5th International Conference on Pedestrian and Evacuation Dynamics

March 8-10, 2010

National Institute of Standards and Technology

Gaithersburg, MD

PED 2010

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PED 2010 Planning

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Dr. Doug Samuelson, InfoLogix, Inc.

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About NIST

- Founded in 1901
- Non-regulatory
- Part of US Dept. of Commerce

- Work in fire goes back to 1904 Baltimore Fire
  - Non-standard hose couplings
  - 1,526 buildings destroyed

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About NIST

- Gaithersburg, Md. headquarters is 578-acre campus
  - 2,900 scientists, engineers, technicians, and support and administrative personnel.
  - 2,600 associates and facility users from academia, industry, and other government agencies

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About NIST

- Fire Research Division
  - 100 Employees
    - ~50 Full time permanent employees
    - ~50 Guest scientists, temporary employees, and students

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Logistics

- Green Auditorium
- Lecture Room A (around to the left)
- Posters
- Lunch tickets
- Exits and Alarm Sounds
- Restrooms
  - Behind the green auditorium
  - Rear of lobby (main entrance) to building

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Logistics

- Conference Dinner Tonight
  - Bus will leave from the front of the building at 15:45
  - Bus will leave from Holiday Inn at 16:00
  - Guided tour of Washington, DC highlights
  - Hors D'oeuvres and cash bar at 6:00 pm at the JW Marriott Hotel (1331 Pennsylvania Avenue NW)
  - Metro Center Stop on Metro

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Logistics

- Speakers have 25 minutes
  - Brief 15 second self-intro
  - Twenty minutes for presentation
  - Five minutes at the conclusion for question and answer

- Moderators will be enforcing the time limits to maximize discussion and ensure fairness for all speakers

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Logistics

- Proceedings
  - Submitted papers are being edited
  - Four months from final edit to shipping
  - Target ship date: late summer

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Questions?

- See staff at the registration area outside the conference room
- Ask Jason Averill,
  Erica Kuligowski or Richard Peacock

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Five Grand Challenges in Pedestrian and Evacuation Dynamics

Jason D. Averill

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Problem

- Widely distributed research efforts

Disciplinary

- Pedestrian Movement
- Architecture
- Human Factors
- Engineering
- Modeling
- Building Management
- Fire Service
- Modeling
- Statistics

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Problem

- Limited resources relative to the magnitude of the problem
- Emerging discipline
- Lack of coordination results in duplication of effort
  - Numerous models (Kuligowski) using limited number of data sets (Kady, Gwynne, & Davis)

Approach

- Generate a discussion about the priority problems which impede progress

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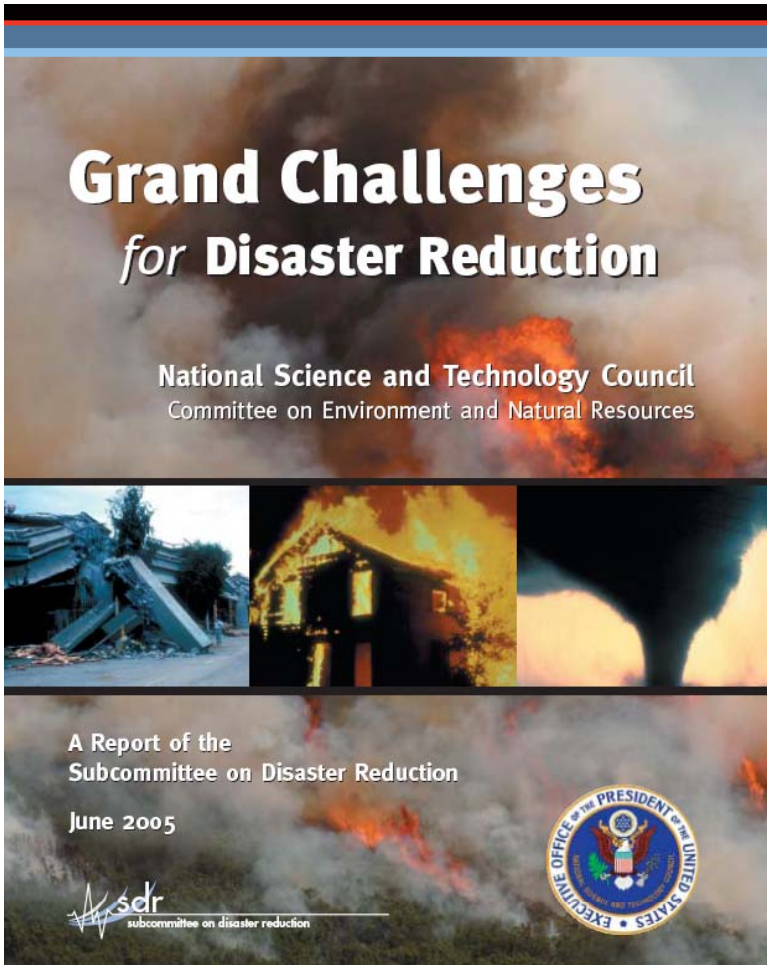
Grand Challenges



