

A New Generation of Scholars

CCRM hopes to introduce hundreds of young scholars to the power and promise of interdisciplinary thinking. It plans to develop and provide a rich set of educational programs such as courses, domestic and international fellowships, workshops, and long- and short-term interdisciplinary research opportunities for graduate and undergraduate students. These programs will give a new generation of researchers and students an expanded research vocabulary and abilities in more than one discipline and enhanced understanding of the interconnectedness inherent in catastrophes.

Seeding the New Approach

The Center seeks to impact not only on the academic community but on society as well. CCRM researchers will publish in the popular press and trade journals where practitioners often go for information. In addition, CCRM maintains an ongoing dialog with several federal agencies as well as private corporations and foundations regarding structuring innovative initiatives that if successful will improve society's resiliency to catastrophic events.

The Center in the near future hopes to launch the CCRM Business Alliance (CBA). CBA will be comprised of companies and mission-oriented governmental agencies, each of which financially supports CCRM's research agenda. CBA members will have advance access to CCRM products such as technical reports, working papers, databases, and software. Results of CCRM research may be applied by CBA members who will also provide feedback on research relevance to the commercial sector.

Measuring Success

CCRM aims to lead the nation in developing novel solutions to pressing problems that historically plague society. CCRM will also identify future problems and solutions that have yet to come. CCRM approaches this task through interdisciplinary thinking as well as strategic partnerships in government and industry.

CCRM's success is measured by the quality and innovativeness of its scientific research and the educational activities. The ultimate test however is the research's significance in making our society less vulnerable to catastrophes and in enriching the academy's body of knowledge.

The Center's first eighteen months were particularly exciting and promising for its future success. Its activities include 20 publications in referred journals, over 20 conference publications and presentations, 10 national level testimonies, and 3 workshops and Town Hall meetings (each including over 100 people). In the aftermath of Hurricane Katrina, CCRM researchers were interviewed and cited by popular media such as the New York Times, CNN, the PBS NewsHour with Jim Lehrer, the History Channel, the Discovery Channel, and Spike Lee's documentary

movie, *When the Levees Broke*. CCRMs engineering and institutional forensic analyses have served as a national primer for future academic studies and inquiries. Its members also pioneered new interdisciplinary course offerings that will pave the way for university-level degree and certificate programs. Ideas formulated at the Center are rapidly extending into classrooms, corporations, academia, and the world of policy formulation and governance.



CENTER FOR CATASTROPHIC RISK MANAGEMENT

The Center for Catastrophic Risk Management (CCRM) – a nonprofit research initiative seeking support from both public and private sources – was launched in 2005. Located at the University of California, Berkeley, its mission is to undertake cutting-edge research and policy analysis regarding catastrophic hazards faced by society. Examples of recent work include such topics as Catastrophe Risk and Decision Analysis Modeling, Terrorism, Climate Change, and Flood Protection Systems. The Center recognizes and respects the complexity and importance of social systems in creating and preventing both natural and willful catastrophes. Hence, human processes and interactions are at the core of CCRM's work.

A Unique Research Environment

CCRM's research community is both multidisciplinary and interdisciplinary, and in keeping with its mission, the Center offers a collaborative environment for the conduct of its work. Founded at the University of California, Berkeley, CCRM has access to unparalleled resources with which to conduct research and policy analysis. The most recent *National Research Council* study found that 35 of Berkeley's 36 graduate programs were ranked in the top 10 in terms of faculty competence and achievement, with six being ranked No. 1. The latest *U.S. News World & Report* ranked Berkeley the best overall doctoral institution



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in the United States. Hence, Berkeley's academic excellence coupled with CCRM's strong commitment to interdisciplinary thinking provides the nation with a rare opportunity: creating a true first-class multidisciplinary research center aimed at improving the safety and resilience of physical and social infrastructure in the face of disaster.

Researchers include both resident and visiting scientists, practitioners, and students (both graduate and undergraduate). By choice, the scientists drawn to the Center are typically those whose vision encompasses more than their immediate academic disciplines. CCRM collaborations with industry and government will open doors to new research questions as well as to provide researchers with novel new insights into their own fields of study.

The Center's work focuses on the important interaction among natural, physical, and engineering systems and the institutional and social setting in which they occur. Organizational objectives, constraints, and incentives are crucial to understanding why disasters occur and how they can be managed, controlled and avoided. Even if the natural and technological risks are identical in various locations and situations, the institutional and social settings can be entirely different. Consequently, the Center advocates a bottom-up approach to research. Our research acknowledges attention to the individual peculiarities of the social and physical context, while still looking to identify the commonalities across problems in different situations.

