continues to be an integral component of DRC's mission.

Faculty members from the University of Delaware's School of Public Policy and Administration, the Department of Sociology and Criminal Justice and the Department of Civil and Environmental Engineering oversee DRC projects. Classes are taught in the Department of Sociology and Criminal Justice's graduate concentration in Collective Behavior, Social Movements, and Disasters as well as in the undergraduate concentration in Emergency and Environmental Management. Classes on Risk Analysis, Civil Infrastructure Systems, and Modeling Systems are also taught in the graduate program in Civil and Environmental Engineering in the concentration on Infrastructure Systems, while classes on organizational behavior and fundamentals of disasters are taught in the School of Public Policy and Administration.

Researchers at DRC have conducted over 695 field studies since the Center's inception, traveling to communities throughout the United States and to a number of foreign countries. DRC researchers have carried out systematic studies on a broad range of disaster types, including but not limited to hurricanes, floods, earthquakes, tornadoes, hazardous chemical incidents, plane crashes, civil disturbances, and terrorism. Past DRC studies have focused on such topics as emergency medical and mental health service delivery in disasters, community responses to acute chemical hazards, mass evacuation and sheltering, preparations for and responses to major community disasters by lifeline organizations, group and organizational improvisation, and community earthquake mitigation and emergency preparedness in the U.S. to name just a few. This report provides detailed information regarding DRC's current studies and projects.

Since its founding nearly five decades ago, DRC's activities have been supported by diverse sources, including the National Institute of Mental Health, the Federal Emergency Management Agency (FEMA) and its preceding agencies, the NOAA Sea Grant Program, and the U.S. Geological Survey. Major research funding is currently provided by grants from the National Science Foundation (NSF), FEMA, the Department of Homeland Security (DHS), the National Institute of Standards and Technology (NIST), and the United State Department of Transportation through the UD University Transportation Center.

In addition to maintaining its own databases, DRC serves as a repository for materials collected by other agencies and researchers. DRC's specialized library, the E. L. Quarantelli Resource Collection, contains the world's most complete collection on the social and behavioral aspects of disasters—now numbering more than 57,000 items. It is open to both interested scholars and agencies involved in emergency management.

The Center has its own book, monograph, and report series with nearly 1,400 publications including preliminary papers and published articles. The DRC maintains ongoing contact with scholars from throughout the United States, Asia, Europe, and Mexico, some of whom have been visiting research associates at the Center for periods of up to a year. Many of these contacts have led to ongoing research collaboration.

For more information, consult DRC's home page at www.udel.edu/DRC, find us on Facebook at <https://www.facebook.com/disasterresearchcenter?sk=info> and follow us on Twitter at <http://twitter.com/udelldrc>

Director's Message

Dear DRC Alumni, Staff, and Friends,

We are pleased to present the Annual Report for 2011. This year was indeed a momentous one.

For me it was a year filled with new experiences as I took over as director from Sue McNeil. Her years of able leadership at DRC helped the Center to navigate through several transformations, including shifts in DRC's administrative home and guiding us to enhanced interdisciplinary work across the social sciences and engineering. We are glad for her continued wisdom and wish her well on her well-earned sabbatical.

Like the rest of the world, we watched with concern the terrible events of the March Tohoku, Japan earthquake and tsunami. DRC has many colleagues and friends in Japan and while we were glad for their safety, we were, at the same time, saddened by the tremendous loss of life and physical destruction. I think most of us would conclude that this catastrophe was the most complex that we have seen in recent disaster research, owing not just to the vast scale of the event—with international consequences—but also to the complexity of the emergency situation and the cascade of crises that confronted officials, nonprofit organizations, and, of course, ordinary residents who had to first run to safety, and then begin the sobering task of assessing losses of life and property. Earthquake, tsunami, multiple nuclear reactor meltdowns (even one of which would have been a surpassing emergency), fires, and landslides came first. Then, as a final misery for survivors, cold and damp winter weather covered the northern regions of the country, while rolling blackouts continued through the summer.

Dr. Tricia Wachtendorf, DRC Associate Director, and Rochelle Brittingham, a doctoral student in the School of Public Policy and Administration, visited Japan as part of a study tour sponsored by the Japan Institute for Social Safety Science. This was the first of three trips by DRC to examine the role of nonprofit organizations and their work with, or alongside, public agencies. In catastrophes—large events whose effects sweep all across civil society and confront officials and non-officials alike with new and perplexing decisions—we would anticipate a need for robust civic involvement, since a catastrophe will interrupt all community functions on a wide scale. In fact, we might even consider that catastrophes can hardly be called “events,” but are rather constellations of interconnected or escalating crises. This re-conceptualization should affect theories of planning and response.

I had hoped when arriving at DRC that we might begin to slowly reorient our emphasis from predominantly sudden-onset emergencies and disasters to crises that have a longer period of gestation, or whose effects may be less noticeable in the short term but which might aggregate or accelerate over time. Pollution, environmental degradation, and global warming are among the roster of potential hazards that fit this description, and we've begun to turn some attention in this direction. Of course, DRC has long had a cosmopolitan view of disaster challenges before, during, and after an event. For example, DRC's evaluation of Project Impact some ten years ago was focused on mitigation and disaster resistance—the things you can do before a disaster strikes to make it less likely or less destructive. But the alert observer can now see the signs of stresses on electricity systems, on supplies of clean drinking water, on reserves of fossil fuels, on transportation infrastructure, and on the interface between developed and undeveloped lands. And in some developing countries the challenges are particularly dire. We've asked ourselves, if DRC had been around in the 1930s, what would we have had to say about the Dust Bowl? Thinking

in those terms is a shift for DRC in terms of the center of gravity of our projects, but well within the interests and expertise of the faculty and students. Dangers of regional or even global scope are among our interests, including those whose precise form cannot be described but whose potential is increasing, such as those that may arise from global or even local climatic changes. We are broadening our interests in the area of public health aspects of disasters, as well.

We are now looking ahead to a noteworthy milestone—DRC’s fiftieth anniversary year! We are working with a number of possible dates in 2013–2014, so stand by for further news on this.

Meanwhile, we hope that 2011 was a safe and prosperous year for you. As always, we are interested in hearing from our friends.

Best wishes,
Jim Kendra



DRC Director Dr. James Kendra attends “UD on the Hill”—a one-day showcase of federally funded research conducted by various University of Delaware centers. DRC’s research was prominently featured in presentations to federal legislators.

(photo by DRC staff)

Research

DRC has a well-established research tradition built on its foundations in the social sciences, a proven capacity for quick response field research, and a culture of collaboration between faculty, staff, graduate students, and undergraduate students. A number of issues, events, and elements have created not only an increased demand for DRC's traditional expertise, but have also provided motivation to go beyond multidisciplinary work to develop a sustainable interdisciplinary program. These include the increase in focus on issues related to disasters, the multidisciplinary funding climate, emerging collaborations between DRC and external agencies, the many unfunded mandates related to disaster planning that have been imposed on governmental agencies, and DRC's University-level administrative location under the Research Office. All have converged to further support and encourage DRC's efforts to establish a strong interdisciplinary research environment. In developing such an environment, DRC plans to draw on the core research areas current DRC faculty engage in, all of which are prime for interdisciplinary collaboration, including:

- The identification of the social, physical and environmental factors/conditions that influence vulnerability and resiliency of social and physical systems
- Individual and collective threat perception and behavior
- Organizational and inter-organizational dynamics
- Development and disasters
- Social and political dynamics that enhance the development of public policy for disaster reduction
- Analysis and management of infrastructure systems

In developing and conducting research projects, DRC aims to act as a catalyst for and serve as the intellectual home for interdisciplinary disaster related research. Our integrated project teams leverage the interests and capacities of other disciplines on campus that balance quantitative and qualitative approaches to research, that demonstrate systems-level thinking, that employ the broadest possible set of methodologies and analytic techniques, and that nurture a culture which values the integration of disciplinary insights and thinking.

Project Descriptions

This section provides short descriptions of active and recently completed projects involving faculty from the Disaster Research Center at the University of Delaware. Although by no means an exhaustive list of capabilities, these projects demonstrate the Center's expertise and our current agenda.

Projects Initiated in 2011

Community Resilience Index

Principal Investigator: James Kendra

Funding Agency: Centers for Disease Control, sub-award from Johns Hopkins University Bloomberg School of Public Health

This research will advance understanding of a community's survivability. In cooperation with colleagues at the Johns Hopkins School of Public Health, we will consider community resilience in light of both the cur-

rent literature on the topic as well as taking a fresh look at elements of resilience based on DRC's field research and on advanced modeling techniques.

Emergency Planning for Skilled Long Term Care Facilities in Delaware

Principal Investigator: James Kendra

Co-PI: Bethany Hall-Long, School of Nursing, University of Delaware

Funding Agency: Delaware Department of Health and Social Services

This project, in cooperation with the College of Health Sciences at the University of Delaware, focuses on disaster preparedness of nursing homes and other congregate care facilities in Delaware. Through focus groups, interviews, and a set of planning sessions with facility

administrators, project staff will analyze emergency preparedness challenges and, working closely with state officials, help facilities bolster their emergency planning capacities.

Issues in Disaster Science and Management: A Critical Dialogue between Scientists and Emergency Managers

Principal Investigators: Joseph Trainor, Disaster Research Center, and Tony Subbio, Tetra Tech

Funding Agency: The Federal Emergency Management Agency (FEMA) Higher Education Program

This project will help bridge the divide between disaster science and practice. Our approach focuses the attention of academic/practitioner teams on a series of critical contemporary issues related to disasters. For each issue, academics and practitioners will be selected to describe what we "know." Researchers will be asked to focus on the scientific findings and practitioners will be asked to discuss patterns and variation in national poli-

cies/state of practice. The focus of the project will be on facilitating an exchange of ideas between these communities and developing a vision for how their important insights could be brought together to make the U.S. emergency management system better. Ultimately this work will result in a textbook for advanced undergraduate and introductory graduate level courses.

Lessons Learned from Traffic Data Collected Before, During and After a Hurricane

Principal Investigator: Sue McNeil

Graduate Research Assistant: Erik Archibald

Funding Agency: University of Delaware University Transportation Center with funding from U.S. Department of Transportation

Access to real-time collection and analysis of traffic data that can be used to inform the evacuation planning process and enhance the efficiency of operations before and after a disaster presents an interesting opportunity. The objective of this work is to identify ways to use traffic data to better understand evacuation behavior and to explore ways to integrate traffic data into evacuation planning and response. Analysis of these data is performed and the usefulness of these type of data is then discussed. Hurricane Irene provides a rich source of data

on actual behavior during a mandatory evacuation that has important implications for future events including developing strategies for improving situational awareness and post-incident review and planning. These issues are important as the perceived increases in frequency and intensity of weather related events mean that there are increasing pressures to address evacuation issues. The use of traffic data will ultimately allow government to better plan and execute evacuations and help make the corridors used for evacuation more resilient.

RAPID: Post-earthquake Fires in the March 2011 Japan Earthquake and Tsunami

Principal Investigator: Rachel Davidson

Graduate Research Assistant: Sizheng Li

Funding Agency: National Science Foundation RAPID Program

The Tohoku earthquake and tsunami caused approximately 300 fires—more recorded fires than any other earthquake in history. By comparison, there were about 110 recorded in Kobe (1995), 110 in Northridge (1994), 128 in San Fernando (1971), and 36 in Loma Prieta (1989). In this RAPID project we are studying the fire-related aspects of the March 2011 Japan earthquake with the aims to improve understanding of where, when, and how fires ignite, how fires spread through a neighborhood, and how they ignite and are suppressed in industrial facilities. The project involves

three main steps: (1) collecting data on the fire-related aspects of the event through site visits, interviews with key informants, and secondary data sources; (2) compiling the data into easily usable, comprehensive databases that include all data on each fire and relevant auxiliary data in a consistent format; and (3) analyzing the data through descriptive statistics, fitting generalized linear statistical models to the ignition data, and comparing observations of spread to those estimated by a new physics-based urban fire spread model.

