BOOK OF ABSTRACTS

Centennial Engineering Center Auditorium
UNM School of Engineering

UNM 2017 Resilience Colloquium

Urban Resilience: Research Gaps and Implementation Roadmap

August 7th – 8th, 2017
Albuquerque, New Mexico

THE UNIVERSITY OF NEW MEXICO

UNM RESILIENCE INSTITUTE

The University of New Mexico
2017 Resilience Colloquium

Urban Resilience: Research Gaps and Implementation Roadmap

August 7th–8th, 2017

Sunday, August 6th, 2017

Santa Fe Trip

8:30 AM – 9:30 AM	Bus to Santa Fe
10:00 AM – 11:30 AM	Walking Tour of Santa Fe
12:00 PM – 1:00 PM	Lunch in Santa Fe
1:00 PM – 3:00 PM	Individual Exploration in Santa Fe
3:00 PM – 4:00 PM	Bus to Albuquerque

Monday, August 7th, 2017

7:15 AM – 8:00 AM — Check-In & Late Registration

7:30 AM – 8:30 AM — Breakfast in Stamm Commons and Courtyard, Centennial Engineering Center

8:00 AM – 8:10 AM — Opening:
Mahmoud Reda Taha, *University of New Mexico*
John Quale, *University of New Mexico*

8:15 AM – 8:45 AM — Welcome:
President Chaouki Abdallah, *University of New Mexico*
Dean Christos Christodoulou, *School of Engineering, University of New Mexico*
Dean Geraldine Forbes Isais, *School of Architecture and Planning, University of New Mexico*

Session 1

1 — 8:50 AM – 9:20 AM — *Disaster Resilience of Infrastructure Systems: Measurement Science and Economics*
Bilal Ayyub, *University of Maryland*

2 — 9:25 AM – 9:55 AM — *Current Practices in Resilience Assessment*
Catherine Fox-Lent, *US Army Engineer Research and Development Center*

10:00 AM – 10:30 AM — Coffee Break in Stamm Commons and Courtyard, Centennial Engineering Center

Session 2

3 — 10:35 AM – 11:05 AM — *Infrastructure Security and Resilience: DHS Initiatives to Bridge Sectors and Scale*
Sarah Gambill, *Department of Homeland Security*

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4	11:10 AM – 11:45 AM	Panel: *Resilience and National Security* *Moderator:* Nancy Brodsky, *Sandia National Labs* *Panelists:* Catherine Fox-Lent, *US Army Engineer Research and Development Center* Sarah Gambill, *Department of Homeland Security* John Organek, *Electric Infrastructure Security*
12:00 PM – 1:00 PM		**Lunch in Stamm Commons and Courtyard, Centennial Engineering Center**

Session 3

5	12:45 PM – 1:15 PM	*Building Black Sky Resilience* John Organek, *Electric Infrastructure Security*
6	1:20 PM – 1:50 PM	*Building Resilient Electrical Power Systems for Community Needs* Robert Jeffers, *Sandia National Labs*
7	1:55 PM – 2:40 PM	Panel: *Resilience of the Power Grid* *Moderator:* Andrea Mammoli, *University of New Mexico* *Panelists:* Ross Guttromson, *Sandia National Labs* Jon Hawkins, *Public Service Company of New Mexico* Robert Jeffers, *Sandia National Labs*
2:45 PM – 3:15 PM		**Coffee Break in Stamm Commons and Courtyard, Centennial Engineering Center**

Session 4

8	3:20 PM – 3:50 PM	*Policies and Planning for Transportation Resiliency* Katherine Turnbull, *Texas A&M University*
9	3:55 PM – 4:25 PM	*Mobile Automated Rovers Fly-By (Mars-Fly) for Bridge Network Resiliency* Nasim Uddin, *University of Alabama at Birmingham*
10	4:30 PM – 5:15 PM	Panel: *Transportation Infrastructure Resilience* *Moderator:* Mahmoud Reda Taha, *University of New Mexico* *Panelists:* Bilal Ayyub, *University of Maryland* Greg Rowangould, *University of New Mexico* Katherine Turnbull, *Texas A&M University* Nasim Uddin, *University of Alabama at Birmingham*
5:20 PM		**Adjourn**

