Working Group 3: Assessment Techniques to Quantify the Risk Posed to Individual Infrastructure and Systems of Infrastructures

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Quantifying Risk to Infrastructure Systems Under Multiple Hazards

Objectives

Quantify the risk posed to individual components and systems of infrastructure that properly address:

(1) Multi-scale modeling
   (a) Interdependence between components and systems
   (b) Effects of city scale on risk and cascading events
(2) Multiple hazards
(3) Ageing effects
(4) Interdependence and correlations of vulnerabilities

Broader Impacts

- Improved guidance for pre-event mitigation activities and public policy decisions
- More robust modeling framework to support rapid event analysis and response planning
- More accurate communication of risk and establishment of the potential benefits of mitigation activities
- More robust tool for benefit/cost analyses
- Tools for balancing short-term maintenance needs and long-term risk reduction objectives

Technological Challenges

Current approaches **cannot be simply extrapolated** to accurately capture the risk posed to complex, large-scale infrastructure systems by multiple hazards

Questions to be addressed include:

- How does risk evolve over time?
  - How do component capacities degrade over time?
  - How do we account for these changes in the risk models?
- How do we quantify the benefits of mitigation activities to support allocation of limited resources?
- How does the size/density of the city affect the risk?
- How do we properly model these effects?
- How do we model the cascading of these effects?
- How to accurately assess vulnerability for widely varying structural systems and standards of construction?
- How do we account for multi-hazard vulnerability and correlations between design considerations and mitigation activities targeting a particular hazard?
- How do we quantify direct and indirect consequences of damage?
- How should resilience/performance be objectively defined and should this be hazard dependent?

Enhancing the Resilience of Communities by Harnessing the Information Revolution

Objectives

1. To create a flexible, robust framework that can accommodate the latest models and databases for evolving hazard and vulnerability assessment
2. To harness the power of evolving data collection mechanisms from diverse and even unconventional sources to enrich , enhance and expand the data driving risk assessment
3. To enable real-time, data-driven decision making during an event to enhance evacuation, response and recovery efforts

Broader Impacts

1. Enhancing resilience of communities against hazards through "living" assessment frameworks that take advantage of the latest advances in risk modeling and real-time granular data
2. Creating a data fertile environment will improve risk assessment models and lead to the potential discovery of new knowledge about hazards and vulnerabilities in Megacities
3. Engaging citizens in assessing and maintaining the infrastructure they are reliant upon raises civic awareness regarding the importance of infrastructure and inspires a more proactive approach to disaster preparedness and public participation
4. Validating models after an event through the use of harvested data

Technological Challenges

1. Existing risk assessment platforms **have not evolved with the latest developments in modeling and are not equipped to harvest data from innovative sources**
    a) Requires an integrated framework that can achieve interoperability between diverse data sets and models, access/interface shared resources via cyber infrastructure, and address issues of data fusion and conflation
    b) Necessitates new platforms sensitive to the technology adoption life cycle and end user needs
2. Data driving these models lacks sufficient detail, is often incomplete, outdated or inaccessible/proprietary
    a) Develop automated harvesting mechanisms for data from diverse and even unconventional sources (distributed sensor networks, private and public sector records, and citizen contributions)
    b) Create appropriate mechanisms to process data from diverse sources, assure its quality and trustworthiness, and aggregate/integrate into risk assessment platforms
3. Need to acquire, process and assimilate in-situ observations from unconventional sources in near-real-time
    a) Provide risk assessment framework with a modality capable of incorporating in-situ observations and executing near-real-time updating of risk
    b) Require redundant communication pathways and network-level data processing and mash up of a variety of data formats delivering in-situ observations from diverse sources