RAPID: The Tohoku Catastrophe: Volunteers and Non-profit Organizations in Post-Kobe Japan

Principal Investigator: James Kendra

Co-PI: Joanne Nigg

Funding Agency: National Science Foundation

On March 11, 2011, the nation of Japan experienced a catastrophe—a great earthquake of M9.0; a near-shore tsunami 10 meters high that reached the coast in less than 30 minutes and traveled inland four miles in some locations; and a nuclear emergency in six reactors on one site that released significant amounts of radiation into the air, land, and water. These events resulted in dif-

ficult and delayed search and rescue efforts, extremely short warning periods, evacuation and sheltering of over 500,000 people, heroic efforts to stop the melting of cores and spent fuel rods at nuclear power plant reactors, and confusion in risk communication to the public. Given the enormity of the Tohoku destruction and the evident inventiveness that was required at all stages

of response, an entirely new framework is needed in responding to catastrophic events. This project focuses on volunteers and how they coordinate (or do not coor-

dinate) with officials and with each other, and considers the needs for distributed and independent actions in all-encompassing events.

Understanding Post-event Transportation Network Performance

Principal Investigator: Sue McNeil

Graduate Research Assistant: Sekine Rahimian

Understanding and modeling both the supply of and demand for transportation services after an event is vitally important for emergency managers and government agencies to mitigate, prepare for, respond to, and recover from potential impacts effectively. The changes in the supply side of transportation networks include failure of and capacity reduction for bridges and roadways as discussed in several studies while the demand side, capturing changes in travel patterns, has drawn less attention.

Models to estimate travel demand after an event

are necessary to estimate the performance of the whole system. This research focuses on modeling trips after an earthquake recognizing that the purposes of these trips are completely different from the normal situation. The demand models are being developed and then assigned to the disrupted network with reduced capacity so performance measures can be computed. Moreover, to be able to use this study for mitigation planning, probabilistic performance measures based on earthquake scenarios will be developed.

Workshop on Deploying Post-disaster Quick-response Reconnaissance Teams: Methods, Strategies, and Needs

Principal Investigator: James Kendra

Funding Agency: National Science Foundation

Scholars in a number of disciplines have long recognized the importance of deploying research teams to the site of a disaster as soon as possible in order to gather perishable or ephemeral data, i.e., data that might be available for only a short period of time. Initial data gathering, scoping out the likely scientific content, proposal development, assembling a team (including collaboration with colleagues in the affected area), and reaching the field quickly are among the challenges in this research. While findings from RAPID studies have enriched knowledge across the phases of disaster, techniques for conducting quick-response research are less shared across the research community. The workshop will provide a forum for information exchange and development of best practices, including new and innova-

tive ones, for this demanding research genre. Projected workshop attendees are RAPID grant recipients, as well as representatives of the principal research centers, agencies, and societies whose work involves disaster-related research. The objectives of the workshop are to explore burgeoning methods for developing initial situation awareness after disaster strikes (such as through growing social media); transforming initial situation awareness into researchable questions for transformative potential; team-building and best practices for deploying researchers (including the prospect of novel approaches); and recommendations to NSF and the hazards community on how to best organize and support RAPIDs following a major disaster for maximum efficiency, alacrity in reaching research sites, and scientific benefits.

Ongoing Projects

Collaborative Research Proposal on Improvisation and Sensemaking in Sudden Crisis

Principal Investigators: Tricia Wachtendorf, Disaster Research Center, and James M. Kendra, University of North Texas

Senior Personnel: Jasmin Ruback, Ruback & Associates

Graduate Research Assistant: Brandi Lea, University of North Texas

Undergraduate Research Assistants: Alicia Badoff, Josh Kelly, Samantha Penta

Funding Agencies: National Science Foundation, University of Delaware Research Foundation

The waterborne evacuation project focuses on the unplanned waterborne evacuation of more than 500,000 commuters from Lower Manhattan by an ad hoc flotilla of ferries, tugs, workboats, dinner cruise boats and other assorted harbor craft after the 9/11 attacks on the World Trade Center, and the subsequent improvised boat-lift of supplies and equipment into the city. The goal of this project is to examine organizational improvisation and distributed sensemaking under conditions of rapid change and urgent needs for decision making and action. The focus of this research is on geographically dispersed organizations that are able to coordinate actions and responses by “making sense” of their surroundings and environment during a crisis. The study works to ascertain:

- The cues upon which participants relied in assessing shifting environmental information;

- The existing and developing networks which were significant in coordinating action;
- The processes of gathering, assessing, and disseminating information to support distributed learning; and
- The significance of prior experience and the process by which it was employed in changing circumstances, including the emergence of new norms.

Principal analytical methods include an inductive qualitative approach, a social network analysis of pre- and post-attack relationships among participants and GIS mapping of vessel activity. The study will provide an explanatory framework for how organizations understand rapid change, communicate with others in turbulent and complex environments and develop new strategies and procedures for emergent needs under crisis conditions.

DRU: Contending with Materiel Convergence: Optimal Control, Coordination, and Delivery of Critical Supplies to the Site of Extreme Events

Principal Investigators: Jose Holguin-Veras, Rensselaer Polytechnic Institute, Tricia Wachtendorf, Disaster Research Center, Havidán Rodríguez, Disaster Research Center, Satish V. Ukkusuri, Purdue University, and Didier M. Valdes, University of Puerto Rico-Mayagüez

Undergraduate Research Assistants: Austin Barlow, Zephi Frances, Josh Kelly

Funding Agency: National Science Foundation

The overall goal of this project is to develop methodologies and tools to foster an accelerated convergence between the dynamic needs and supplies of critical resources (e.g., blood, water) to the site of an extreme event. Achieving the overall goal of this project requires a modeling framework that integrates concepts from the social sciences, control theory, and robust and stochastic optimization of supply chains to bridge the gap between dynamic demand and supply of critical resources (i.e., resources available on site, private donations, resources

provided by emergency agencies) after an extreme event, as a system, and consistent with social science principles. These mathematical procedures would help proactively advise the general public about donation priorities, thus reducing the probability of a repeat of previous extreme events in which a massive influx of non-priority donations hampered the flow of critical resources.

The project seeks to develop novel analytical formulations to:

- Forecast what is needed, providing robust estimates

of the dynamic resource requirements following an extreme event (e.g., demand for water or food);

- Estimate what is available, i.e., critical resources available on site and in adjacent areas;
- Estimate the dynamic pattern of unmet needs, i.e., what needs to be transported to the site;
- Establish an optimal strategy of priority allocation among the donations from the general public and emergency agencies;
- Design the most effective ways to deliver, store and distribute critical supplies to the impacted area;
- Identify institutional impediments to coordinating an effective response to extreme events, and formu-

late mechanisms to overcome these obstacles; and,

- Identify ways in which tighter integration of the information technology systems can be achieved among the pertinent stakeholders.

The work will lead to scientific contributions in the social sciences, control theory, robust and stochastic optimization, and dynamic modeling of supply chains, and to improved national emergency response capabilities. As part of the effort to promote learning education at all levels, the research team will engage both undergraduates and middle school students in research activities with specific emphasis on members of under-represented groups.

Infrastructure Security and Emergency Preparedness

Principal Investigators: Sue McNeil, Tricia Wachtendorf, Earl Lee, Rachel Davidson, and Joseph Trainor

Graduate Research Assistants: Sekine Rahimian, Gabriela Wasileski

Funding Agencies: Delaware Department of Transportation and University Transportation Center

The first part of this project (funded by Delaware Department of Transportation) considers the protection of our national infrastructure systems. Of special relevance to this project is the joint responsibility of the Department of Transportation and the Department of Homeland Security to collaborate on all matters pertaining to transportation security and transportation infrastructural protection. Given the many pressing needs for transportation resources in Delaware, assessing the vulnerability and risk of Delaware's critical transportation infrastructure, identifying possible countermeasures, and estimating the capital and operating costs of these improvements is challenging.

The objectives of this research are:

- To provide background and context for addressing risks and vulnerabilities as outlined above, and
- To explore the applicability of one tool, CAPTA, for costing asset protection.

The tool requires knowledge of the hazards faced, the events of concern, the assets of high consequence, and appropriate counter measures and preparations. Armed with this information, CAPTA iteratively assists the agency to understand when and where to commit resources.

The research involves a literature review, review of CAPTA, and development of a case study.

A second part of this project (funded by the University of Delaware's University Transportation Center) recognizes that transportation infrastructure security and emergency preparedness present an enormous challenge for both the State of Delaware and for the major transportation corridors that run through the state. The objective of this part of the project is to review the current state of practice for Delaware, review external research, apply insights from state-of-the-art social science and engineering, and develop a plan for integrating research insights into practice.

Interaction between Building and Occupant Responses during Collapse (IBORC)

Principal Investigators: Benigno E. Aguirre, Disaster Research Center, and Sherif El-Tawil, University of Michigan

Graduate Research Assistants: Kimberly Gill, Eric Best

Undergraduate Research Assistant: Shawn Reynolds

Funding Agency: National Science Foundation

The aim of this project is to interview survivors of building collapses in order to find out how they evacuated the building and how they received warnings. We anticipate that perception of danger, decision to flee, choice of evacuation route, and the urge to assist victims will strongly depend on signals (such as sounds, sights and smells) that are produced by the building during and after a collapse. Other goals of this project are to investigate the impact of the building's structure on building collapse response and occupant survival rates through computer simulation modeling.

2010 Project accomplishments:

- Obtained copy of the Oklahoma State Department of Health, Injury Prevention Service Bombing Injury Database for secondary data analysis

Following the April 19, 1995 bombing of the Alfred P. Murrah Federal Building in Oklahoma City, the Commissioner of Health of the State of Oklahoma declared injuries and other health conditions related to the bombing to be reportable conditions for special study. As a result, the Injury Prevention Service (IPS) of the Oklahoma State Department of Health (OSDH) conducted an assessment of physical injuries incurred as a direct result of the bombing.

Following this investigation, an OSDH registry was compiled and developed into a database that included information for 1,259 injured and uninjured persons who were directly exposed to the bombing. Persons involved in search and rescue efforts were excluded. The IPS collected bombing injury data from medical records, surveys, and medical examiner reports. Additionally, in October 1996, the IPS began a follow-up study of Oklahoma City bombing survivors to collect further information about the causes of bombing injuries, long-term health problems, and medical costs associated with the bombing.

We obtained permission to receive a copy of this database, with identifying information removed. The data is provided through a Memorandum of Agreement established between approved qualified research inves-

tigators and the OSDH. The data may be used only for research, characterizing health conditions, and developing prevention strategies. All of the forms that were used for data collection can be found on the OSDH website at: http://www.ok.gov/health/Disease_Prevention_Preparedness/Injury_Prevention_Service/Injury_Surveillance_Toolbox/index.html

We are now using this data set to study people who were trapped by the explosion, and intend to use the dataset to expand the ongoing effort to build a computer based Agent Based Model of building evacuation that would apply to multi-floor buildings like the Murrah Building in OKC.