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Tuesday, August 8th, 2017

7:15 AM – 8:00 AM		Check-In & Late Registration
7:30 AM – 8:30 AM		**Breakfast in Stamm Commons and Courtyard, Centennial Engineering Center**

Session 1

1	8:00 AM – 8:30 AM	*Leveraging Experiences in U.S.-Japan Collaboration Projects* Kazunori Nakayama, *Shimizu Corporation*
2	8:35 AM – 9:20 AM	Panel: *Development for Urban Resilience* *Moderator:* John Quale, *University of New Mexico* *Panelists:* Susan Clark, *University at Buffalo* Tadao Hashimoto, *SixPoint Materials* Kazunori Nakayama, *Shimizu Corporation* Sandra Pinel, *Department of Homeland Security*
9:25 AM – 9:55 AM		**Coffee Break in Stamm Commons and Courtyard, Centennial Engineering Center**

Session 2

3	10:00 AM – 10:30 AM	*How Data Science and Visualizations Can Pinpoint Resilience Solutions* Charles Rath, *Resilient Solutions 21*
4	10:35 AM – 11:10 AM	Panel: *Resilience of Cyber Infrastructure* *Moderator:* Eric Vugrin, *Sandia National Labs* *Panelists:* Cedric Carter, *Sandia National Labs* Nicholas Jacobs, *Sandia National Labs* Chris Lamb, *Sandia National Labs*
5	11:15 AM – 11:45 AM	*Las Vegas, Nevada - Resilient, or a Train Wreck Waiting?* John Fleck, *University of New Mexico*
6	11:50 AM – 12:25 PM	Panel: *Resilience of Water Infrastructure* *Moderator:* Mark Stone, *University of New Mexico* *Panelists:* John Fleck, *University of New Mexico* Elizabeth Kistin Keller, *Sandia National Labs* Adrian Oglesby, *Utton Transboundary Resources Center* Caroline Scruggs, *University of New Mexico*
12:30 PM – 1:30 PM		**Lunch in Stamm Commons and Courtyard, Centennial Engineering Center**

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Session 3

7	1:15 PM – 1:45 PM	*A Human-Centered Approach to the Prioritization of Critical Infrastructure Resilience* Susan Clark, *University at Buffalo*
8	1:50 PM – 2:20 PM	*Designing and Building Resilient Communities: An Implementation in Nepal* Lauren Jaramillo, *University of New Mexico*
9	2:25 PM – 3:00 PM	Panel: *UNM4Nepal - Resilience: The Students' Perspective* *Moderator:* Elisa Borowski, *University of New Mexico* *Panelists:* Johnathan Hebert, *University of New Mexico* Lauren Jaramillo, *University of New Mexico* Jenn Osdel, *University of New Mexico* Mark Stone, *University of New Mexico*
2:30 PM – 3:30 PM		**Farewell Coffee Social in Stamm Commons and Courtyard, Centennial Engineering Center**
3:30 PM		**Adjourn**

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DISASTER RESILIENCE OF INFRASTRUCTURE SYSTEMS: MEASUREMENT SCIENCE AND ECONOMICS

Bilal Ayyub, PhD, PE, Dist.M.ASCE

Professor & Director, Center for Technology and Systems Management, Department of Civil and Environmental Engineering, University of Maryland, College Park, MD, USA
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ABSTRACT

Natural disasters in 2011 alone resulted in $366 billion (2011 US$) in direct damages and 29,782 fatalities worldwide. Storms and floods accounted for up to 70% of the 302 natural disasters worldwide, with earthquakes producing the greatest number of fatalities. Managing these risks and others rationally requires an appropriate definition of resilience and associated metrics. This presentation provides a resilience definition that meets a set of requirements with clear relationships to reliability and risk as key relevant metrics. Such metrics provide a sound basis for the development of effective decision- and policy-making methods for multihazard environments for various system types including lifeline, environmental, financial, etc. systems. The presentation also examines recovery, with its classifications based on level, spatial, and temporal considerations. Three case studies are used to gain insights to help define recovery profiles. The economics of resilience is briefly discussed.