National Science and Technology Council assembled priority research agenda in order to maximize impact of research on variety of disasters

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Criteria

- Each of the challenges described herein must be
  - addressable within the next ten years, given appropriate resources and,
  - once solved, the solution must enable significant progress in the field.

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Disclaimer

- The following list is neither comprehensive nor complete and is intended only as a spark to the discussion over the next three days, and beyond

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Grand Challenge #1: Human Behavior

- Develop a comprehensive and robust theory for managing individual behaviors which is valid across a wide range of scenarios and technologies
  - Performance prediction
  - Emergency management
  - Codes and standards

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Human Behavior

- Ball bearing and other physics-based models are inadequate to predict the full range of possibilities for pedestrian and evacuation scenarios.
  - People are not robots or inanimate objects responding to natural laws.

Human Behavior

- People make predictable decisions when confronted with predictable information and conditions
  - Predictable does not mean deterministic

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Human Behavior (Steps)

- Develop theoretical models
  - Bryan
  - Sime
  - Keating/Loftus
  - Proulx
- Look broadly
  - Mileti
  - *Kuligowski*

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Human Behavior (Steps)

- Collect, publish, and archive data
  - Proprietary
  - Incomplete descriptions

- Embed human behavior
  - Predictive models
  - Building codes and standards

Grand Challenge #2: Database of actual evacuation

- Develop a database of actual evacuation data comparable or superior to the quality of fire drill evacuation data for a range of scenarios

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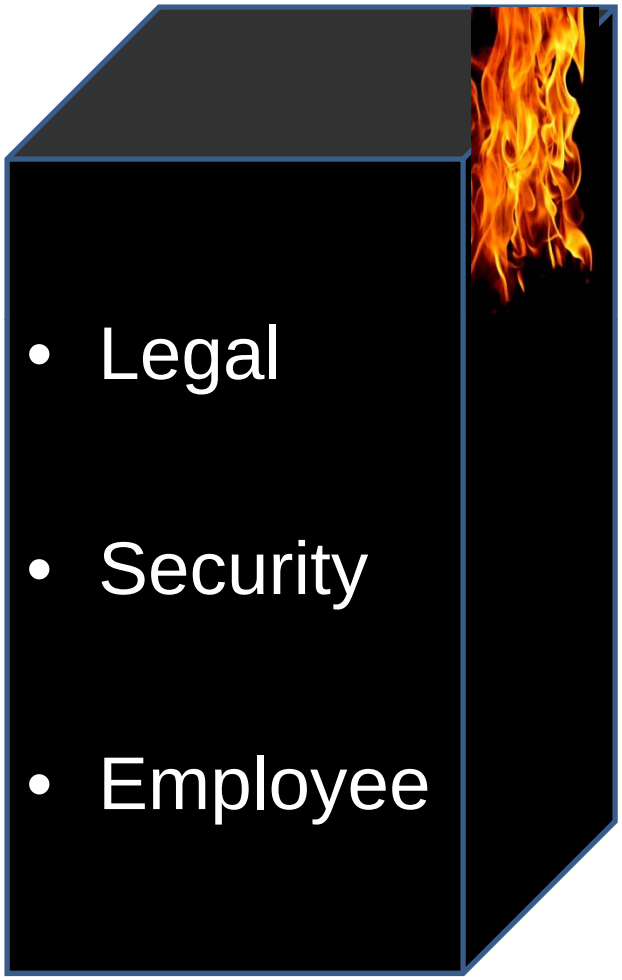
Database