- Obtained copy of interviews conducted by The Oklahoma Historical Society Oral History Program for secondary data analysis

The OHS conducted interviews with survivors, first responders and experts following the 1995 terrorist bombing of the Alfred P. Murrah building. We worked with the Historical Society to determine which of their interviews would be relevant to the goals of our project and we obtained copies of 12 CDs and 5 DVDs that contain interviews with survivors, FEMA task force teams and other first responders, terrorism and bomb experts, and documentation of damage to the buildings.

A sample of the interviews that are available through the Oklahoma Historical Society's Oral History Program can be found on their website at: <http://www.okhistory.org/research/collections/oh/bombing.html>

- Disaster Research Center Interviews with Oklahoma City Bombing Survivors

Continued use of IRB approved in-person/telephone interview guide and web-based questionnaire for use in conducting interviews with survivors of the 1995 Oklahoma City bombing or with survivors of other building collapses. Web-based questionnaire is available at: https://delaware.qualtrics.com/SE/?SID=SV_0ICxLeiLCIAFrEw&SVID=Prod

Nine telephone interviews have been conducted with survivors and six web-based surveys have been completed.

Our recruitment notice was circulated to survivors by the Executive Director of the Oklahoma City National Memorial and Museum through their newsletter.

Recruitment efforts also included a direct mailing to approximately 300 survivors of the bombing for whom addresses could be determined.

International Research Network

Principal Investigators: Joseph Trainor, Disaster Research Center, Erna Danielsson, Mid Sweden University, Anna Olofsson, Mid Sweden University, Kurt Petersen, Lund University, Ann Enander, Karlstad University, and Tricia Wachtendorf, Disaster Research Center
Graduate Research Assistants: Rochelle Brittingham, Susan Brink
Funding Agency: Swedish Central Bank Tricentenary Fund

The goal of this project is the development of a national and international “knowledge network” with the requisite skills necessary to support the growing interest in risk, crisis, and disaster research. New technologies and new approaches to research have made it possible to create 21st century solutions to coordinating and integrating researchers. These activities will create synergy among participants, will aid in the production of innovative approaches, and will have great potential to produce ideas, solutions, and techniques that would not come into being without this grant’s assistance.

The level of sustained research interaction this funding can provide will help us to overcome the barriers that distance and disciplinary training have created. By continuing to work together, our interactions will facilitate the creation of permanent relationships that can serve as the basis for future projects that will expand our proposed work in directions that other groups will simply not be equipped to handle. In particular we are focused on empowering graduate students and providing them with collaboration opportunities.

Investment Planning for Regional Natural Disaster Mitigation

Principal Investigator: Rachel Davidson
Co-PI: Linda Nozick, Cornell University
Graduate Research Assistants: Meredith Legg, Cornell University, Pantea Vaziri, Cornell University
Funding Agency: National Science Foundation

In this project, we are developing a set of mathematical models to help guide an optimal expenditure of regional natural disaster mitigation funds, and to provide insight into the many factors that interact to determine the best mix of mitigation strategies. Focusing on earthquakes and hurricanes, the regional natural disaster mitigation analysis models will help an at-risk region with a limited budget decide how much to spend on pre-event mitigation that aims to reduce future losses versus post-event recovery, and which of the many possible pre-event mitigation activities to fund so as to meet the region’s objectives. The proposed set of models will advance knowl-

edge about natural disaster risk management and the simultaneous planning for multiple hazards. While it is widely thought that pre-disaster mitigation is desirable, and a lot has been done to develop structural and other techniques for disaster mitigation, the circumstances in which it is desirable to implement different mitigation measures are not well understood. This project will merge optimization and loss estimation modeling to provide new insights into resource allocation decisions for mitigation. The findings may be generalizable to other hazards and to risk managers in other contexts.

Modeling Natural Disaster Risk Management: A Stakeholder Perspective

Principal Investigator: Rachel Davidson

Co-PIs: Linda Nozick, Cornell University, Jamie Kruse, East Carolina University, and Thomas D. O'Rourke, Jr., Cornell University

Graduate Research Assistant: Jiazhen Peng

Funding Agency: National Institute of Standards and Technology (NIST)

Natural disasters are a significant and growing national challenge. This project involves developing risk and game theoretic optimization models to support design of a regional natural disaster risk management system that is effective, efficient, sustainable, equitable, and that is appealing to each of the key stakeholders so that it will be implementable. The modeling will be novel in (1) using sophisticated large-scale game theory optimization to model regional natural disaster risk management; (2) incorporating realistic representations of regional risk and mitigation options; (3) explicitly considering the differing objectives, constraints, and

alternatives of each of the key stakeholders (e.g., building owners, insurers, government); (4) recognizing the biases people and organizations have in making disaster risk decisions; (5) allowing decisions and investments to be made over time; and (6) representing the large uncertainty in disaster losses. The new models will be demonstrated through case studies focusing on earthquake risk in Los Angeles and hurricane risk in North Carolina. Successful completion of the project will provide tools to help address the increasingly severe problem of natural disaster risk, a topic of major national concern.

Modeling Post-earthquake Fire Spread

Principal Investigator: Rachel Davidson

Graduate Research Assistant: Sizheng Li

Funding Agency: Multidisciplinary Center for Earthquake Engineering Research (MCEER)

In the aftermath of an earthquake, many fires may ignite simultaneously and at the same time that a region's suppression capabilities are severely diminished due to damaged water supplies, transportation, and communication systems, and increased demands on fire service personnel. The result can be conflagrations that cause losses exceeding those caused by ground shaking. In this project, we are developing a new simulation model of post-earthquake fire spread and applying it to a case study area in Los Angeles. The model is designed to have several desirable features: (1) to be physics-based, representing the various modes of fire spread separately (e.g. radiation, branding); (2) to be computationally tractable so that it can be applied to an entire urban area;

(3) to provide many types of detailed results including, for example, total area burned, spatial description of spread, and relative importance of different modes of spread so that it can provide insight into the relative importance of different contributors to fire spread; (4) to quantify uncertainty in the results; and (5) to be flexible to allow for easy modification. The new post-earthquake fire spread model is designed to be used to (1) improve estimation of fire damage for a specified earthquake scenario, (2) provide new insight into the relative importance of factors that contribute to post-earthquake fire spread, and (3) help future evaluation of potential long- and short-term post-earthquake fire risk reduction strategies.

Modeling the Interactions between Development and Regional Disaster Risk

Principal Investigator: Rachel Davidson

Graduate Research Assistant: Susan Brink

Funding Agency: National Science Foundation (NSF) Graduate Research Fellowship

In order to understand the root causes of risk and the full implications of mitigation and recovery decisions on a city's development trajectory, a broad decision frame is needed that considers disasters in a long time framework and fully captures the many interactions between normal development processes and the ongoing cycle of mitigation, preparedness, response and recovery. This

research aims to understand the interactions between a city's disaster risk and its development trajectory by developing a system dynamics model capable of describing vulnerability and development, applying the model to Port-au-Prince, Haiti and Padang, Indonesia, and using the model to answer questions about development and disaster risk.

Multi-organizational Collaborative Leadership and Interaction

Principal Investigators: Tricia Wachtendorf, Disaster Research Center, and William Waugh, Georgia State University

Funding Agency: Department of Homeland Security: Center of Excellence for the Study of Natural Disasters, Coastal Infrastructure, and Emergency Management

The goal of this project is to help officials do a better job of coordinating incidents that are Multi-organizational and/or multi-jurisdictional. Consideration is given to traditional formal responders as well as other community-based involvement and the integration of public and private sector efforts, social and human factor elements, and political and cultural facilitators/barriers to response participation. This project will (1) assess the effectiveness of current organizational structures and incident management systems in building and maintaining collaboration among stakeholders involved in man-

aging hazards and disasters; (2) identify best practices, major issues, and the skill-sets (individual and organizational) necessary to build and maintain collaborative relationships; (3) identify skills, cultural features, and social relationships that can foster effective improvised action when a multi-organizational response is necessary; and (4) design and test a training program in collaborative management and leadership for community and state officials involved in managing hazards and disasters. Research methodology includes focus groups, in-depth interviews, and test-bed application.

NEES-SG. NEESWood: Development of a Performance-based Seismic Design Philosophy for Mid-rise Woodframe Construction

Principal Investigator: John van de Lindt, Colorado State University

Co-PIs: Rachel Davidson, Disaster Research Center, Andre Filiatrault, University of Buffalo, David Rosowsky, Texas A&M University, and Michael Symans, Rensselaer Polytechnic Institute

Graduate Research Assistant: Greg Black

Funding Agency: National Science Foundation (NSF) Network for Earthquake Engineering Simulation (NEES) Program

The objective of this project is to develop and experimentally validate a performance-based seismic design (PBSD) procedure that would make construction of mid-rise wood-frame construction possible in regions of moderate to high seismicity in the U.S. While wood-frame structures have historically performed well in earthquakes with

regard to life safety, they have sustained significant structural and non-structural damage in recent events. Further, the height of wood-frame construction has been limited to approximately four stories, and current building code requirements for engineered wood construction are not based on a global seismic design philosophy but rather

wood elements are designed independently of each other. In this project, we seek to provide the necessary mechanisms to take advantage of the engineering characteristics that make wood-frame construction perform well with regard to life safety, while safely increasing the height of

wood-frame structures in seismically active areas and mitigating damage to low-rise wood-frame structures. The UD portion of the project is to develop a regional earthquake loss model for wood-frame buildings to help guide the specification of appropriate performance objectives.

Netherlands US Water Crisis Research Network (NUWCREN)

Principal Investigators: Joseph Trainor, Disaster Research Center, Sue McNeil, Disaster Research Center, Karen Engle, COT, Jack Harald, Virginia Tech, Liesel Ritchie, Natural Hazards Center, University of Colorado, Boulder, Harold Bousche, TNO, and Georg Frerks, Wageningen University

Graduate Research Assistant: Lucia Velotti

Funding Agency: The Ministry of Public Works, Transport, and Water Management, The Netherlands

The purpose of NUWCREN is to develop a sustainable network of Dutch and U.S. knowledge institutes that can facilitate the advancement of the Netherlands' preparedness with respect to possible floods. In addition to distributing existing knowledge, we also aim to develop

scientific knowledge and assess operational practices for flood disaster management. The ultimate goal is to institutionalize a collaborative international network that can generate approaches to policy in the Netherlands and/or the United States.

New Methods for Measuring, Monitoring, and Evaluating Post-disaster Recovery

Principal Investigator: Ronald Eguchi, Imagecat, Inc.

Co-PIs: Rachel Davidson, Disaster Research Center, Stephanie Chang, University of British Columbia, Arleen Hill, University of Memphis, and Beverley Adams, Imagecat, Inc.

