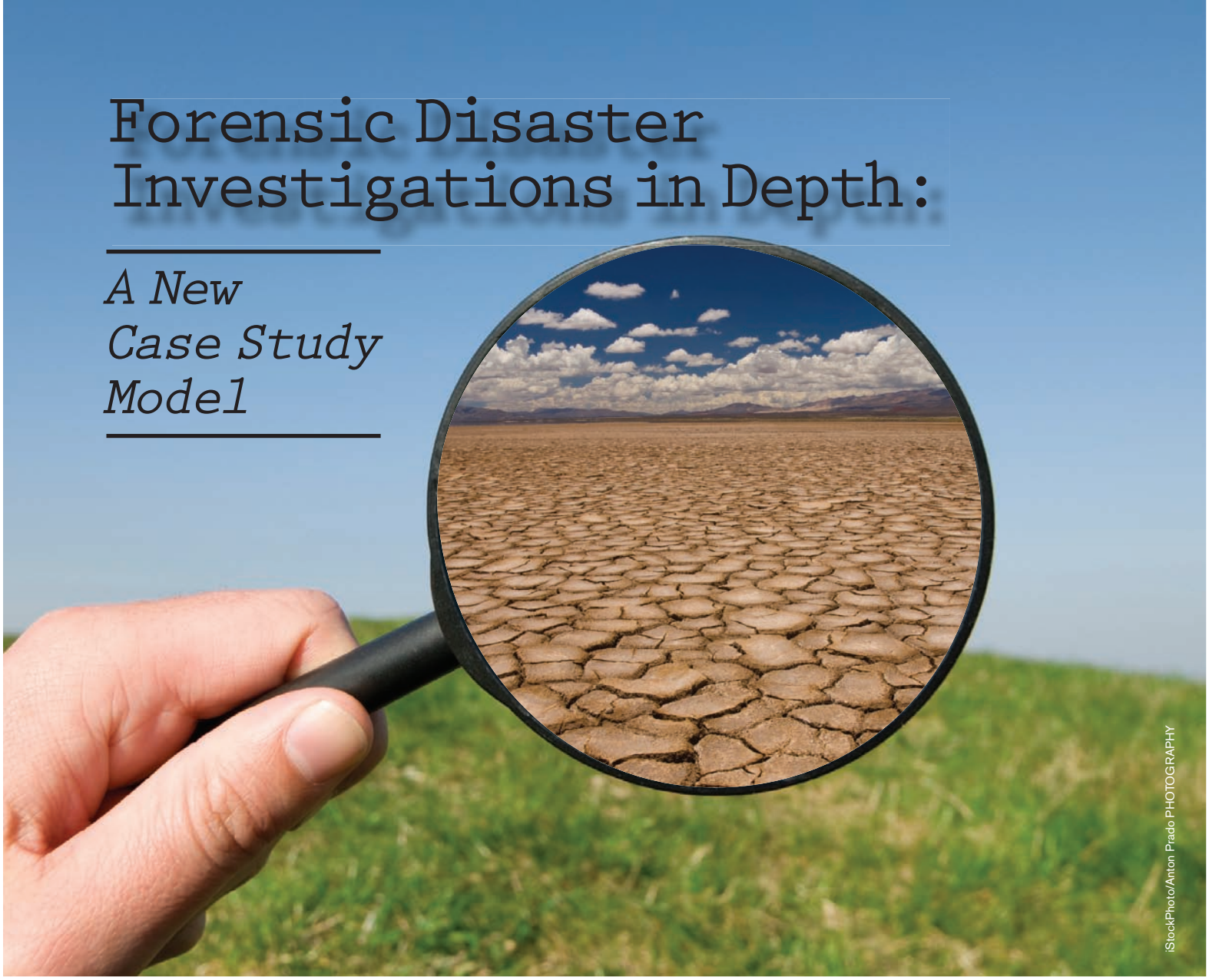
Forensic Disaster Investigations in Depth:

