

MCEER: A Paradigm for Decision Support to Improve Multiple Hazards Resilience



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MULTIDISCIPLINARY CENTER FOR EARTHQUAKE ENGINEERING RESEARCH



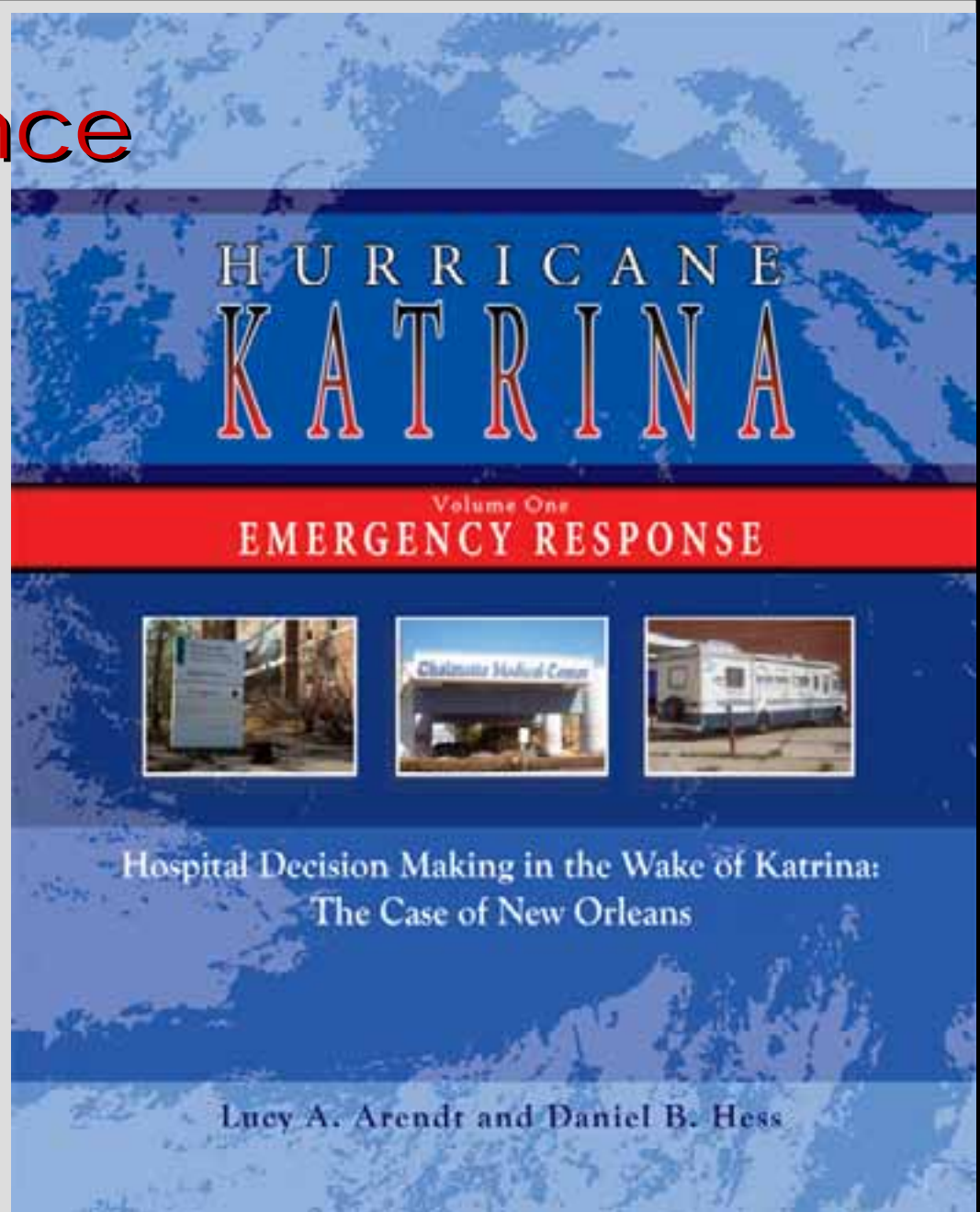
Meeting Our Nation's Needs...Improving Disaster Resilience

- **Thanks Ryan**
- **Welcome to MCEER Annual Meeting**
 - **MCEER Investigators**
 - **MCEER IAB Members (Strategic Partners)**
 - **MCEER Guests**

MULTIDISCIPLINARY CENTER FOR EARTHQUAKE ENGINEERING RESEARCH

Reconnaissance Report

- Ryan's story is only one of countless stories from Hurricane Katrina.
- Summarized in introduction to MCEER Report that focused on hospital decision making and evacuations during the disaster (as part of post-Katrina reconnaissance investigations).