Graduate Research Assistant: Dana Rathfon

Funding Agency: National Science Foundation

Post-disaster recovery—one of the phases of the disaster management cycle—is a complex physical, social, economic, environmental, and political process. It lasts years, requires enormous financial and other resources, and can define the character of the affected communities for years to come. The literature includes theoretical frameworks of recovery and empirical case studies of historic events. The empirical studies have often focused on a single dimension of recovery, such as housing, and have typically relied on interviews, focus groups, and one-time surveys for data gathering. This literature offers rich cross-sectional insights into recovery at a point in time, but limited systematic, quantitative empirical descriptions of regional recovery over time. Using newly available high-resolution satellite imagery, previously underutilized statistical data, and advanced field survey techniques that capture a detailed geographically referenced record of recovery through photographs, video, and observations, this study will develop innovative methods for systematically and quantitatively measuring and monitoring post-

disaster recovery. Using a single recent hurricane as a case study, in this project we are (1) developing methods to process and interpret remote-sensing data to describe the physical and socio-economic manifestations of post-disaster recovery; (2) obtaining and compiling quantitative and qualitative recovery data from remote-sensing, field reconnaissance surveys, secondary statistical sources, interviews, and surveys; (3) developing methods to analyze and synthesize the recovery data to comprehensively measure and monitor recovery; and (4) demonstrating application of the new methods within the case study area. Improved tracking of recovery will serve as a critical first step for future efforts to better explain and evaluate recovery by addressing questions such as: For a disaster that has just occurred, over what timeframes and in what ways is recovery likely to unfold?; Why is recovery proceeding in a particular way?; and How are recovery speed and character correlated with various pre- and post-disaster decisions and actions?

Post-earthquake Water Supply Restoration

Principal Investigator: Rachel Davidson

Graduate Research Assistant: Susan Brink

In this project, we are developing a discrete event simulation model of post-earthquake restoration for the Los Angeles Department of Water and Power water supply system and using it to provide insight into the factors that govern restoration efficiency and ways to improve the process. The model mimics the real-life process in detail, simulating the movement of different types of crews as they inspect, reroute around, isolate, and repair system damage. For any given earthquake, it pro-

vides restoration curves with uncertainty bounds, maps showing the spatial distribution of outages over time, and crew and repair material usage information. Results for the 1994 Northridge earthquake suggest the model is capable of accurately estimating the time and spatial sequence of the restoration. This is the first application of discrete event simulation to post-disaster water supply restoration, and one of the first for any infrastructure system.

RAPID/Collaborative Research: The Forgotten Aspects of Evacuation: Mass Evacuee Processing and Care by Host Communities Following the Haiti Earthquake

Principal Investigator: Sudha Arlikatti, University of North Texas

Co-PIs: Joanne Nigg, University of Delaware, and James Kendra, University of North Texas

Funding Agency: National Science Foundation

This project researches the hosting of evacuees in the Miami area from the January, 2010 earthquake in Haiti. The field team is interviewing public and non-profit decision makers and analyzing agency reports and news media accounts. In May of 2010 James Kendra and Sudha Arlikatti (University of North Texas) and Manuel Torres (University of Delaware) traveled to the Miami area for interviews and site visits.

Principal research questions included:

- What procedures were used to identify airlift passengers from Haiti or the Dominican Republic bound for the US?
- What organizations/agencies are providing processing and services in the cities receiving an influx of displaced Haitian earthquake survivors? What specific services are needed?
- Are these organizations and agencies adopting new roles or expanding their normal activities in the processes of receiving and providing services for evacuees?
- What are the key issues surrounding inter-organizational or inter-governmental coordination in the processes of evacuation and invacuation?

zational or inter-governmental coordination in the processes of evacuation and invacuation?

- Has improvisation occurred among these agencies/organizations when solving expected and/or emerging needs?

Preliminary findings include:

- Organizations reported the importance of prior experience and (for the most part) familiarity with each other.
- Organizations reported the utility of the Incident Command System
- Organizations reported lack of a federal lead agency as introducing ambiguity. Our document search suggests there were multiple “leads.”
- Congruence of Florida and FEMA ESF structures likely assisted in multiorganizational coordination.
- Local NGOs reported local challenges in assisting non-citizen evacuees.
- Economic conditions in Florida negatively affected the ability of families to assist evacuees and to send money to Haiti.

RAPID: San Bruno, CA Sept. 9, 2010 Gas Pipeline Explosion and Fire

Principal Investigator: Rachel Davidson

Co-PIs: James Kendra, Disaster Research Center and David McEntire, University of North Texas

Graduate Research Assistant: Sizheng Li

Funding Agency: National Science Foundation (NSF) RAPID Program

On September 9, 2010, in San Bruno, California, a suburb of San Francisco, a 30-inch steel natural gas pipeline exploded in flames, igniting a fire that ultimately killed seven residents and damaged or destroyed dozens of houses. In this RAPID project, we are studying the San Bruno explosion and fire with the aims of (a) improving understanding of how urban fires spread and are suppressed, (b) supporting development and validation of

next-generation urban fire simulation models, and (c) advancing theories of resilience. An interdisciplinary field team will gather data that will provide a holistic account of the event across the engineering and social sciences. In particular, the team will examine the composition and distribution of structures, rate and means of fire spread, local topography and weather conditions, and elements of multi-organizational coordination and decision making.

Resilience of Transportation Corridors during Disaster

Principal Investigator: Tricia Wachtendorf

Senior Personnel: Joseph Trainor

Graduate Research Assistant: Ben Johnson

Undergraduate Research Assistants: Austin Barlow, Joshua Kelly, Samantha Penta

Funding Agency: University Transportation Center, University of Delaware

Transportation corridors are vital in allowing for public and commercial mobility. When these corridors are compromised during a disaster, the way in which emergency response networks function is critical to ensuring continuity or resumption of the transportation flow. Inter-organizational coordination is central to an effective disaster response and may require interaction across jurisdictions, timely exchange of information, and provision of personnel or material resources. This study examines how multi-organizational actors/agencies expect and are expected to interact during a transportation corridor disaster. Using social network analysis, researchers will examine the codified and

actor-anticipated interaction in maintaining the continuity of transportation flows along the I-95 corridor in Delaware.

The study works to:

- Provide information to facilitate planning and management of response in Delaware and the surrounding states;
- Increase our understanding of social response networks in place during corridor disasters which may have applicability in other geographic areas;
- Generate results useful in the development of socio-technical systems to improve communication and coordination during corridor disasters.

Technology, Weather Forecasts, and Warnings: Integrating the End-user Community

Principal Investigator: Joseph Trainor

Graduate Research Assistants: Danielle Nagele, Brittany Scott, Lucia Velotti

Undergraduate Research Assistants: Andrea Fendt, Caitlin Gruber, Precious Morris

Funding Agency: National Science Foundation (NSF) Engineering Research Center for the Collaborative Adaptive Sensing of the Atmosphere (ERC-CASA)

Through research, scientists at the Disaster Research Center are contributing to the end user integration efforts of the Center for Collaborative Adaptive Sens-

ing of the Atmosphere (CASA) by exploring the social and human dimensions of severe weather forecasts and warnings. CASA is an Engineering Research Center

(ERC) within NSF's Directorate for Engineering that focuses on the development of revolutionary sensing technology that will enable earlier and more accurate forecasts of severe weather events. The aim of CASA is to design the necessary infrastructure to sense, analyze, and predict lower atmospheric events and to respond to potentially hazardous phenomena in order to significantly reduce their impact on society. More accurate and reliable weather forecasts and warning systems (based on the technology proposed by CASA researchers) may lead to improved disaster mitigation, preparedness, and response initiatives. Social scientists in the CASA project are focusing their research efforts on examining how improved forecasting can reduce the exposure and vulnerability of individuals and property to everyday and extreme weather events. Specifically, through the use of survey methodology, focus groups, face-to-face in-depth interviews, and phone interviews using DRC's CATI (Computer Assisted Telephone Interviewing) system we are examining how the end-user community

members access, utilize, and respond to weather forecasts. We also seek to explore their knowledge and interests concerning weather forecasting issues, attitudes towards climatological information, and their needs and interests in relation to the use of meteorological information. We aim to answer a variety of questions, including: What are the primary sources of weather information used by emergency management agencies?; How much confidence do these end-users have in this type of information?; According to the end-users, how reliable are weather forecasts and warnings?; How does climatological information affect the decision-making processes of this community of end-users?; and finally, How does the public respond to and interpret warnings? To collect data on the public, we launched a CATI survey in June 2008 and continued collecting data during the 2009 and 2010 tornado seasons. During 2011 we focused on cleaning and analyzing that data as well as contributing to new programs evolving in CASA including the Dallas Fort Worth Test Bed.

Recently Completed Projects

DRU: Integrated Optimization of Evacuation and Sheltering for Hurricanes

Principal Investigator: Rachel Davidson

Co-PIs: Tricia Wachtendorf, Disaster Research Center, and Linda Nozick, Cornell University

Post-doctoral Research Associate: Pruttipong Apivatanagul

Undergraduate Research Assistant: Geoffrey Dilg

Funding Agency: National Science Foundation-HSD

This project sought to improve understanding of and decision support for evacuation and mass care sheltering in hurricanes. In the past, math modeling in this application has been limited to estimating the time required to clear a region, assuming many characteristics of the problem are uncontrollable input (e.g., where shelters are located). Instead, we expanded the decision frame and used optimization models to support the full range of strategic and operational evacuation and sheltering decisions with higher-level objectives such as minimizing life loss, cost, and inequity. These models were developed through a tight interaction between sociologists and engineers to ensure that they were firmly grounded in the reality of people's behavior. For the first time, the models were based on individual hurricane scenarios instead of conservative aggregations of many events

and they were dynamic, accounting for the fact that officials can update their decisions as an event unfolds and information about the situation changes. The project had 5 main steps: (1) determine a suite of hurricane scenarios for use in evacuation and shelter models such that they probabilistically represent the full range of possible events, but are limited in number enough to allow detailed analysis with each; (2) conduct focus groups of key decision makers and stakeholders to identify and characterize key decision making elements; (3) using the focus group input, develop long-term strategic mathematical optimization models for evacuation and sheltering decisions; (4) conduct surveys of affected citizens to test the validity of the optimization model assumptions and results; and (5) demonstrate the models with case study applications in North Carolina.

RAPID: Assessing Community-scale Disruption and Restoration of Basic Needs in Post-earthquake Haiti

Principal Investigator: Ronald T. Eguchi, Imagecat, Inc.

Senior Personnel: Rachel Davidson, Disaster Research Center, Beverley Adams, Imagecat, Inc.,

Stephanie Chang, University of British Columbia, and Arleen Hill, University of Memphis

Graduate Research Assistant: Susan Brink

Funding Agency: National Science Foundation (NSF) RAPID program

In this RAPID project, we conducted fieldwork and analysis aimed at better understanding the nature of the relationship between physical damage in disasters and socio-economic disruption on the community scale. Specifically, we sought to examine how building damage can be used to predict the severity of disruption to a community's social fabric and economy. What is the relationship between physical damage and community disruption? Is there a damage threshold beyond which an event becomes a catastrophe? How does the damage-disruption relationship change over time during the response and restoration phases? The project included two specific objectives: (1) gather perishable data describing physical damage and disruption at the community level

following the Haiti earthquake—this included satellite and aerial imagery, Pictometry data, GPS-referenced street-view video and photographs (VIEWS data), and responses from semi-structured interviews with knowledgeable NGO staff; and (2) analyze the relationship between community-scale physical damage and disruption over space and time. The project was undertaken through three main tasks: (1) collecting remote sensing imagery and Pictometry data; (2) collecting field data through a deployment of the VIEWS system and a series of semi-structured interviews with NGO personnel; and (3) using the data collected in this study and previously to develop estimates of community-scale damage and disruption and to examine their relationship.