- Small number of (30+ year old) data sets.
  - The data is routinely extrapolated beyond the scope of the original data.
  - Ill-described

Actual Emergencies

Presently, buildings with emergencies are black boxes, wrapped in a myriad of technical and bureaucratic obstacles



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Actual Emergencies

- Unknown mapping between fire drill or experimental data and real emergency scenarios.
- Crucible in which theory and drills are tested
- Necessary for acceptance and validation of all knowledge in the field.

Actual Emergencies

- If you knew when and where an event would occur, the infrastructure to comprehensively and consistently
  - collect,
  - analyze, and
  - archive

  the data is underdeveloped.

Database (Steps)

- Outline a comprehensive database - Gwynne (2009)
  - Common vocabulary (Pauls)
  - Describe methods
  - Document initial conditions
  - Incident environmental conditions
  - Occupant information and responses, both during the incident and post-incident.

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Actual Incidents (steps)

- Investigate and publish incidents
  - Interviews or surveys
  - Security records

- Analyze for consistency with theory and existing data

Actual Incidents (steps)

- Develop mechanism for comprehensively archiving actual incidents
  - Pre-negotiate access to security systems (cameras, readers)
  - Pre-install equipment in buildings
  - Deploy first-person equipment
  - Deploy equipment with emergency responders

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Grand Challenge #3: Embrace variance

- Current generation models largely deterministic with singular input options.
- Pedestrian movement and building evacuations are highly stochastic processes.

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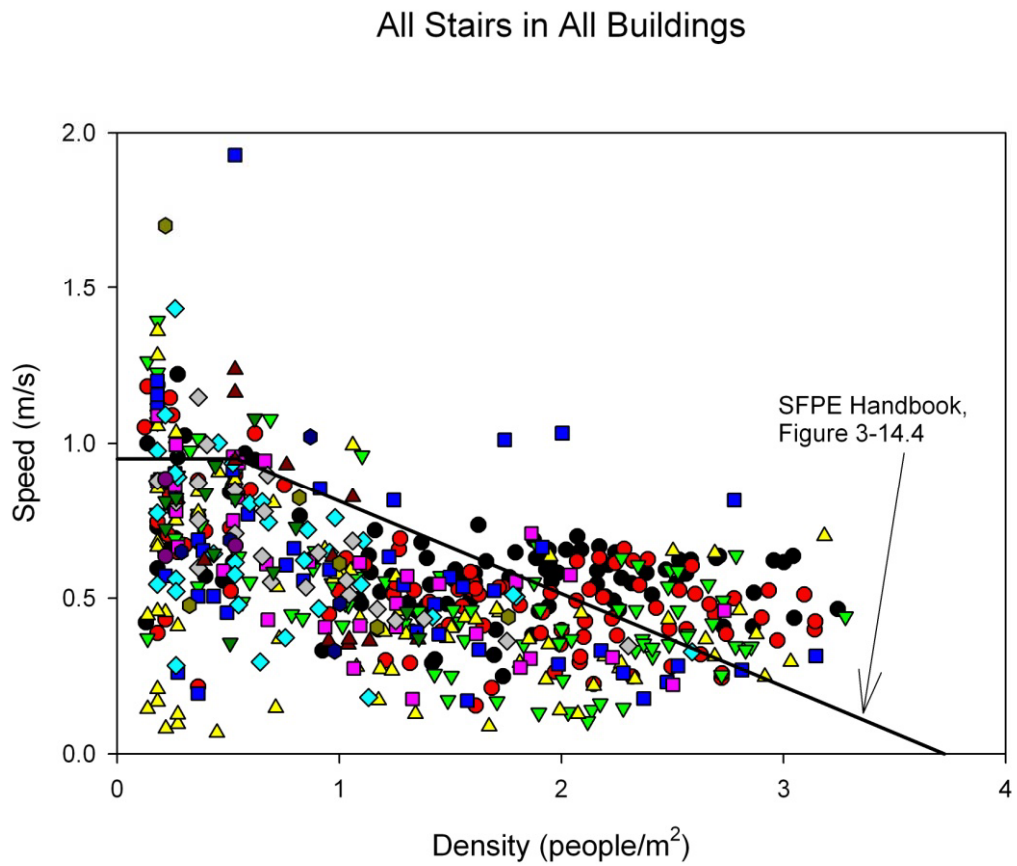
Embrace Variance