BIOGRAPHY

Dr. Ayyub is a University of Maryland Professor of Civil and Environmental Engineering, Professor of Reliability Engineering, and Professor of Applied Mathematics and Scientific Computation. He is also a chair professor at Tongji University, Shanghai, China. Dr. Ayyub's main research interests are risk, resilience, uncertainty, decisions, and systems applied to civil, mechanical, infrastructure, energy, defense and maritime fields. Dr. Ayyub is a distinguished member of ASCE, and a fellow of the Society for Risk Analysis, ASME, and SNAME. Dr. Ayyub completed projects for governmental and private entities, such as NSF, ONR, AFOSR, USACE, DHS, NRC, ASME, Hartford, Chevron, Bechtel, etc. Dr. Ayyub is the recipient of several awards from ASCE, ASNE, ASME, NAFIPS, the Department of the Army, and the Governor of the State of Maryland. He has authored and co-authored more than 600 publications including 8 textbooks and 14 edited books. He is also the Editor-in-Chief of the ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems. Presently, he is the chair of the Infrastructure Resilience Division (IRD) and the Committee on Adaptation to a Changing Climate (CACC) of ASCE.

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CURRENT PRACTICES IN RESILIENCE ASSESSMENT

Cate Fox-Lent

Research Engineer, Risk and Decision Science, Environmental Laboratory
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ABSTRACT

Risk-based analysis methods have been used to mitigate consequences associated with changing environment for centuries, formally or informally, but these approaches are limited in their application in a world of complex global interconnectedness and rapidly emerging technologies. In the absence of the full data needed for risk analysis, resilience has been posited as a supplement. However, whether resilience is an end goal to strive for, a management paradigm, or system property has not been universally established. In this way, resilience struggles from some of the same challenges as sustainability. In many ways, resilience and sustainability can be thought of as complements, but at times they are also antithetical concepts. The same can exist for resilience and "smart" systems. These issues and others must be considered when selecting a resilience assessment method that can inform decision making for urban — and other budget-constrained — systems. Current resilience assessments span a range of approaches, from rapid screening-level methods to highly customized network models. Each approach has advantages and disadvantages and provides different forms of information for the user.

BIOGRAPHY

Cate Fox-Lent is a research engineer with the US Army Engineer Research and Development Center. Her work centers on using decision analytic and geospatial method to inform adaptive ecosystem management, coastal resilience, installation management, and humanitarian assistance.

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INFRASTRUCTURE SECURITY AND RESILIENCE: DHS INITIATIVES TO BRIDGE SECTORS AND SCALES

Sarah Gambill

Chief, Infrastructure Development and Recovery, Office of Infrastructure Protection,
US Department of Homeland Security, Arlington, VA, USA
Sarah.Gambill@hq.dhs.gov

ABSTRACT

The Department of Homeland Security (DHS) Office of Infrastructure Protection (IP) leads the national effort to promote the resilience of critical infrastructure. Critical infrastructure resilience is defined as the ability to prepare for, withstand, adapt to and rapidly recover from changing conditions and acute disruptions (PPD 21). IP has established strong partnerships across all levels of government and the private sector and new programs to enhance security and resilience in the face of changing technological, human, and natural threat environments, the potential for cascading failures across systems, and the complex network of public and private jurisdictions that own and operate these systems. Elements of this approach include: 1) a focus on the entire infrastructure life-cycle from design to long-term operations and recovery; 2) considering multiple hazards and interdependencies; 3) leveraging the expertise of multiple disciplines, academic institutions, and non-governmental partners to develop and share solutions across the federal government; 4) co-leading federal interagency work groups including mitigation and recovery programs; 5) development of tools for communities to consider and address risks in the policy, planning, design, and recovery processes; and 6) expanding regional engagement with planners and state, local, and tribal policy makers.

Resilience initiatives would be advanced by applied research in the areas of regional analysis of spatial and cross-jurisdictional and cross-sector interdependencies to prioritize investment, governance of complex cross-jurisdictional and cross-sector governance, the development of regional resilience indicators, and training professionals to work across complex systems.