Reporting for Duty: Selected Workforce Issues in Disasters

Principal Investigator: Joseph E. Trainor

Senior Personnel: Lauren Barsky

Graduate Research Assistants: Ziqiang Han, Yvonne Rademacher, Ben Walker, Eva Wilson

Undergraduate Research Assistant: Andrea Fendt

Funding Agencies: Virginia Department of Emergency Management, University of Virginia

This project was a small portion of a larger study entitled *Behavioral Aspects of Sheltering and Evacuation Planning for the National Capital Region* conducted by the University of Virginia on behalf of the Virginia Department of Emergency Management. As part of this effort, researchers at DRC reviewed published reports and study findings related to workforce during disasters. In particular we are focused on summarizing the state of knowledge related to 1) role conflict and role abandonment and 2) convergence. Our intent was to provide a

report that uses plain language to explain what social scientists have learned about these issues and to provide emergency managers with recommendations on how they might adjust their plans and policies based on the findings.

DRC personnel collected, catalogued, and reviewed approximately 200 articles and papers related to this topic and wrote the final report. We expect to use the results to develop an academic review and presentations of the material.

Research Experience for Undergraduates (REU) Program: Training the New Generation of Disaster Researchers

Principal Investigators: Havidán Rodríguez and Joanne Nigg

Faculty Mentors: Tricia Wachtendorf, Benigno Aguirre, Sue McNeil, Joseph Trainor, Rachel Davidson, and Earl Lee II, Disaster Research Center, and Walter Díaz, University of Puerto Rico-Mayagüez (UPRM)

Graduate Research Assistant: Lauren Barsky

Undergraduate Research Assistants: Brittany Scott, Kathleen Shea

Funding Agencies: National Science Foundation (NSF), U.S. Department of Defense and University of Delaware

The National Science Foundation originally funded the University of Delaware's Disaster Research Center (DRC) to establish a Research Experience for Undergraduates (REU) site to engage ten (10) undergraduate students in hands-on research training to enhance their understanding of the social science aspects of disasters for three years beginning in the summer of 2005. A renewal of this funding was received in 2008 to continue the program for an additional three years through 2011. Each summer during the funding period, a nine (9) week research training institute was held at DRC to provide students with the necessary academic background, training, and relevant research experiences to prepare them to function as relatively independent research scholars. Course models focused on research methodology, social

science approaches to understanding the causes and consequences of disasters, and ethical implications of the research process. Students worked with leading scholars and researchers on state-of-the-art research projects that focused on issues such as disaster mitigation, preparedness, response, recovery, vulnerability, and resilience. A multi-disciplinary group of leading disaster researchers and practitioners participated in the Invited Speaker Series in order to emphasize the contributions that other disciplines bring to this field. A series of professional development and social-cultural activities complemented the trainees' overall education and training. Recently, the REU added students from engineering, as well as from India and Sweden, making the REU an interdisciplinary program with an international component.

Resiliency of Transportation Corridors before, during, and after Catastrophic Natural Hazards

Principal Investigators: Sue McNeil, Disaster Research Center, Joanne Nigg, Disaster Research Center, and Tracy DeLiberty, Geography Department, University of Delaware

Graduate Research Assistant: Silvana Croope

Funding Agency: University of Delaware University Transportation Center with funding from U.S. Department of Transportation

The objective of this project was to develop a framework to evaluate the resiliency of transportation corridors before, during, and after a catastrophic event. The project addressed the challenge of working with diverse sets of data that present several problems such as incomplete data, lack of data, data that are too dense for real-time analysis, and data not made available due to homeland security policies. Given these data challenges, we developed the framework using a specific example and then attempted to generalize our findings. We used U.S. 13 in Sussex County, Delaware as the example. U.S. 13 is subject to flooding, and we had access to much of the data DELDOT has available. The evaluation used real-

time emergency event management utilizing data generated from the Transportation Management Center integrated with data from other DELDOT sections and other institutions.

The research served to develop a preliminary framework for a suite of tools to assist agencies to better prepare for, better respond to and better recover from catastrophic events due to natural hazards. The research used existing data, GIS tools and concepts of resiliency to assist in this important area. A technical report and presentation documented the research results and provided direction for further research, development and implementation.

DRC Field Studies

In addition to our regular projects, researchers at DRC have conducted over 695 field studies since the Center's inception, traveling to communities throughout the United States and internationally in the immediate aftermath of disasters. Our work has encompassed a broad range of disaster types. Recent field studies have focused on a number of topics including organization, multi-organizational coordination, behavioral response to disasters, warning and evacuation, and vulnerability.

This section offers a brief list of the field research conducted by DRC faculty and graduate students during the past calendar year.

Location: San Bruno, California
Dates: February, 2011
Researchers: Sizheng Li, Laurie Long (University of North Texas), David McEntire (University of North Texas), and Charles Scawthorn (independent consultant)
Funding Agency: National Science Foundation
Project Title: RAPID: San Bruno, CA Sept. 9, 2010 Gas Pipeline Explosion and Fire
Purpose: The visit was undertaken to interview individuals involved with the response and recovery for this event and to observe the site.

Location: Japan
Dates: Multiple trips in 2011
Researchers: Rachel Davidson and Charles Scawthorn (independent consultant)
Funding Agency: National Science Foundation
Project Title: RAPID: Post-earthquake Fires in the March 2011 Japan Earthquake and Tsunami
Purpose: The visits were undertaken to collect data on the fires that occurred during this event.

Location: Alabama, Tennessee
Dates: May 9–13, 2011
Researcher: Joseph Trainor
Funding Agency: National Weather Service
Project Title: National Weather Service Assessment Team for the April 27, 2011 Historic Tornado Outbreak
Purpose: This field research was conducted to interview forecasters, television meteorologists, emergency managers and the public in order to determine what, if any, improvements could be made to National Weather Service products and procedures in order to improve public safety during tornadoes.

Location: Iwata and Miyagi Prefectures, Japan
Dates: June 17–28, 2011
Researchers: Tricia Wachtendorf and Rochelle Brittingham
Funding Agency: National Science Foundation
Project Title: RAPID: The Tohoku Catastrophe: Volunteers and Non-Profit Organizations in Post-Kobe Japan
Purpose: Participation on Earthquake Engineering Research Institute's (EERI) social science reconnaissance team examining the impacts of the March 11 Great East Japan Earthquake.

Location: Padang, Indonesia
Dates: August 2010–December 2011
Researcher: Susan Brink
Funding Agencies: National Science Foundation Graduate Research Fellowship and University of Delaware Graduate Student International Travel Award
Project Title: Modeling the Interactions between Development and Regional Disaster Risk
Purpose: To collect information regarding the infrastructure in Padang and its development over time as well as details reflecting the impact of the 2009 earthquake on both infrastructure and the building processes. A goal was to collect both qualitative explanations of the trends in building construction as well as quantitative data on the infrastructure itself to use as input for a system dynamics model.

Location: Stewart National Guard Air Force Base, Newburgh, New York
Dates: August 28–September 4, 2011
Researcher: Eva Wilson
Project Title: National Forest Service Support of FEMA Response to Hurricane Irene
Purpose: To conduct research pertaining to the researcher's Master's Thesis regarding the structure and functions of the Federal Emergency Management Agency (FEMA).

Location: Mineral, Virginia, Louisa, Virginia, Culpeper, Virginia, and Washington, D.C.
Dates: September 14–15, 2011
Researchers: James Kendra, Alex Greer, Yvonne Rademacher, and Laura Keeley (Center for Historic Architecture and Design (CHAD), University of Delaware)
Funding Agency: Disaster Research Center
Project Title: Joint Study of the August 2011 Virginia Earthquake
Purpose: DRC deployed a rapid response team with the objective of gathering data to (1) establish a comprehensive assessment of the impact of the earthquake, (2) understand actual versus perceived behavior during/after the event, and (3) identify lessons learned.

Location:	Iwate Prefecture, Japan
Dates:	October 29–November 6, 2011
Researchers:	Alex Greer and Yvonne Rademacher
Funding Agency:	National Science Foundation
Project Title:	RAPID: The Tohoku Catastrophe: Volunteers and Non-profit Organizations in Post-Kobe Japan
Purpose:	To make initial contact and further define the scope of a planned DRC study anticipated for January 2012, which intends to study the engagement of volunteers and volunteer organizations following the Great East Japan earthquake of March 2011. Specifically, as an advance mission, the team was tasked with (1) identifying potential stakeholders to interview; (2) identifying sites to carry out these interviews; and (3) more narrowly defining potential research questions and issues.



Following the 2010 Haiti earthquake, relief efforts included distribution of basic supplies such as blankets and pillows. DRC personnel returned to Haiti several times to conduct follow-up field research on efforts such as these.

(photo by DRC staff)



Scenes from Leogane, Haiti in the wake of the 2010 earthquake that struck Port au Prince and surrounding areas.

(photo by DRC staff)

Education/Mentoring

Students, staff, and faculty affiliated with DRC all play an important role in graduate and undergraduate education at the University. Faculty offer related classes, advise students (as academic advisors and advisors for independent studies and research), and serve on comprehensive exam and dissertation committees; faculty and staff offer professional training sessions for graduate and undergraduate students; and graduate students mentor undergraduates and serve as teaching assistants. The Disaster Research Center has a history of engaging graduate and undergraduate students in research. Although DRC does not admit students, offer classes, or award degrees, faculty teach classes as part of their responsibilities in their home departments, influence academic programs, and also provide instruction through the interdisciplinary M.S. and Ph.D. program in Disaster Science and Management.

This section provides information and examples regarding DRC's efforts to manifest its vision of education and mentoring in a concrete way.

Doctoral Dissertations

Lauren Elyse Barsky

"Framing Responsibility: A Political Economy Approach to Meeting Basic Needs in Disaster." Department of Sociology and Criminal Justice and Disaster Research Center, University of Delaware, Newark, Delaware.

DRC Sponsored Seminars

"Sacrifice Zones: The Front Lines of Toxic Chemical Exposure in the United States." Presented by Steve Lerner, Commonweal, May 12, 2011. Co-sponsored by the University of Delaware Sociology Club.

Graduate Student Achievements

DRC graduate students are typically among the more outstanding graduate students at the University of Delaware and frequently excel within their major discipline. The following graduate students were recognized by the University for their academic achievements with the awards cited or participated in the noted disaster related extra-curricular activities.

Erik Archibald received a University Transportation Center Graduate Fellowship.

Eric Best was awarded a National Science Foundation/University of Delaware RAISE fellowship to study research ethics.

Ray Chang and **Amy Crabill** were both recipients of a \$5,000 Emergency Information Infrastructure Project (EIIP) Scholarship. **Ray** also received a Study Abroad Scholarship from the Ministry of Education, Republic of China (Taiwan) Government.

Alex Greer received a University Graduate Fellowship for the 2011–2012 academic year from the University of Delaware.

Ziqiang Han received the Student Award for Best Research Paper Presentation at the Northeast Conference on Public Administration (NECoPA), October, 2011.

Danielle Nagele was named to the Dean's List.

Maggie Nelan joined members of BonaResponds in Margaretville, New York and Fleischmanns, New York to assist with flood recovery efforts in the wake of Hurricane Irene, September 2–4, 2011. BonaResponds is a volunteer organization affiliated with St. Bonaventure University near Olean, New York, that was created following Hurricane Katrina to provide volunteer disaster recovery support. It continues to provide recovery support following other disaster events.

Yvonne Rademacher received a travel grant from Beijing Normal University to attend the Summer Institute for Advanced Study of Disaster and Risk (SIASDR) at BNU, August 1–12, 2011 in Beijing, China.

Undergraduate Student Achievements

DRC undergraduate students typically achieve high academic standards and participate in various academic and professional organizations as they are relevant to the student's course of study and academic interests. Below is a partial list of undergraduate students along with some of their most recent accomplishments and activities.

Paige Mikstas

- Completed a practicum at the Delaware Emergency Management Agency (DEMA), which included drafting a commodity distribution plan for New Castle County.