Meeting Our Nation's Needs...Improving Disaster Resilience

- Ryan's story shows
 - The many faces of disaster
 - The many forces of disaster
 - ◆ Forces "within" – facing uncertainty and separation
 - ◆ Forces "upon" – delivering important post-disaster services in spite of poor disaster resilience of critical facility (cascading failures: power loss, flooding, poor communication, loss of telephone and cell phone communications, the loss of water, and looting in the streets)



Meeting Our Nation's Needs...Improving Disaster Resilience

- **Fundamental Resilience – In Hospital:**
 - **Structure and operations of the facility survived initial hit of the hurricane. Emergency generators powering life support equipment, adapting to minor damage, etc.**
 - **Cascading failures: breach of levees, resulting in hospital becoming a virtual island unto itself (e.g. disaster resilience in multiple hazards)**



Meeting Our Nation's Needs...Improving Disaster Resilience

- **Fundamental Resilience – Human:**
 - **Weathering the storm**
 - **Rising above personal fears and frustrations**
 - **Individuals feeling alone, yet accomplished great things for others when they came together as one**



Meeting Our Nation's Needs...Improving Disaster Resilience

- **Need to achieve higher state of Disaster Resilience, for example:**
 - In the physical strength or “Robustness” of critical infrastructure,
 - In “Redundancy” and “Resourcefulness” in maintaining operation of critical facilities and geographically-distributed systems
 - In the “Rapidly” with which emergency managers can dispatch first responders to hardest hit areas, with knowledge of what they’ll face upon arrival.



Meeting Our Nation's Needs...Improving Disaster Resilience

- **Effort to enhancing resilience does not rest with any one individual, but one individual's actions can lead to enhanced disaster resilience.**
- **Collaboratively, operationalize a concept of disaster resilience:**
 - **that can reduce the impact of future disasters**
 - **upon which to build specific metrics to measure and improve upon an entity's state of resilience before it is challenged and revealed by disaster**

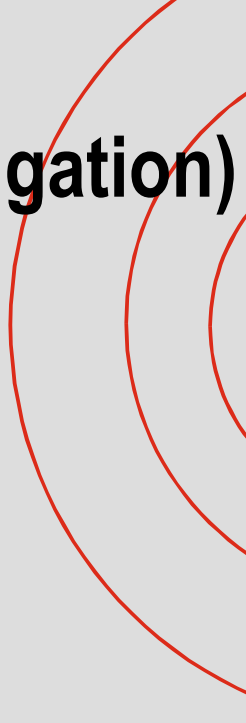


Meeting Our Nation's Needs...Improving Disaster Resilience


- **Fundamental Principles**
 - **Quality Decisions are Directly Proportional to Quality of Life**
 - **The Best Decisions are not Made in a Time of Crisis**
- **Ability to gather and assemble information and make quality decisions leads to quality actions, which lead to enhanced resilience and quality of life**