BIOGRAPHY

Sarah Gambill is a geographer and Chief of Infrastructure Development and Recovery in the Office of Infrastructure Protection. IP established the Infrastructure Development and Recovery Program (IDR) to work across IP units and the existing infrastructure partnership to promote cross-sector, multi-threat/multi-hazard resilience solutions.

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BUILDING BLACK SKY RESILIENCE

John Organek, PE

Water Sector Coordinator, Electric Infrastructure Security Council, Washington, DC, USA
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ABSTRACT

This presentation addresses how complexity affects resilience to Black Sky hazards that could cause widespread, long-duration power outages.

Our Nation is sustained by complex lifeline infrastructures that produce and provide the resources we need to continue as a society. Virtually everything has become electrified, so loss of the power grid will cascade through all other societal infrastructures. Our inability to understand, protect or manage this complexity creates a vulnerability that places our Nation at risk.

The 16 infrastructures Department of Homeland Security recognizes comprise thousands of decision makers making and executing decisions autonomously to enable the flow of goods and services from source to consumer. Besides becoming increasingly more efficient, these infrastructures have evolved to increasingly greater levels of interdependency, while becoming more deeply embedded in society, creating a co-dependency that could produce catastrophic consequences and place society at risk.

The behavior of this infrastructure collection is both complex and adaptive, meaning this system of systems continuously changes, adapts and evolves as it interacts with its environment, before, during and after a Black Sky event. Infrastructures are not designed but instead evolve, and are not managed from the top down but continuously adapt bottom up, reflecting the decisions of independent actors pursuing their self-interest base on their perception of the evolving environment. Self-organization, emergence and non-linearity that characterize complex systems greatly complicate the process of building the resilience needed to save lives and protect our society.

BIOGRAPHY

As Water Sector Coordinator in the Electric Infrastructure Security Council, Mr. Organek is responsible for coordinating public and private sector efforts that enhance Water Sector resilience to Black Sky hazards. He is also a retired US Army Corps of Engineers Officer with nation-level infrastructure resilience planning experience. His interests include infrastructure modelling, resilience planning, and system of systems engineering.

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BUILDING RESILIENT ELECTRICAL POWER SYSTEMS FOR COMMUNITY NEEDS

Robert Fredric Jeffers, PhD

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ABSTRACT

The electrical power grid has been termed a "capstone" infrastructure for community-level resilience. Nearly every infrastructure that provides services to citizens following a major disruption depends on reliable, efficient electric power. To date, however, resilience within the electric utility community has focused on minimizing the overall number of customers without power, and decreasing the duration of major outages. This presentation will describe the disconnects between this definition of resilience and that of many urban emergency planners. We propose a community-oriented resilience metric that can be internalized by electric utilities and incentivized by regulators. We discuss how this is being employed in New Orleans, Louisiana, and mention the gaps to wider adoption of electric utility resilience services.

BIOGRAPHY

Dr. Robert F. Jeffers is a Senior Member of the Technical Staff at Sandia National Laboratories, where he has contributed as a systems scientist since 2013. Robert has applied techniques such as system dynamics, interactive visualization, agent-based modeling, and spatial network modeling to diverse problems concerning the intersection between human, natural, and engineered systems - particularly energy and commodity systems. He is the technical representative for Sandia's Urban Resilience Initiative, which seeks to apply Sandia's infrastructure modeling and expertise to city-scale resilience problems. Robert began his career as a research scientist at the Idaho National Laboratory, where he served as Principal Investigator on three diverse projects simulating the energy-water nexus, critical material supply chain economics, and novel concepts for integration of intermittent renewable energy on the power grid.

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POLICIES AND PLANNING FOR TRANSPORTATION RESILIENCY

Katherine F. Turnbull, PhD

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ABSTRACT

The safe and efficient operation of the transportation system is critical to the movement of people and goods, supporting the economic vitality and the quality of life in communities, states, and the nation. Ensuring the resiliency of all transportation modes has become even more important recently given more frequent extreme weather events, natural catastrophes, and manmade disasters, as well as the increasing potential of terrorist attacks.