Samantha Penta

- American Association of University Professors Outstanding Senior Award
- Inducted into Phi Beta Kappa Honor Society, University of Delaware chapter
- Recipient of the Thomas J. Craven Prize, University of Delaware
- Inducted into Phi Alpha Theta History Honor Society, University of Delaware chapter
- Graduated with Honors, Bachelor of Arts in Sociology and History, Cum Laude Degree with Distinction, Concentrations in Emergency and Environmental Management and United States History
- Successfully completed defense of Senior Thesis entitled "Masculinity on the Hudson: Gendered Representations of the Flight 1549 Response" (Thesis Advisor: Dr. Tricia Wachtendorf)

The following students were also named to the Dean's List:

Austin Barlow

Kristen Dukes

Joseph Duszak

Sophia Elliott

Andrea Fendt

Caitlin Gruber

Paige Mikstas

Samantha Penta

Spencer Schargorodski

Michael Sherman



Former DRC Director and Program Director for UD's Disaster Science and Management Program Sue McNeil (left) stands with Julianna Manniso, the first student to graduate from the recently formed program.

(photo by Mark Manniso)



DRC undergraduate students (from left) Sam Penta, Spencer Schargorodski, and Caitlin Gruber enjoy the DRC summer gathering at Associate Director Tricia Wachtendorf's home.

(photo by DRC staff)



(from left) DRC grad student Alex Greer, Alex's wife Delilah, and DRC grad student Eva Wilson enjoy lunch at the summer gathering.

(photo by DRC staff)

Outreach/Dissemination

DRC is well known in the academic community of disaster researchers as a major force for the development of research methods and theory within the field. This section illustrates our activities aimed at applying or distributing the information and knowledge gained from DRC research projects and institutional history.

Peer Reviewed Publications

The following are publications authored or co-authored by DRC faculty, students and staff that are related to disasters and which have undergone the peer review process. The list is divided according to publication type.

Articles

B. E. Aguirre, Sherif El-Tawil, Eric Best, Kimberly B. Gill, and Vladimir Fedorov

2011. "Contributions of Social Science to Agent-based Models of Building Evacuation." *Contemporary Social Science*, 6(3): 415–432.

B. E. Aguirre, Manuel R. Torres, Kimberly B. Gill, and H. Lawrence Hotchkiss

2011. "Normative Collective Behavior in the Station Building Fire." *Social Science Quarterly*, 92(1): 100–118.

Pruttipong Apivatanagul, Rachel Davidson, Brian Blanton, and Linda Nozick

2011. "Long-term Regional Hurricane Hazard Analysis for Wind and Storm Surge." *Coastal Engineering*, 58(6): 499–509.

Silvana V. Croope and Sue McNeil

2011. "Improving Resilience of Critical Infrastructure Systems Post-disaster." *Transportation Research Record*, 2234: 3–13.

Ziqiang Han

2011. "Introduction to Disaster Research in the United States." *Chinese Social Sciences Today*: 13.

Ziqiang Han, Xiaojiang Hu, and Joanne Nigg

2011. "How Does Disaster Relief Works Affect the Trust in Local Government? A Study of the Wenchuan Earthquake." *Risk, Hazards & Crisis in Public Policy*, 2(4): Article 5.

Ziqiang Han and Joanne Nigg

2011. "The Influences of Business and Decision Makers' Characteristics on Disaster Preparedness—A Study on the 1989 Loma Prieta Earthquake." *International Journal of Disaster Risk Science*, 2(4): 22–31.

Arleen Hill, John Bevington, Rachel Davidson, Stephanie Chang, Ronald Eguchi, Beverley Adams, Susan Brink, Dilnoor Panjwani, Robin Mills, Sarah Pyatt, Matthew Honey, and Paul Amyx

2011. "Community-scale Damage, Disruption, and Early Recovery in the 2010 Haiti Earthquake." *Earthquake Spectra*, 27(S1): S431–S446.

Bas Kolen, Lucia Velotti, Joseph E. Trainor, and Kees van Ruiten

2011. "Case Study: US Experience to Define Safety Standards for Flood Response Planning in the Netherlands." *International Journal of Water Governance*, 3: 53–59.

Anna C. Y. Li, Ningxiong Xu, Linda Nozick, and Rachel Davidson

2011. "Bilevel Optimization for Integrated Shelter Location Analysis and Transportation Planning for Hurricane Events." *Journal of Infrastructure Systems*, 17: 184–192.

Danielle Nagele and Joseph E. Trainor

2011. "Human Response to Tornado Warnings" *HazNet*, 3(1): 12–14.

Yvonne Rademacher

2011. "Outcontracting in Emergency Management: More than a Business Conundrum." *International Journal of Disaster Risk Science*, 2(4): 15–21.

Joseph E. Trainor

2011. "Review of *The Shock of the News: Media Coverage and the Making of 9/11* by Brian Monahan." *Journal of Homeland Security and Emergency Management*: 8(1): 2.

Gabriela Wasileski, Havidán Rodríguez, and Walter Díaz

2011. "Business Closure and Relocation: A Comparative Analysis of the Loma Prieta Earthquake and Hurricane Andrew." *Disasters*, 35(1): 102–129.

Jay Wilson

2011. "Learning from Earthquakes: First Person Reports—Tohoku Japan Earthquake & Tsunami." EERI Tohoku Japan Earthquake & Tsunami Clearinghouse. <<http://www.eqclearinghouse.org/2011-03-11-sendai/2011/06/28/eeriisss-team-government-and-community-response/>>

(Tricia Wachtendorf and Rochelle Brittingham were partnering organization members of the team that produced this publication.)

Book Chapters

John Bevington, Arleen Hill, Rachel Davidson, Stephanie Chang, Alessandro Vicini, Beverley Adams, and Ronald Eguchi

2011. "Measuring, Monitoring and Evaluating Post-disaster Recovery: A Key Element in Understanding Community Resilience." *Proceedings of the 2011 Structures Congress* edited by Dana Ames, Theodore L. Droessler, and Marc Holt. Reston, VA: American Society of Civil Engineers (ASCE).

DRC Preliminary Paper Series

Morteza Tabatabaie Shourijeh, Jamshid Laghaei, Eric Best, Leslie Nii Odartey Mills, Ardeshir Faghri, and Khaled Hamed.

2011. "Risk Analysis of Oil Spill in the Delaware River and Bay." Preliminary Paper No. 367.

Pat Young

2011. "Objects of Value: Addressing Emergency and Disaster Mitigation, Preparedness, Response and Research in Libraries and Archives." Preliminary Paper No. 366.

Other Publications

The following are lists of publications authored or co-authored by DRC faculty, students, and staff generated by DRC-conducted research projects or which represent writings within the recognized area(s) of expertise for the author or authors.

Books and Monographs

E. L. Quarantelli and Ian Davis

2011. *An Exploratory Research Agenda for Studying the Popular Culture of Disasters (PCD): Its Characteristics, Conditions, and Consequences*. Newark, DE: Disaster Research Center. Book and Monograph No. 35. Available online at <http://dspace.udel.edu:8080/dspace/handle/19716/5968>

Miscellaneous Reports

Joseph E. Trainor and Lauren E. Barsky

2011. "Reporting for Duty? A Synthesis of Research on Role Conflict, Strain, and Abandonment among Emergency Responders during Disasters and Catastrophes." Report to the Virginia Department of Emergency Management. Miscellaneous Report No. 71.

Lucia Velotti, Karen Engel, Jeroen Warner, and Bart Weijs

2011. "Meeting Communities Where Communities Meet: Borgharen and Itteren, Maastricht, The Netherlands." Miscellaneous Report No. 73.

Tricia Wachtendorf and Rochelle Brittingham

Great East Japan (Tohoku) Earthquake Reconnaissance Team, Earthquake Engineering Research Institute (EERI)

2011. "Learning from Earthquakes: The March 11, 2011, Great East Japan (Tohoku) Earthquake and Tsunami, Societal Dimensions." EERI Special Earthquake Report. (Tricia Wachtendorf and Rochelle Brittingham, Team Members.) Miscellaneous Report No. 72.

This year DRC also launched its new semi-annual newsletter, *DRC Dispatch*, with its inaugural issue in December.

Presentations at Professional Conferences

DRC personnel regularly participate in conferences and professional meetings that contribute to the field. Below are lists of these activities.

Paper Presentations

Eric Best

"Visual and Social Displays in Simulation Environments." Presented at the University of Delaware Graduate Forum, May 6, 2011, Newark, Delaware.

"Incorporating Social Behavior Elements in Disaster Simulation Models." Presented at the Natural Hazards Workshop, July 9–12, Broomfield, Colorado.

"Smartphone Location Data: A Single User's Journey." Presented at the International Research Committee on Disasters Researchers Meeting, July 13, 2011, Broomfield, Colorado.

John Bevington, Arleen Hill, Rachel Davidson, Stephanie Chang, Alessandro Vicini, Beverley Adams, and Ronald Eguchi

“Measuring, Monitoring and Evaluating Post-disaster Recovery: A Key Element in Understanding Community Resilience.” Presented at the ASCE Structures Congress, April 14–16, 2011, Las Vegas, Nevada.

Susan Brink and Rachel Davidson

“Evolving Regional Natural Disaster Risk in the International Development Context.” Presented at the Society for Risk Analysis Annual Meeting, December 4–7, 2011, Charleston, South Carolina.

Rochelle Brittingham

“Disaster and Disability: Preliminary Findings Following the 2011 Tohoku Earthquake and Implications for the United States.” Presented at the International Research Committee on Disasters Researchers Meeting, July 13, 2011, Broomfield, Colorado.

“Special Needs or Civil Rights: Evacuation and Sheltering Concerns for the Functionally and Developmentally Impaired.” Presented at the Eastern Sociological Association’s 10th Conference: Social Relations in Turbulent Times, September 7–10, 2011, Geneva, Switzerland.

“The Japan Earthquake: Disaster and Disability: Preliminary Findings Following the 2011 Tohoku Earthquake and Implications for the U.S.” Presented at the 1st International Network on Risk, Crisis and Disaster Video Conference, October 22, 2011, Newark, Delaware.

Amy Crabill and Yvonne Rademacher

“Increasing Whole Community Accountability: Building Confidence in Emergency Services by Communicating Government Limitations.” Presented at the Northeast Conference on Public Administration (NECoPA), October 28–29, 2011, New York, New York.

Rachel Davidson, Pruttipong Apivatnanagul, Linda Nozick, and Tricia Wachtendorf

“Risk-based Regional Hurricane Evacuation Planning.” Presented at the Society for Risk Analysis Annual Meeting, December 4–7, 2011, Charleston, South Carolina.

Alex Greer

“Earthquake Preparedness and Response: A Comparison of the United States and Japan.” Presented at the International Research Committee on Disasters Researchers Meeting, July 13, 2011, Broomfield, Colorado.

“Earthquake Preparedness and Response: A Comparison of the United States and Japan.” Presented at the Northeast Conference on Public Administration (NECoPA), October 28–29, 2011, New York, New York.

Yeliang Han, Rachel Davidson, Guofeng Su, and Hongyong Yuan

“An Efficient Simulation-based Seismic Hazard Analysis Method.” Presented at the 3rd International Conference on Risk Analysis and Crisis Response, May 22–25, 2011, Laredo, Texas.

Ziqiang Han

“How Does Disaster Relief Works Affect Trust in Local Government in Rural China?—A Study after the Wenchuan Earthquake in 2008.” Presented at the International Research Committee on Disasters Researchers Meeting, July 13, 2011, Broomfield, Colorado.