- Even the most simplistic relationships in egress have substantial variance

(For more on this data go to talk by Peacock)



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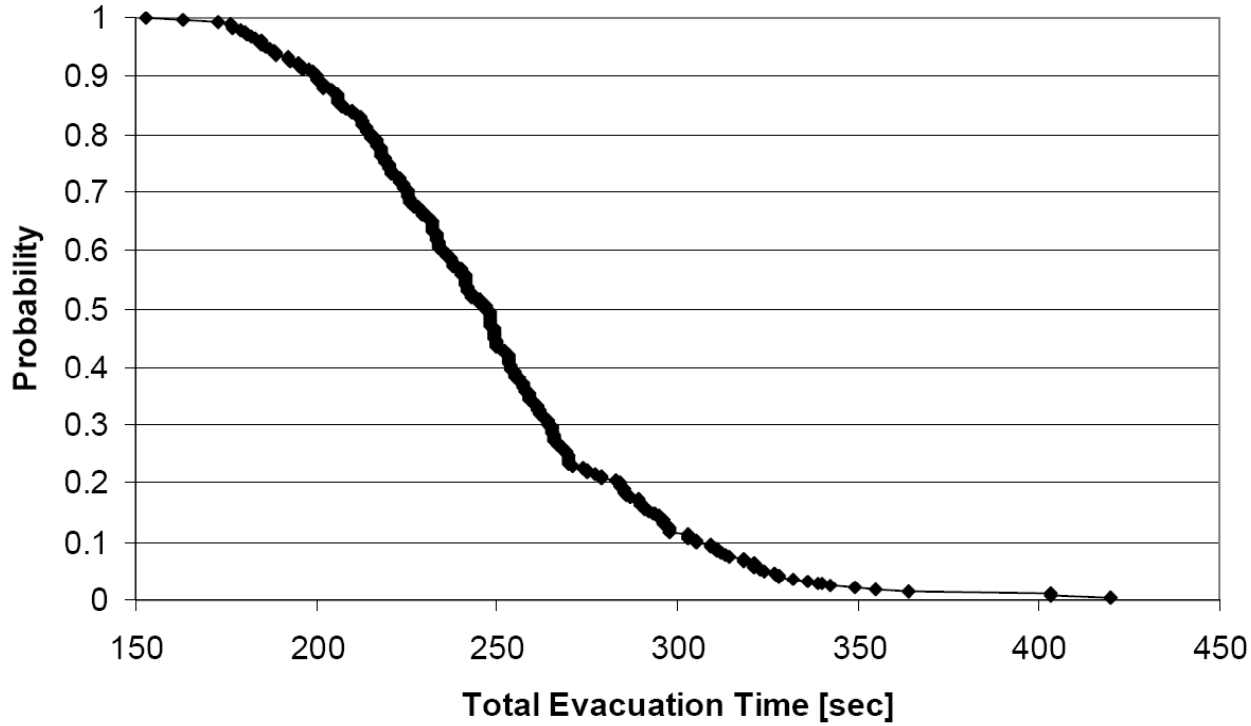
Probabilistic Approach