This presentation will describe the need for transportation resilience and will highlight policies and planning tools for transportation resiliency. Examples will address the use of vulnerability assessment frameworks, scenario planning, design changes, asset management strategies, and new operations and maintenance techniques. Areas for additional research will also be discussed.

BIOGRAPHY

Dr. Turnbull is an Executive Associate Director at the Texas A&M Transportation Institute, a part of The Texas A&M University System. She is also an Executive Professor in the Department of Landscape Architecture and Urban Planning at Texas A&M University. Dr. Turnbull maintains a diverse research portfolio for numerous sponsors. Her recent research on transportation resilience includes a multi-state pooled-fund study examining the impact of energy sector developments on the transportation system and serving as the rapporteur for the 2016 and 2017 European Union/United States symposia on transportation resilience, mitigation, and adaptation related to extreme weather events.

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MOBILE AUTOMATED ROVERS FLY-BY (MARS-FLY) FOR BRIDGE NETWORK RESILIENCY

Nasim Uddin, PhD

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ABSTRACT

Recent bridge failures highlight the fact that transportation infrastructure is not resilient under man-made or natural loads, and sensors and algorithms that will monitor its condition and communicate this information to the infrastructure manager are needed for timely intervention and/or resilient recovery from a damaging event. The resiliency of physical systems depends mainly on the strength, recovery, redundancy, and resourcefulness; however, the impact of the redundancy and resourcefulness and the correlation between these parameters are not clearly understood.

Structural Health Monitoring (SHM) is shown to be useful in the diagnosis of structural damage but only tells half of the story. The solution to the bridge safety problem is, therefore, two-fold: control of overloaded trucks, and safety assessment/ monitoring of bridges and their loads. This paper advances an innovative cyber-physical system (CPS) called "Mobile Automated Rovers Fly-by (MARS-Fly) for Bridge Network Resiliency" designed to monitor the health of highway bridges, control the loads imposed on bridges by heavy trucks, and provide visual inspectors with quantitative information for data-driven bridge health assessments. CPS MARS-Fly has the ability to accurately quantify the reduction in the performance, establish priorities and mobilize the resources. The proposed method will also help in identifying damages in wildfire, flood or earthquake affected infrastructures where classical SHM is not feasible without the need for an electrical supply.

BIOGRAPHY

Professor Uddin's research program focuses on high performance resilient and sustainable infrastructure, and structural safety of bridge and building structure. He is currently PI of NSF project: Mobile Automated Rovers Fly-By (MARS-FLY) for Bridge Network Resiliency (NSF-CNS -1645863). He served as the Chair of the Executive Committee of the ASCE Council on Disaster Reduction Management (CDRM). He is the Editor-in-Chief of the ASCE Natural Hazards Review Journal and associated with the leadership of the ASCE Infrastructure Resilience Division (IRD) and UAB Sustainable Smart City Research Center (SSCRC).

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LEVERAGING EXPERIENCES IN U.S.-JAPAN COLLABORATION PROJECTS — INTRODUCTION OF 3 TYPES OF ONGOING PROJECT SCHEMES

Kazunori Nakayama

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Shimizu Corporation, Tokyo, Japan
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ABSTRACT

Shimizu Corporation is a major Architect, Engineering and Construction firm in Japan and has experience in two U.S.-Japan Collaboration Projects in the U.S., one for Zero Energy in NY currently and the other for Micro-grid System in NM in 2012, pursuing the way to contribute to realizing the sustainable and resilient society.

The key factor is technology commercialization to fit into the local conditions and economical viabilities. It is crucial to be connected to people there. Today, three ongoing activities are introduced for discussion how to materialize it in the state of New Mexico.

BIOGRAPHY

Mr. Nakayama joined Shimizu in 1981, graduated from Waseda University in Tokyo, Japan, with a Bachelor of Architecture, Science and Engineering. He is a Class 1 Architect and Building Construction Engineer qualified in Japan, as well as a LEED AP BD&C in the U.S. His work career started in Japanese Domestic construction engineering and management 1981 thru 1990, which included Office, Residential complex, Public Library, Manufacturing Plants, Thermal Power Plant and Private Hospital. He took roles of International construction engineering and management 1990 thru 2006 in 5 countries: Singapore, Australia, Mexico, U.S. and Thailand, for various sectors of projects. (Such as Office/ Commercial High-rise Complex, Industrial facilities). He has been in the current position since April 1, 2006, in charge of developing of the new types of businesses with wider roles of capability, globally and locally (“glocally”).