“The Long-term Influences of Business and Decision-makers’ Characteristics on Disaster Preparedness—A Study on the Loma Prieta Earthquake.” Presented at the International Research Committee on Disasters Researchers Meeting, July 13, 2011, Broomfield, Colorado.

“How Does Disaster Relief Works Affect the Trust in Local Government?” Presented at the Northeast Conference on Public Administration (NECoPA), October 28–29, 2011, New York, New York.

Samantha Penta

“Independent Student Research Conducted Through Summer Scholars Program.” Presented at the Undergraduate Session, Geis Student Research on Women Conference, April 9, 2011, Newark, Delaware.

“Miracle on the Hudson and the Making of Masculinity: Gender and the Social Construction of Disaster.” Presented at the Society for the Study of Social Problems (SSSP) Annual Meeting, August 19–21, 2011, Las Vegas, Nevada.

Invited Presentations

Rachel Davidson

“A New Approach to Regional Hurricane Evacuation and Sheltering.” Presented at the NCEM, NWS, ECU Hurricane Workshop, May 18–19, 2011, Greenville, North Carolina.

“Disaster Risk Reduction: An Engineering Perspective.” Presented at the National Science Foundation Workshop for a Cross-disciplinary Program for Disaster Resilience, Vulnerability, and Risk Reduction, June 1–3, 2011, Arlington, Virginia.

“An Urban Fire Simulation (UFS) Model.” Presented at NIST: Urban and Wildland-Urban Interface (WUI) Fires: A Workshop to Explore Future Japan/USA Research Collaborations, June 27, 2011, Gaithersburg, Maryland.

Joshua Kelly, Sudha Arlikatti, James Kendra, Joanne Nigg, and Manuel Torres.

“The Challenges for Unconventional Response Agencies in Serving Haitian Earthquake Survivors: The Needs in NIMS Training and Practices.” Presented at the International Research Committee on Disasters Researchers Meeting, July 13, 2011, Broomfield, Colorado.

James Kendra

“Disciplinary Perspectives on Resilience.” Panelist presentation at the Natural Hazards Workshop, July 9–12, 2011, Broomfield, Colorado.

Sarah Knosp, Sudha Arlikatti, James Kendra, Joanne Nigg, and Manuel Torres

“Role of NGOs in Assisting Post-earthquake Haitian ‘Invacuees’ to the US: Compensating or Complementing?” Presented at the International Research Committee on Disasters Researchers Meeting, July 13, 2011, Broomfield, Colorado.

Scott Knowles and James Kendra

“The Emergency Managers: A Profession on the Edge.” Presented at the International Research Committee on Disasters Researchers Meeting, July 13, 2011, Broomfield, Colorado.

Sizheng Li, Rachel Davidson, and Selina Lee

“Recent Advances in Post-earthquake Fire Modeling: An Urban Fire Simulation Model (UFS).” Presented at the 2011 PEER Annual Meeting, Fire & Lifelines Session, October 1, 2011, Berkeley, California.

William Lovekamp and Joseph Trainor

“Trends in Contemporary Disaster Dissertations.” Presented at the FEMA in Higher Education Conference, June 9, 2011, Emmitsburg, Maryland.

“Trends in Contemporary Disaster Dissertations.” Presented at the American Sociological Association (ASA) Annual Meeting, August 20, 2011, Las Vegas, Nevada.

Sue McNeil and David Ames

“Understanding the Impacts of Climate Change on the I-95 Corridor in Maryland and Delaware.” Presented at the UD-UTC Brown Bag, September 28, 2011, Newark, Delaware.

Tony Subbio and Joseph Trainor

“Issues in Disaster Science and Management.” Presented at the FEMA in Higher Education Conference, June 9, 2011, Emmitsburg, Maryland.

Joseph Trainor

“Warning and Alert in the United States: Systems and Behavioral Response.” Presented at the Netherlands-United States Water Crisis Research Network (NUWCRen) Symposium, May 3, 2011, Den Haag, Netherlands.

“Reporting for Duty.” Presented at the National Capital Region Emergency Managers Committee meeting, July 6, 2011, Washington, D.C.

“Reporting for Duty.” Presented at the National Capital Region Fire Chiefs Committee meeting, July 7, 2011, Washington, D.C.

“Do False Alarm Rates Lead to Desensitization?” Presented at Weather Ready Nation: A Vital Conversation, December 13, 2011, Norman, Oklahoma.

Joseph Trainor and Lucia Velotti

“Catastrophe and the Construction of Safety: What Haven’t 9/11, Katrina and Japan Taught Us?” Presented at the Society for the Study of Social Problems (SSSP) Annual Meeting, August 19–21, 2011, Las Vegas, Nevada.

Lucia Velotti and Joseph Trainor

“How Safe is Safe Enough: Insights on the Administration of Safety.” Presented at the Netherlands-United States Water Crisis Research Network (NUWCRen) Symposium, May 3, 2011, Den Haag, Netherlands.

Tricia Wachtendorf and Rochelle Brittingham

“Learning from Catastrophe: The 2011 Tohoku Earthquake and Tsunami and the Challenges Facing People with Disabilities.” Presented at the Center for Disabilities Studies, University of Delaware, November 14, 2011, Newark, Delaware.

Pat Young

“Building Disaster Information Research Centers: The Disaster Research Center.” Presented at the ACURIL XLI Conference, May 30–June 3, 2011, Tampa, Florida.

“Objects of Value: Addressing Emergency and Disaster Mitigation, Preparedness, Response and Research in Libraries and Archives.” Presented at the ACURIL XLI Conference, May 30–June 3, 2011, Tampa, Florida.

Poster Presentations

Silvana Croope and Sue McNeil

“Improving Resilience of Critical Infrastructure Systems Post-disaster for Recovery and Mitigation.” Presented at the Transportation Research Board Annual Meeting, January 23–27, 2011, Washington, D.C.

Anna C. Y. Li, Ningxiong Xu, Linda Nozick, and Rachel Davidson

“Integrated Shelter Location Analysis and Transportation Planning for Hurricane Events.” Presented at the 2011 Solutions to Coastal Disasters Conference, June 26–29, 2011, Anchorage, Alaska.

Sizheng Li and Rachel Davidson

“Urban Post-earthquake Fire Spread Modeling: Application to the 2007 Grass Valley, California Fire.” Presented at the 10th International Symposium on Fire Safety Science, June 19–24, 2011, College Park, Maryland.

Michelle Oswald and Sue McNeil

“Adaptation to Climate Change: Engineering Sustainability into the Transportation Planning Process.” Presented at Engineering Sustainability 2011: Innovation and the Triple Bottom Line, April 10–12, 2011, Pittsburgh, Pennsylvania.

Morteza Tabatabaie Shourijeh, Jamshid Laghaei, Eric Best, Leslie Mills, and Arde Faghri

“Risk Analysis of Oil Spill in Delaware River and Bay.” Presented at the Transportation Research Board Annual Meeting, January 23–27, 2011, Washington D.C.

In addition, DRC staff members regularly attend various professional conferences and workshops and contribute to the collective knowledge of the disaster research field through their attendance. Below is a partial list of events recently attended.

The Transportation Research Board Annual Meeting, Washington, D.C., January 23–27, 2011. Attended by Samantha Penta.

“Water and Society,” Les Houches, France, May 8–13, 2011. Attended by Danielle Nagale.

The 36th Annual Natural Hazards Research and Applications Workshop, Bloomfield, Colorado, July 9–12, 2011. Attended by Eric Best, Rochelle Brittingham, Alex Greer, Ziqiang Han, James Kendra, Joseph Trainor, and Tricia Wachtendorf.

“The Demography of Disasters: Informing Recovery Decisions” luncheon briefing by the Population Association of America and the Association of Population Centers along with the Office of Congressman David Price, Washington, D.C., July 18, 2011. Attended by Benigno Aguirre.

“Science: Becoming the Messenger” workshop hosted by the National Science Foundation, Newark, Delaware, July 21, 2011. Attended by Alex Greer.

The Summer Institute for Advanced Study of Disaster and Risk, Beijing Normal University, Beijing, China, August 1–12, 2011. Attended by Ziqiang Han.

National Academy of Science’s Summit for Managing Extreme Events, Washington, D.C., September 7–9, 2011. Attended by Rachel Davidson.

NECoPA (Northeast Conference on Public Administration) “Building Trust and Confidence in Public Service” at John Jay College of Criminal Justice, New York, New York, October 28–29, 2011. Attended by Amy Crabill, Alex Greer, Ziqiang Han, and Yvonne Rademacher.



DRC graduate student Eric Best presenting at UD’s Graduate Student Forum.

(photo by DRC staff)

DRC in the News

DRC events and activities were publicized regularly throughout the calendar year by the University's electronic newsletter, *UDaily*. The following are the news stories for 2011 along with their Web URLs:

"After the Disaster"

DRC Associate Director Tricia Wachtendorf and Graduate Research Assistant Rochelle Brittingham were two members of an Earthquake Engineering Research Institute (EERI) reconnaissance team that traveled to Japan following the devastating earthquake and tsunami that occurred in March, 2011. This article highlights their research and findings.

Available online at <http://www.udel.edu/udaily/2012/aug/disaster-research-japan-083111.html>

"Homecoming Spirit"

DRC students, faculty and staff showed their University spirit during UD's Homecoming Spirit competition and were recognized for their efforts with the "People's Choice Award" through university-wide popular voting.

Available online at <http://www.udel.edu/udaily/2012/nov/alumni-award-111411.html>

"RAISE-ing the Bar on Research Ethics"

The Responsibility and Integrity in Science and Engineering (RAISE) program funds and trains advanced graduate students as "ethics educators" to provide peer instruction. DRC Graduate Research Assistant Eric Best was among those students participating in this program.

Available online at <http://www.udel.edu/udaily/2012/oct/raise-research-ethics-102411.html>

"They Will Respond"

This article highlighted research conducted by DRC Core Faculty member Joseph Trainor and DRC Graduate Research Assistant Lauren Barsky which analyzed whether or not emergency responders would be willing to report for duty in the case of a catastrophic disaster.

Available online at <http://www.udel.edu/udaily/2012/aug/disaster-first-responders-081811.html>

"UD's Kirby, McNeil Recognized for Industry Expertise"

Sue McNeil, Professor in Civil and Environmental Engineering and in the School of Public Policy and Administration as well as DRC Core Faculty member, was honored by the American Society of Civil Engineers (ASCE) for exceptional career contributions to her field.

Available online at <http://www.udel.edu/udaily/2011/mar/ASCE-career-contributions030311.html>

The research work of Associate Director Tricia Wachtendorf and Graduate Research Assistant Rochelle Brittingham was also highlighted in an article titled “Tiny Sensors, New Software May Help Predict Earthquakes” by Karen B. Roberts which appeared in the *University of Delaware Messenger* and discussed research connected with the Japan earthquake and tsunami being conducted by UD scientists.

Article available online at <http://www.udel.edu/udmessenger/vol19no3/stories/research-tauffer.html>

Sue McNeil, professor of Civil and Environmental Engineering, was awarded the ASCE Transportation and Development Institute’s 2011 Harland Bartholomew Award for her pioneering contributions to the redevelopment of brownfield sites and for infrastructure management education and research. She was recognized in the August, 2011 issue of the *University of Delaware Messenger*.

