

Advisory Committee on Earthquake Hazard Reduction Program

EERI White Paper Summary

**Earthquake Risk Reduction:
Addressing the Unmet Challenges**

The Need for an Interdisciplinary Research Approach

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Challenges facing the earthquake risk reduction community

- How to insure continuity in problem focused interdisciplinary problem focused research following the graduation of the centers
- How to sustain and increase the knowledge gained in working toward the goals of NEHRP
 - to reduce the earthquake risk to communities
- How to sustain the gains made over the past two decades in developing active collaboration among the disciplines

Project objectives

- Develop understanding that achieving earthquake risk reduction requires a problem focused approach involving multiple disciplines that span social, technical, administrative, political, legal and economic boundaries
- Identify the role interdisciplinary research plays in improving understanding of the issues and potential solutions and lessons learned
- Assess the impact of the EERC's had on increasing interdisciplinary research
- Prepare recommendations aimed at developing continuing support for true interdisciplinary research leading to effective implementation of earthquake risk reduction measures

Project recommendations

- Primary recommendations are targeted at NEHRP and other potential funding agencies, and
 - Policy makers in executive and legislative branches at various levels of government,
 - Universities and academic researchers
 - Professional societies that support the earthquake risk reduction community.

1. Government policy and legislative bodies and private sector should provide leadership that acknowledges the critical value of an interdisciplinary research approach

- This requires helping policymakers understand how additional support for such research projects could produce transformative results
- Helping funding agencies, industry and community organizations understand that continued funding can provide significant benefits

2. NEHRP agencies must provide innovative, risk-taking leadership

- NSF as the primary funding agency for research in earthquake risk reduction and other NEHRP agencies who's primary focus is on implementation of known science should play a leadership role in advocating for interdisciplinary research.
- Multidisciplinary problems require relatively larger funding amounts over relatively long periods so that different disciplines can be effectively involved and collaborate with other disciplines.

3. NEES Network agencies should support additional grand challenge projects that require interdisciplinary research.

- Current grand challenge projects are good models. They provide sufficient funds and a time frame long enough to build necessary relationships
 - However, too few have been funded and since NEES absorbs much of the available earthquake research resources additional opportunities to advance interdisciplinary research should be explored
- NEES should support more interaction among various research teams, and make this part of its mission.
- NEES should build into its structure more required communication with stakeholders as potential users of research

4. NEHRP agencies should advocate problem-focused research in earthquake risk reduction, and set a percentage of their budgets for this purpose

- Agencies that support research and “implementation” should look for ways to encourage and require proposals to offer interdisciplinary research teams focused on the risk reduction problem rather than teams organized by disciplines.
- RFPs from the NEHRP agencies should encourage collaborative interdisciplinary projects with a focus on implementation

5. Funding agencies should support the study of earthquakes as systems-level, natural laboratories

- Systems-level problems, such as earthquake risk management, are difficult to simulate in laboratories
- NRC, stated that “the key to future environmental research will be to develop a capability to examine regions comprehensively, instead of one variable or one issue at a time” (NRC 2001). The same applies to earthquake risks.
- Earthquake events require commitment to take advantage of short time window for field research and should involve interdisciplinary teams for data collection to capture as much data as possible in this natural laboratory.

8. Funding agencies develop proposal evaluation strategies that recognize rich / complex nature of problem - focused research with reviewers from broad relevant disciplines.

- One of the needs in supporting interdisciplinary research projects by funding agencies is the need for broad based reviewers who are not solely focused on discipline-specific approaches.
- Reviewers who have been active in such projects should be better able to understand and evaluate the approach, time, and budget needs.

9. NEHRP agencies should support creation of interdisciplinary centers

- Government should be encouraged to implement research centers that address interdisciplinary issues in earthquake risk reduction. The NRC pointed to the need for a social science-focused research center to address societal problems in risk and hazard management (NRC 2006).
- The National Academy recommended an R&D structure for Department of Homeland Security based on Defense Advanced Research Projects Agency (DARPA) as an interdisciplinary model (NAS 2005: 122). NEHRP agencies should consider this as an alternative approach

6. Funding agencies and partners should develop or expand mentoring programs

- Mentoring program objective is to introduce aspiring scholars to the culture of hazards and disaster research, including its rewards as a career.
- Workshops designed to provide opportunity for young faculty scholars to discuss research opportunities and challenges in the field with senior researchers and NEHRP officials.
- By end of a mentoring period, each participant should have prepared with the cooperation of senior advisors a proposal for submission to NSF or some other sponsor.