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HOW DATA SCIENCE & VISUALIZATIONS CAN PINPOINT RESILIENCE SOLUTIONS

Charles Rath

President and CEO, Resilient Solutions 21, Albuquerque, NM, USA
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ABSTRACT

New advancements in technology are revolutionizing the way data and information is analyzed, understood and communicated. Pinpointing the determinants, or root causes, of societal outcomes is essential to improving our collective quality of life. This requires a detailed understanding of the way populations interact with, and are affected by, the social, economic and ecological systems that shape the human experience. Empowered with this knowledge, communities can pinpoint solutions and drive positive outcomes. Big data, analytics and visualization hold the key to addressing this challenge. Over the past decade, the collection and dissemination of data related to physical, social, economic, ecological and behavioral conditions has increased faster than at any point in human history. In parallel, advanced methods such as machine learning, cloud based computing and predictive analytics are creating innovations faster than ever imagined. In addition, the technology to organize the data, analyze it and visualize insights via intuitive interactive platforms has created breakthroughs that unlock possibilities that seemed unattainable just years ago. Charles Rath, the President and CEO of RS21, will showcase the company's latest innovations in web-based interactive decision platforms, but will also provide useful insights about the tools that are being used, the process RS21 is using to create them and the unique blend of experts that are required to translate information into insights.

BIOGRAPHY

Charles R. Rath is the President & CEO of Resilient Solutions 21 (RS21), a global consultancy created to help communities, cities and businesses flourish in today's world. RS21 specializes in creating insightful, web enabled analytics that inform some of the world's most difficult national security challenges. The company's current portfolio of work includes innovative risk and resilience projects with Rockefeller's 100 Resilient Cities Challenge, the US Department of State, US Department of Homeland Security, and cities around the globe. Before starting RS21, Rath led the Resilient Cities Program at Sandia National Laboratories (SNL). Prior to joining SNL, Rath served as Deputy Director in the Department of Homeland Security (DHS), where he built analytic capabilities and delivered risk analysis to decision-makers at the federal and local levels. He regularly speaks globally on issues related to risk and resiliency, with a particular focus on systems thinking and next generation analytics and visualizations.

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LAS VEGAS, NEVADA - RESILIENT, OR A TRAIN WRECK WAITING?

John Fleck

Director, Water Resources Program, University of New Mexico, Albuquerque, NM, USA
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ABSTRACT

Las Vegas has often been viewed as an urbanist's nightmare, a sprawling offence to nature. From a population of just 16,000 in 1940, it has grown to over two million people today, a more than hundred-fold growth in the driest major metropolitan area in the United States. Fake waterfalls and lush foliage around the casinos of Las Vegas's famed gambling strip mask a desert heart. In the early 1990s, Las Vegas seemed headed for a crash, with some 50,000 new residents arriving each a year and a water supply that appeared about to run out. But in the decades since, the Nevada metropolitan area has remade its water management institutions and reframed the community's attitudes toward the scarce resource in a way that offers lessons for cities facing the challenges of resilience in the 21st century.

BIOGRAPHY

John Fleck is Professor of Practice in Water Policy and Governance in the University of New Mexico's Department of Economics and director of the University's Water Resources Program. He specializes in water governance in the Colorado River Basin, and is the author of *Water is for Fighting Over: and Other Myths about Water in the West*, published in 2016 by Island Press.