Article available online at <http://www.udel.edu/udmessenger/digital/vol19no2/index.html>

Associate Director Tricia Wachtendorf was also interviewed by the University of Delaware’s Student Television 49 News on March 23 for a story titled “Impacts and Responses to the March 11, 2011 Tohoku Earthquake and Related Disasters in Japan.”

In addition to regular inclusion in the *UDaily*, DRC staff members were also contacted for expert opinions that appeared in outside public media sources. The following are examples of these DRC appearances.

“Charting the Right Course.” Ken Mammarella, *The [Wilmington, Delaware] News Journal*.

Growing up on a sailboat and traveling the world helped to prepare DRC Graduate Research Assistant Susan Brink for her research abroad, including field work in Haiti following the 2010 earthquake. Her experiences are highlighted in this article.

“DE Forest Service Team Sent to NY State for FEMA Hurricane Response.” Mari Lou, WGMD News.

This brief article describes the efforts of a 20-member crew from the Delaware Forest Service deployed to New York in the wake of Hurricane Irene. The team included DRC Graduate Research Assistant Eva Wilson who was also conducting preliminary research on the trip for her doctoral dissertation.

Article available online at <http://www.wgmd.com/?p=33945>

“Do People Fail to Respond to Tornado Warnings?” Amina Khan, *The Los Angeles Times*.

The research work of former DRC Graduate Research Assistant William Donner and Graduate Research Assistant Jenniffer Santos-Hernandez is featured in this article which explores the effectiveness of tornado warnings. The article was prompted by the violent tornado that ravaged Joplin, Missouri, in May, 2011.

Article available online at <http://articles.latimes.com/2011/may/26/news/la-heb-joplin-tornado-missouri-20110524>

“From 9/11 to Now: Lessons from the Tragedy.” National Science Foundation press release.

Both Director James Kendra and Associate Director Tricia Wachtendorf were among those interviewed for this article and accompanying video describing NSF-funded research conducted following the terrorist attacks of September 11, 2001.

Article and video links available online at http://www.nsf.gov/news/news_summ.jsp?cntn_id=121605

“Japan’s Disaster Preparedness.” Anna Maria Tremonti, *The Current*, CBC Radio.

This audio interview with DRC Associate Director Tricia Wachtendorf discusses Japan’s disaster preparedness as reflected in the events surrounding the earthquake and subsequent tsunami and nuclear plant failure of March, 2011.

Audio link available online at <http://www.cbc.ca/thecurrent/episode/2011/03/14/japans-disaster-preparedness/>

“Risque Contre Catastrophe: Le Choc des Cultures.” Cécile Dehesdin, *Slate* (French version).

DRC Associate Director Tricia Wachtendorf was interviewed for this online article exploring the impact of the March, 2011, earthquake and tsunami on the Japanese culture.

Available online at <http://www.slate.fr/story/35507/culture-risque-culture-catastrophe>

“Sociology in the Storms.” Libby A. Nelson, *Inside Higher Ed*.

This article which includes quotes from DRC Associate Director Tricia Wachtendorf, describes the role of sociologists in the aftermath of disasters as analysts and scientists gathering information to mitigate the impact of future disaster events.

Article available online at http://www.insidehighered.com/news/2011/08/29/sociologists_of_disaster_see_research_in_storms

“UD Scientist Gauges Impact of Tsunamis on East Coast: Big Waves Rare, but Still a Danger.” Mike Chalmers, *The [Wilmington, Delaware] News Journal*.

DRC Director James Kendra was interviewed for this article discussing vulnerability to a tsunami on the East Coast of the U.S. and specifically along the Delaware shoreline in light of the events that occurred in Japan just a day before the article’s publication.

“University of Delaware’s Disaster Research Head Set to Aid Japan Following ‘Catastrophe.’” Todd Quinones, CBS 3, Philadelphia.

In a brief interview, DRC Director James Kendra reflected on the situation in Japan following the March, 2011 earthquake and tsunami and noted that a research trip was being organized to the impacted regions.

Story available online at <http://philadelphia.cbslocal.com/2011/03/11/university-of-delawares-disaster-research-head-set-to-aid-japan-following-catastrophe/>

“The Untold Story of Ground Zero Evacuations by Boat.” Jessica DuLong, *The Huffington Post*.

This article described in detail some of the events that occurred as part of the waterborne evacuation of lower Manhattan following the terrorist attacks of September 11, 2001. The article also notes the upcoming release of a book by Director James Kendra and Associate Director Tricia Wachtendorf based on their research of this event.

Article available online at http://www.huffingtonpost.com/jessica-dulong/the-untold-story-of-ground_b_955893.html

“When Explaining Science is a Matter of Life and Death.” Francis X. Rocca, *The Chronicle of Higher Education*.

Core Faculty member Benigno E. Aguirre was among those interviewed for this article which discussed the trial of Italian seismologists accused of being responsible for the fatalities that occurred during the L'Aquila earthquake in April of 2009. The situation highlights the risks taken on by researchers going public when an emergency looms.

Article available online at <http://chronicle.com/article/When-Explaining-Science-Is-a/129274/>



DRC graduate student Ziqiang Han (in gray sweatshirt, right) takes notes as he observes the disaster drill conducted by the Nursing Department at the University of Delaware. DRC students provided feedback regarding nursing student performance during the drill.
(photo by DRC staff)

Visitors to DRC

DRC hosts numerous national and international visitors throughout the year, many of whom come to work with DRC personnel and to utilize the E. L. Quarantelli Resource Collection. In addition, DRC also sponsors a speaker series intended to initiate novel and provocative discussion of disaster related topics.

The following is a list of the visitors to DRC during the past year along with their institutional affiliation.

April

Federica Appotti, Università Politecnica della Marche, Marche, Italy

Carmen Diego Gonçalves, Centro de Estudos Sociais, Laboratório Associado, University of Coimbra, Coimbra, Portugal

June

Chris Webb, Auckland University of Technology, Auckland, New Zealand

July

Mohan Bera, Tata Institute of Social Sciences, Mumbai, India

Bill Donner, Indiana University of Pennsylvania, Indiana, Pennsylvania, USA

Long-term visitors:

Takumi Miyamoto, Graduate School of Human Sciences and Japan Society for the Promotion of Science, Osaka University, Osaka, Japan

Tao Peng, School of Government, Nanjing University, Nanjing, China

Zhengyi (Stone) Shi, Minzu University, Beijing, China



Visiting scholars honored at the DRC August reception included (from left) Takumi Miyamoto, Fang Huang, Zhengyi (Stone) Shi, Mohan Bera, and Tao Peng.
(photo by DRC staff)



DRC staff gather with visiting scholars at the August reception to wish them a fond farewell.
(photo by DRC staff)

Other Disaster-Related Activities

In addition to the activities listed above, DRC faculty, students and staff also participate in a range of activities pertaining to disasters including affiliations with various Boards, serving as reviewers for disaster related journals, etc.

Below is a brief list of affiliations currently held by DRC personnel.

Vicky Becker

- Member, National Council of University Research Administrators
- Member, Society of Research Administrators

Rachel Davidson

- President, Society for Risk Analysis, December 2010–December 2011
- Vice Chair (October 2010–October 2011) and Chair (October 2011–October 2012), Executive Committee, ASCE Technical Council on Earthquake Engineering
- Reviewer, *Earthquake Spectra*, *Natural Hazards*, and *Fire Safety Journal*

Joseph Trainor

- Reviewer, National Science Foundation
- Reviewer, Department of Homeland Security
- Reviewer, *Disasters*, *International Journal of Mass Emergencies and Disasters*, and *Journal of Homeland Security and Emergency Management*
- Co-Coordinator, International Research Committee on Disasters (IRCD) Researchers Meeting

Pat Young

- Vice Chair, Emergency Response Working Group (ERWG), University of Delaware
- Vice Chair, Delaware Disaster Assistance Team (DDAT)



Preparedness efforts prior to Hurricane Irene's arrival on the East Coast were completed ensuring the safety of the Resource Collection from potential storm damage.

(photo by DRC staff)



The E. L. Quarantelli Resource Collection



Pat Young, Resource Collection Coordinator, is seated in the collection space of the E. L. Quarantelli Resource Collection.

(photo by Erna Danielsson, DRC visiting researcher from Mid Sweden University)

Report of Activities

As in recent past years, the E. L. Quarantelli Resource Collection has experienced much activity and growth again this year. As one of the key resources at DRC that supports its ongoing missions of Research, Education/Mentoring, and Outreach/Dissemination, the Resource Collection and its various components continue to enjoy a leading role within the Center as a whole.

Collection Growth and Development

During 2011, 1,155 new items were added to the Resource Collection. Sources included selective purchases, both internal and external donations, methodical compilation of open access Web resources, and utilizing opportunities such as the Surplus Books Program offered by the Library of Congress. DRC continues to practice a careful collection development policy that both supports ongoing research efforts and also enhances the existing collection, now numbering approximately 59,000 items. The Collection continues to provide vital resources and information to disaster researchers at DRC and around the globe.

Those utilizing the Collection in person throughout the year included 49 students from the University of Delaware and across the United States along with our nine visiting researchers from Italy, Portugal, Japan, India, New Zealand, China, and the U.S. Additionally, countless researchers were assisted remotely via Web-based communication avenues.

A relatively new development within the management and oversight of the Resource Collection is enhanced efforts to obtain grant funding for specific preservation and conservation projects. Part of this enhancement was Resource Collection Coordinator Pat Young's completion of the *Grantsmanship and Proposal Writing* graduate course offered at the University of Delaware. Completing the course equipped Pat with skills to seek out and obtain grant funding from diverse sources to support such projects as the preservation of DRC's rare sound recording collection which captures the oral history of the disaster research field from the perspective of several of its founders. DRC looks forward to undertaking more such projects in the future as our capabilities in this area grow.

Resource Collection staff also attended a series of training workshops covering such collection management topics as *Inventory and Assessment*, *Digitization & Preservation Reformatting*, *Disaster Prevention, Planning and Response*, and *Environmental Management for Collecting Institutions* presented by national experts. In this way, we are working toward even better management of the collections that we already have as well as enabling ourselves to expand our broader role in collection care within the greater disaster research community.

Activities of the Resource Collection Staff

This past May, Resource Collection Coordinator Pat Young had the opportunity to address a gathering of international library and archival personnel when she served as the plenary speaker at *ACURIL XLI* for the Association of Caribbean University, Research and Institutional Libraries. The event's theme was *The Role of Libraries and Archives in Disaster Preparedness, Response, and Research* and it afforded Pat a means to share her experiences in working with collections staff across the state of Delaware in the areas of emergency and disaster mitigation, preparedness, response and recovery. The gathering was a wonderful opportunity for exchanging ideas regarding how staff safeguard vital collections in the face of disaster risk and local emergencies.

Pat also continues her active involvement in both the Delaware Disaster Assistance Team (DDAT) and in UD's Emergency Response Working Group (ERWG). She continues to serve as Vice Chair of both organizations as well as coordinating membership activities for DDAT and education and training activities for ERWG. Both organizations address the broad spectrum of emergency- and disaster-related topics that pertain to collections. Additional information on both groups can be found on their respective web sites (DDAT – <http://libraries.delaware.gov/services/ddat.shtml>; ERWG – www.udel.edu/ERWG).

Future plans for the Resource Collection include growing collaborations with established disaster researchers to explore the possibility of DRC serving as a repository for the professional collections of those researchers. We hope that we will be able to formulate procedures that will enable us to provide a lasting home for these intellectually valuable collections. We will also be working diligently to identify new and innovative ways to collect, capture, preserve and provide access to the vital information that has become so integral to the disaster research field and process.



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