RESEARCH OVERVIEW

The Center for Catastrophic Risk Management brings together some of the world's most accomplished and innovative researchers to tackle questions beyond the bounds of traditional academic disciplines. CCRM's "core" research is led by the faculty with the assistance of highly skilled and motivated students. Research programs and themes are developed through "founding" workshops and working groups. It is envisioned that over time, new themes will emerge and new researchers will be identified and invited to participate. This will ensure a steady stream of new ideas and scholars, keeping CCRM at the forefront of knowledge that intersects catastrophe related issues.

A sampling of CCRM's current research interest is captured in the following broad thematic areas.

Emergency Decision Making

Developing effective decisions in the face of rapidly developing crises is critical to interactive management of complex sequences of events that can bring systems to 'failure'. This research thrust seeks to enhance our knowledge and skills in emergency decision making involving large segments of the population in metropolitan areas. The goal is to develop a crisis decision process to neutralize the tendency for elected officials to

delay initiating broad public action because of perceived potential political/economic adverse consequences.

For instance, various New Orleans flood control agencies failed to coordinate prior to Katrina. Local agencies' maintenance practices for levees varied and differed from those of state and federal agencies. Private actors were often excluded from the preparedness effort. In short, Katrina revealed organizational processes that – before, during, and after the hurricane battered the Gulf Coast – were tragically inadequate.

Despite indications of a complex, systemic failure, more limited perspectives have predominated post-Katrina analysis utilizing only a single discipline such as economics or engineering and to shortchange issues of organizational structure and dynamics.

In 2006, CCRM launched a project with the support of the National Science Foundation which deploys a wider range of perspectives on disaster preparation, response and recovery. It focuses on organizational learning (and failure to learn), as well as on the variously interdependent relationships in and across organizations. In keeping with CCRM's mission, the research draws participants from the fields of engineering, social sciences, economics, management, and law. Rather than engaging practitioners in these disciplines in parallel but unconnected efforts, the project provides a unified framework based on intra- and inter-organizational learning, within which each discipline can work.

Anticipating and responding to natural and human-generated disasters have proven to be a challenge to the United States and to the world community. This project investigates why engineering, organizational, legal, and political systems have failed in the past and what changes can be made to prevent or mitigate future disasters. Because of its multidisciplinary nature and the effort to explore previously overlooked issues and data, the project breaks new ground. Analytical tools drawn from management, law, engineering, and economics will be used to illuminate the forces that shape how organizations learn and communicate about catastrophic risks.

Catastrophe Risk Analysis

A critical issue at the forefront of the risk analysis community is incorporating human and organizational behavior in risk assessment and planning models.

The current paradigm of risk analysis is based on reductionism and the linear mathematics of superposition; a system's reliability can be estimated by finding the expected reliability of its constituent parts and summing them. This is appropriate for systems where cause and effect are relatively obvious (deterministic) and risks are dominated by local risks of constituent elements.

Today, however, infrastructural systems that are essential to modern society have reached unprecedented levels of complexity, making complex system research directly relevant. Complex systems exhibit signs of chaotic behavior: they are unpredictable (probabilistic),

interactive, and have properties that can only be observed at the system level. As a result, classical risk analysis methods, such as fault and event trees, are alone insufficient to effectively guide infrastructure design and management decision-making. A novel holistic approach is needed to quantify this emergence and thus provide society with the necessary tools to successfully bring our infrastructure to this new age of complexity. CCRM's expertise in a wide range of academic disciplines including non-market value economics, human factors, and applied mathematics, uniquely positions it to contribute to this revolution.

Environmental Management of Crises

A body of laws, regulations, and operational plans has evolved in the United States to protect human health and preserve ecosystem functions. This management system was not designed to anticipate catastrophic events, provide a consistent response during a severe event, or guide remediation after the immediate crisis. An analysis of the responsiveness of this environmental management system using recent catastrophic events as case studies is needed from the combined perspectives of public health, ecosystem functions, legal, technical, institutional, and public policy perspectives.

In theory, environmental assessments should identify potential risks. The present assessment process, however, has not been successful in doing so. Moreover, environmental assessments are often inaccessible to researchers and the public. The paradox is that society spends huge sums of money to develop crucial environmental information, then buries the information in inaccessible archives.

Simply ensuring that all environmental assessments were available on-line would be a big step forward; a further step would be to combine them in an easily searchable geo-referenced archive. Further steps could include linkages to other environmental information, especially monitoring developments at project sites. The problem is not at all one of finding the path forward. The problem is simply one of beginning the necessary steps.

Geographic Information System (GIS) technologies have advanced to where they are now commonly accepted and employed by the majority of disciplines and professions undertaking environmental research in disaster prediction, management, and mitigation. The challenge that remains is, whether we are to be interdisciplinary in our approach to researching and responding to problems that face society and our environment, or whether we at the very least want to take advantage of a shared and common data system for multi-disciplinary research. CCRM is seeking to answer these and other questions so that information systems can be built that will realize everything from economies of scale to stimulants toward new models and solutions to common environmental problems.