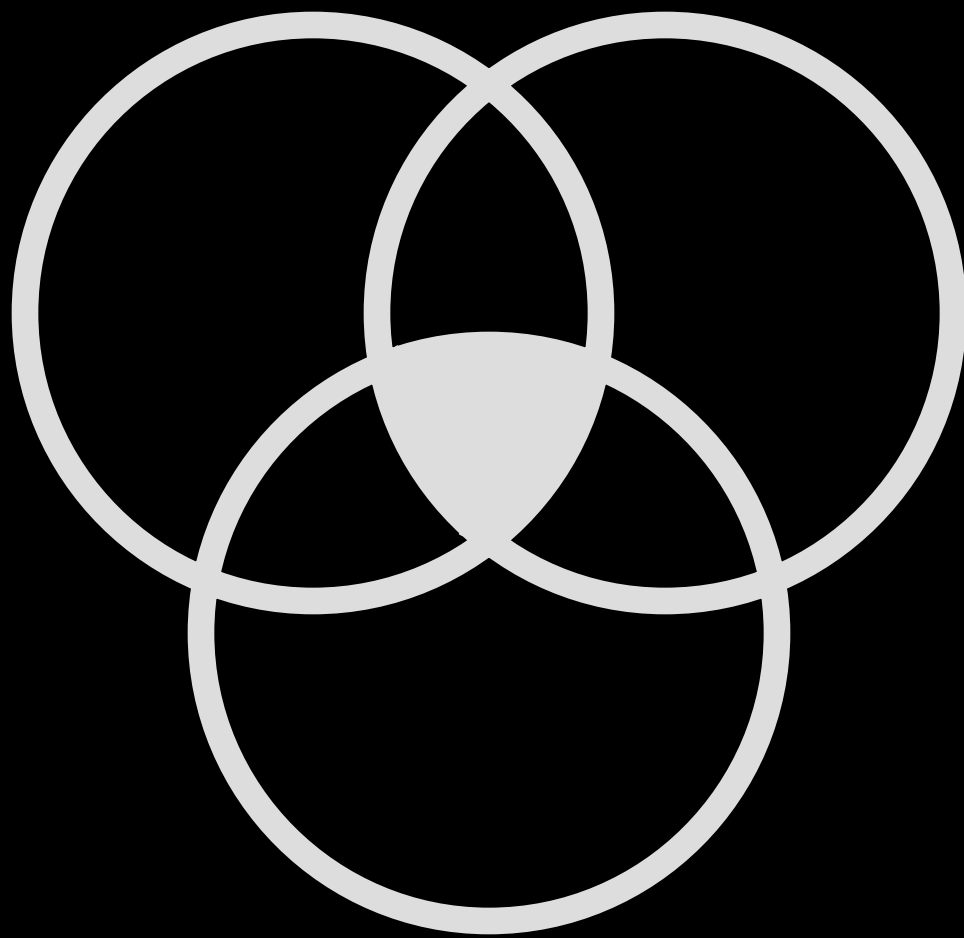
The Way out of Disasters

- Improving Response and Recovery
 - Not having them in the first place (Mitigation)

 - Both hinge on:
 - Resilience
 - Good Decisions
 - Decision Support Systems
- 
- A graphic consisting of several concentric red circles on the right side of the slide, partially cut off by the edge.

MCEER

- **Vision (based on above foundations):**
The overall goal of MCEER is to enhance the disaster resilience of communities
 - *Not reached yet!*
 - **Significant Accomplishments in Right Direction**
 - *Knowledge*
 - *Tools*
 - *Technologies*
 - *Can make it happen!*
- 



Impact:

MCEER Research, Education & Outreach

■ *Research – Developing New:*

- *Knowledge*
- *Tools*
- *Technologies*
 - ◆ *Buildings & Infrastructure*
 - *Lifelines*
 - *Hospitals*
 - *Highways, etc.*
 - ◆ *Response & Recovery*
 - ◆ *Reducing uncertainty to make decisions possible*



Knowledge

Impact:

MCEER Research, Education & Outreach

- *Education – Nurturing:*
 - *Early Interest in Science & Engineering*
 - *Undergraduate Interest in Graduate Studies*
 - *The Next Generation of Professionals*
 - ◆ *Multidisciplinary Concepts*
 - ◆ *Real-World Understanding*
 - ◆ *Real-World Experience*



**Graduate
Experience**

Impact:

MCEER Research, Education & Outreach

■ *Outreach – Fostering Understanding through:*

- *Publication of Reports, Codes, Standards, Guidelines, etc.*
- *Conferences, Workshops, Seminars, Webcasts*
- *Partnerships w/ Business, Industry & Government*
- *Information Services for Researchers, Students, & Practitioners*



**Information
Services**

Uniquely Positioned

- *To Meet Our Nation's Needs*
 - *Multiple Hazards & Extreme Events*
 - *Protection of:*
 - ◆ *People*
 - ◆ *Critical Infrastructure*
 - ◆ *Economy (competitiveness)*



Multi-hazard Resilience

- Resilience is a “Meta-concept” that goes beyond earthquake engineering – fully embraces and applicable to a multi-hazard scope
- Identifying synergies across multiple hazards
- Focused on:
 - WTC Collapses
 - Hurricanes Charley
 - December 2004 South Asian Tsunami
 - Hurricane Katrina