7. Funding agencies and academic departments need to promote involvement of junior faculty in interdisciplinary hazards research

- Should target junior faculty in natural sciences, social sciences, and engineering that show interest in hazards-related interdisciplinary research.
- NSF should work to leverage enthusiasm and interest of young hazards researchers by developing funding programs that encourage them to perform interdisciplinary research.
- A similar program encouraging cross disciplinary collaboration between young researchers would encourage them to continue on an interdisciplinary career path

10. Academic institutions should aid in building communities of scholars and students open to cross-disciplinary collaboration

- Academic researchers in risk reduction research should exercise leadership to advocate on behalf of problem-focused, interdisciplinary research and education.
- This may involve developing strategies for collaborative efforts in research, education, and outreach and the leveraging of scarce resources.
- This could involve sponsoring and advocating problem-focused research in contrast to the more mission-based, narrowly-focused agencies that may support their future work.

11. Agencies and academic institutions should reward institutions and researchers whose work and capabilities cut across disciplinary boundaries

- Academic institutions are often impediments to rather than enablers of interdisciplinary collaboration.
- Younger academics often fear involvement in interdisciplinary research because it may result in work products not counted in tenure decisions or career advancement .
- Academic administrators need to be encouraged to support and reward those who are conducting research, teaching classes, or publishing papers in interdisciplinary areas.

12. Academic institutions should share resources across academic departments

- Traditional academic structures support single discipline departments
- Institutions interested in investing in larger, systems-based societal research problems should consider developing a structural approach to facilitate sharing faculty resources, laboratory and office space
- Earthquake engineering research should seek linkages that cut across hazards so that research in one area could be relevant to another
- Collaborating with other hazard communities will help create a synergy of ideas and solutions, and lead to innovative and different funding sources for future research.

13. Professional societies should be supported in developing strategies to reinforce importance of interdisciplinary research and practice

- The NAS report (2005) highlights the role professional societies can play in fostering interdisciplinary research. In earthquake risk reduction EERI works to remain interdisciplinary
- The NAS suggests that professional societies promote change, through their journals and meetings, interdisciplinary panels, and development of tools to help researchers broaden their understanding of other disciplines
- EERI, and other professional org. that work on earthquake risk reduction (e.g., ASCE, SEAOC, SSA, GSA, etc), should evaluate these recommendations to developing opportunities to play a larger role

Conclusion

- By working together to build organizational arrangements and objectives that promote problem-focused interdisciplinary earthquake risk reduction research, the NEHRP research community of funding agencies, practitioners and policymakers can move aggressively toward reducing earthquake risk.
- Encouraging collaboration among the many disciplines, and defining research activities with a system problem focus is critical to making gains in this direction.
- The earthquake community must continue to work together to overcome barriers and address the challenges that remain to be solved.

Practitioners Perspective

Major Challenges

- Understanding and forecasting social and economic consequences
- Better understanding of the decision making process
- Motivation of stakeholders for action
- Incorporation of advanced sensors

Major Challenges

- Understanding and forecasting social and economic consequences
 - Initial models of economic loss, casualties and shelter demand exist but we have a long way to go to produce the kinds of consequence estimates that will get the attention of decision makers and support better emergency response planning and improve tools that are being developed.

Major Challenges

- Better understanding of the decision making process
 - We still do not know the key leverage points that affect decisions by public officials and building owners as well as the larger public. We really need to improve our ability to characterize and communicate risk and uncertainty. When project budgets are trimmed generally it is the involvement of stakeholders that are eliminated.

Major Challenges

- Motivation of Stakeholders for action
 - The infrequent nature of catastrophic earthquakes presents challenges for preparedness at the individual and organizational levels. Understanding how to motivate the desired behavior of stakeholders for risk reduction is still a major hurdle in the earthquake risk reduction community.

Major Challenges

- Incorporation of advanced sensors
 - Low cost sensors can now provide significant amounts of information on the state and performance of buildings and infrastructure. As the built environment becomes “smart” we need to better understand how to use this information to provide real time information for stakeholders and emergency response.

Examples of Effective Interdisciplinary Approach

- Development of HAZUS – originally developed for analyzing potential losses from earthquakes it has now been adopted to floods and hurricanes.
- ATC 58 – performance based seismic design that provides a realistic understanding of the risk to life, occupancy and economic loss as a result of future earthquakes on a specific building. Provides building owners, tenants, lenders, insurers and other stakeholders the opportunity to specify their desired performance. It will be a huge step forward in the ability of the SE profession to communicate with owners. Resulted from multidisciplinary research at PEER, MCEER and MAE.

Examples of Effective Interdisciplinary Approach

- EERC's produced an environment that supports multi-disciplinary research
 - They created long term projects that enabled the various disciplines to work with and learn what others have to offer.

Examples of Effective Interdisciplinary Approach

- Large scale test bed projects at the earthquake engineering research centers
 - LAMB (MCEER), Memphis Test Bed (MAE), NGA Models (PEER)
 - Use of remote sensing (MCEER), Opensees (PEER), MAE Viz (MAE) OpenSHA (SCEC and USGS)

Future Examples of Effective Interdisciplinary Approach

- NEES Grand Challenge projects
 - Ports and harbors
 - Non-ductile concrete buildings
 - Non-structural systems