- Lord, Meacham, Moore, Fahy, and Proulx. "Guide for Evaluating the Predictive Capabilities of Computer Egress Models." December 2005.
- Available at: http://fire.nist.gov/bfrlpubs/fire05/PDF/f05156.pdf

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Variance (Steps)

- Report and present variance
  - Move away from simplified, static descriptions such as average and singular evacuation time

- Teach distributions
  - Students
  - Engineers/Architects
  - Regulators
  - Building owners and managers

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Variance (Steps)

- Embed stochastic tools in models
  - Tools and techniques should manage distributions of inputs and outputs.

- Communicate in probabilities
  - Probabilities should dominate and a discussion of acceptable risk should take place in every building and community.

Grand Challenge #4: PBD and Modeling

- Develop RSET predictive methods comparable or exceeding the current ASET capabilities and integrate in order to produce valid predictions of building performance over a range of occupancies and scenarios

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PBD and Modeling

- Available Safe Egress Time (ASET) predictions are ahead of Required Safe Egress Time (RSET) predictions.
- Interactions of the occupants with constraints
  - Fire
  - Smoke
  - Information
  - Culture
  - Technology
  - Preparedness
  - Emerg Mgt

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PBD and Modeling

- Measurement science which enables use of performance-based design (PBD) methods may reduce the cost of construction by 0.5 percent (*Impact Assessment of Major Reform Initiatives*, Australian Building Codes Board, Feb. 24, 2000.)

- For the United States alone, this translates to roughly $5B.

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PBD and Modeling (Steps)

- Develop consensus standard evacuation scenarios
  - SFPE fire safety design scenarios are template
  - Use distributions (Grand Challenge #3)

- Develop methods for combining ASET and RSET calculations

PBD and Modeling (Steps)

- Round robin of model assessment
  - Blind predictions of pedestrian and emergency egress scenarios
  - Inter-user reliability, inter-model reliability
  - Range of event probability
  - Range of building types and uses

- Certification of models and users

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Grand Challenge #5: Embrace technology.

- Emerging and existing technology should be leveraged to enhance pedestrian and evacuee experiences
  - Movement
  - Data
  - Communication

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Technology for People Movement

- Given the paucity of data on simple concepts (such as stairs), it should not surprise anyone that virtually no data exist for use of technology to improve building evacuation effectiveness.
  - Elevators,
  - Escalators, and
  - Alterative escape devices.

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Technology

- For these technologies, there are virtually
  - no experimental data,
  - no incident data,
  - no theoretical models, or
  - few computational algorithms

Building Technology

- Integration of building sensor information
  - Energy management systems
  - Life safety systems
  - Security systems

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Notification Technology

- Communication technologies (*revolutionizing / convoluting)*

  the potential for messaging during emergencies.
  - Cellular (voice/text/email)
  - Networked computers
  - Active signage
    - Instructional
    - Directional

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Technology for Data Collection

- RFID

- Video records for actual incidents
- Video analysis for people tracking

- TED.com (Blaise Aguera y Arcas and augmented-reality maps)

Technology (steps)

- Be early adopters
- Use technology for data collection
- Evaluate technology for both utility and unintended consequences

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Summary:
Five Grand Challenges

- Human Behavior
- Database of Actual Emergencies
- Embrace Variance
- Enable Performance-Based Design
- Embrace Technology

- *Others*

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Consensus Agenda

- A consensus research agenda confers many benefits
  - Traceable
  - Prioritized
  - Independent
  - Validated

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Leadership Must Come From the PED Community

- Our problems can also be our strengths through multi-disciplinary teams

Disciplinary

- Pedestrian Movement
- Architecture
- Human Factors
- Engineering
- Modeling
- Building Management
- Fire Service
- Modeling
- Statistics

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Conclusion

- This week, ask yourself the following questions:
  - What greater problem was this work addressing?
  - What problems are not currently being addressed?
  - What was the impact of the work?
  - What are the mechanisms to implement the work?

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