Multi-disciplinary Focus

■ Structural Engineering

- Makola Abdullah (FAMU), Anil Agrawal (CUNY), Amjad Aref (UB), Sarah Billington (Cornell), Michel Bruneau (UB), Ian Buckle (UNR), Stuart Chen (UB), Michael Constantinou (UB), Gary Dargush (UB), Andre Filiatrault (UB), George Lee (UB), M. L. Marsh (BAE), Gilberto Mosqueda (UB), R. Nutt (SE), Rupa Purasinghe (CSULA), Andrei Reinhorn (UB), M. Ala Saadeghvaziri (NJIT), C. Seim (TYLin), T.T. Soong (UB), B.F. Spencer (UIUC), Andrew Whittaker (UB), Y. Xiao (USC)

■ Geotechnical Engineering

- Tarek Abdoun (RPI), Ricardo Dobry (RPI), I. P. Lam (EMI), Lew Marshall (Mactec), Goeff Martin (USC), James Mitchell (VPI), George Mylonakis (CUNY), Thomas O'Rourke (Cornell), Jonathan Stewart (UCLA), S. Thevanayagam, David Tralli (Ind.)

■ Civil Engineering

- Rachel Davidson (Cornell), Christopher Rojahn (ATC)

Multi-disciplinary Focus

■ Electrical Engineering

- Tsen-Chung Cheng (USC), Bijan Houshmand (JPL), Donald Penn (Ind.)

■ Risk Engineering

- Gregory Deierlein (Cornell), Mircea Grigoriu (Cornell), Richard White (Cornell)

■ System Engineering and Lifeline Engineering

- S.T., Mau (NJIT), Brett Sanders (UCI), M. Shinozuka (UCI), Stuart Werner (SSEC)

■ Mechanical/Materials Engineering

- Maria Feng (UCI), Dan Inman (VPI), James McGrath (VPI), M.P. Singh (VPI)

■ Computational/Structural Mechanics

- Anthony Ingraffea (Cornell), E. Maragakis (UNR)

■ Engineering Seismologist

- D. Anderson (CH2M Hill), A. Papageorgiou (UB), Maurice Power (Geomatrix)

Multi-disciplinary Focus

- **Public Administration, Public Policy**
 - Daniel Alesch (UWGB), William Petak (USC)
- **Regional Science**
 - Stephanie Chang (UBC)
- **Decision Sciences**
 - Richard John (USC), Detlof von Winterfeldt (USC)
- **Economist**
 - Howard Kunreuther (Wharton), Adam Rose (Penn)
- **Geospatial Technologies**
 - Ronald Eguchi (ImageCat), Arthur Lembo (Cornell)
- **Sociology**
 - Joanne Nigg (UoD), Kathleen Tierney (Boulder)

MCEER: A Paradigm for Decision Support to Improve Multiple Hazards Resilience

- **At MCEER, we believe:**

- **The best decisions are not made in the midst of disaster; they are made in advance of disaster.**

MCEER: A Paradigm for Decision Support to Improve Multiple Hazards Resilience

- **Our hope for today's meeting:**
 - **To share with you a paradigm and a concept that we believe can reduce the impact of future disasters, that include threats of nature, threats of technology, and threats of terrorism – a paradigm and a concept of resilience that can help enable individuals, organizations, and communities make better decisions in advance of disaster, and measure their progress toward a more resilient response and recovery when disaster strikes.**

Structure of Meeting

■ Plenary Sessions

- Resilience: Defining and Measuring What Matters
- Using Remote Sensing Technologies to Improve Resilience
- Resilience of Geographically Distributed Lifeline Systems
- Resilience of Critical Infrastructure and Facilities (Hospitals, Highways & other Structures)

■ Break-out Sessions – “Drilling” into each topic

Zooming in

■ Remote sensing →



■ Geographically distributed systems (networks) →



Zooming in

- Critical Infrastructure and Facilities



Objectives of Meeting

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MCEER Sponsors

- National Science Foundation
- Federal Highway Administration
- New York State
- Federal Emergency Management Agency
- Strategic Consortia: EPRI (MCEER EUC), CEC, ASHRAE
- Strategic Partners

Disaster Resilience

- We hope this program will inspire and challenge you to think about and build upon the paradigm and concept of disaster resilience, with specific resilience metrics that are relevant to your organization, your clients or your constituents.
- Thank you for being with us today and for your contributions to this program. We are all in this together, and together we can make a difference.