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A HUMAN-CENTERED APPROACH TO THE PRIORITIZATION OF CRITICAL INFRASTRUCTURE RESILIENCE

Susan Spierre Clark, PhD

Policy & Planning Specialist, RENEW Institute, University at Buffalo, Buffalo, NY, USA
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ABSTRACT

The current approach to infrastructure prioritization in the U.S. involves the identification of 16 critical infrastructure sectors that are considered vital because disruption of these systems would have a debilitating impact on security, the economy, or public health and safety. A risk-based approach is then used to prioritize assets within each sector based on the likelihood of threats and infrastructure vulnerabilities, as well as the potential consequences the nation would face if it were to fail. This view of resilience emphasizes the physical condition of the infrastructure rather than the quality of services provided. However, this emphasis is problematic in so far as infrastructure is not an end unto itself but must be judged relative to its purpose, which is to provide services to the public. While confounding infrastructure resilience with physical condition can help plan maintenance schedules that keep performance standards high relative to known hazards, it is likely to fail when confronted with surprise. A more complete resilience approach would instead recognize the importance of infrastructure's extensibility or adaptive capacity for maintaining functionality in the face of surprise, including the capacity of any sectors to substitute for, reinforce, or pose a threat to other sectors. Dr. Clark will summarize ongoing research that employs human development theory as a lens for reframing critical infrastructure prioritization around the services that systems provide, rather than physical characteristics that sectors share.

BIOGRAPHY

Dr.Clark's research focuses on decision-making for improving the sustainability and resilience of critical infrastructure systems to climate change. Her research emphasizes the social processes that are required for designing, operating, and managing resilient infrastructure systems which allow for disaster aversion through adaptive responses. She also has experience teaching and developing new curriculum and tools for resilience and sustainability education.

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DESIGNING AND BUILDING RESILIENT COMMUNITIES: AN IMPLEMENTATION IN NEPAL

Lauren Victoria Jaramillo, MS

Research Assistant, Civil Engineering Department, University of New Mexico, Albuquerque, NM, USA
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ABSTRACT

Resilient communities are necessary to mitigating loss, damage, and other negative impacts associated with system shocks and stressors, such as natural disasters. The objective of this project was to investigate and demonstrate a holistic design and construction process for building resilient communities in the developing world focusing on earthquake recovery efforts in Nepal. The project included the incorporation of resilience theory into the design and construction process of a small-scale building project. The second and final phase of the project was completed in June 2017 with the construction of a dodecagonal parallel Pratt steel truss roof, exterior flat stone façade wall, and recycled flat stone tile flooring. The circular earthbag structure is in the footprint of an old health clinic that collapsed during the 7.8 magnitude earthquake that struck Nepal in Spring of 2015. A holistic approach was used combining engineering research and resilience theory to develop a sustainable, inexpensive, earthquake-resistant, locally-sourced structure that can be replicated by individuals and other communities. Major aspects of the project were (1) consideration for environmental hazards, social conditions, culture, local sustainable materials, climate, and geography, (2) the use of an analytical hierarchical process (AHP) for evaluating project criteria, and (3) incorporation of diverse local labor force to ensure longevity of the building and training of community members on the construction type and building methods and best-practices.

BIOGRAPHY

Lauren Jaramillo is a graduate researcher and Ph.D. Engineering Student at the University of New Mexico in Hydraulics and Water Resources. Her research focuses are resilient social-ecological systems and the impacts of natural resource management and wildfires on water resources. She a cofounder of UNM4Nepal, a humanitarian engineering student group which has developed and implemented a resilience project and was part of a two-part special topics class taught in the Civil Engineer Department at UNM on designing and building resilient communities.

Conference Organizers

UNM Resilience Institute, University of New Mexico
Dr. Mahmoud Reda Taha, *Chairman*, University of New Mexico
Dr. John Quale, *Co-Chairman*, University of New Mexico
Dr. Eric Vugrin, *Co-Organizer*, Sandia National Laboratories
Dr. David Hadwiger, *Co-Organizer*, New Mexico Department of Transportation
Dr. Mark Stone, *Co-Organizer*, University of New Mexico
Elisa Borowski, *Coordinator*, University of New Mexico
Hope McVeety, *Editorial Assistant*, University of New Mexico
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UNM School of Engineering Dean's Office

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Bohannan Huston

National and international experts on resilience are invited from impactful institutions across the world. This multidisciplinary event will foster communication and collaboration between experts in a diversity of fields.