A New Case Study Model



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by Ian Burton

In an effort to take the "natural" out of the term natural disasters, a group of scientists has proposed a new set of international disaster case studies under the title "Forensic Disaster Investigations." The goal behind the case studies is to probe more deeply into the complex and underlying causes of growing disaster losses than previous research has. This long-term effort will require new institutional arrangements and broader interdisciplinary teams. The proposal for these studies is set out in the report of an ad hoc Working Group[1] established under a new international consortium of science organizations including the International Council for Science (ICSU), the International Social Sciences Council (ISSC), and the International Strategy for Disaster Reduction (ISDR).[2] The Forensic Disaster Investigations will form part of the program Integrated Research on Disaster Risk (IRDR),[3] now established under the consortium with its International Programme Office in Beijing, China. The main purpose of this article is to outline the central concepts and rationale for the Forensic Disaster Investigations (FDIs), in the context of IRDR, and to invite comments, suggestions, and contributions.

The FDIs will differ in at least three important ways from most previous disaster case studies:

First, the FDIs will penetrate more deeply into the fundamental causes of disasters in a broad, multidisciplinary, and comprehensive manner, and they will engage specialists from any and all relevant fields. This approach should enable recommendations to be developed that will facilitate "more informed and insightful decisions on actions to reduce their impacts, such that in 10 years, when comparable events occur, there will be a reduction in loss of life, fewer people adversely impacted, and

wiser investments and choices made by governments, the private sector, and civil society."[4]

Second, while the investigations will be carried out independently and at arm's-length from governments, they will also require authority, support, and promotion from the public. In order to be truly investigative and forensic in spirit, the studies must be empowered to pursue the evidence wherever it leads in order to be able to report fully on the train and ensemble of events, responsibilities, and actions that account for the losses. FDIs are not designed to be "witch hunts" or searches for guilt or culpability, although findings of such a kind cannot be ruled out *ab initio.* In almost all cases, responsibility for disaster losses is widely spread over institutions and over place and time. So the target of FDIs is the greater disaster risk management process in its entirety.

Third, for the previously mentioned reasons, the intended outcomes will not concentrate on the precise identification of any specific locus of responsibility, but rather will help bring about a paradigm or cultural shift in the ways in which disasters are understood and managed. As long ago as 1945, Gilbert White wrote, "Floods are 'acts of God' but flood losses are largely acts of man."[5] More recently the second national reassessment of natural hazards in the United States was entitled *Disasters by Design*,[6] which also signifies some level of human responsibility. Yet recognition and acceptance of these conclusions has not resulted in sufficient advances in practice or understanding, and so significant reductions in disaster losses have not been achieved in the developed or developing countries. It is the intent of FDIs, therefore, to ask "what acts of man?" and "what designs?" The flaws in current disaster risk management must be identified in a manner and with an authority that can help to bring about a fundamental improvement. The first step in this process is the willingness to accept that disaster risk management is in need of radical change.

It is hoped that FDIs informed by these ideas will be able to move on from disaster case studies, which have tended to be organized into discipline-based and relatively watertight "stovepipes" of inquiry with insufficient integration, into a more systemic approach. FDIs will move away from an orientation and a mindset that focuses on the disaster event and its initiating causal mechanism in geophysical terms and its aftermath, towards a recognition that the consequences of "natural disaster events" are bound up in the patterns and decisions of everyday life.[7] People and their homes and livelihoods are affected, as well as the environment and all its inhabitants.

With these ambitions in mind, the ad hoc Working Group described four complementary modes of analysis for a suggested research methodology, elaborating upon six important problem dimensions for FDIs.

Research Methodology

Critical Cause Analysis

This is a class of investigative methods that identifies the root causes of the disaster events and is premised on the belief that problems are best solved by attempting to correct or eliminate root causes, as opposed to merely addressing the immediately obvious symptoms. The approach would be multidisciplinary and should aim to integrate social, environmental, and technical assessments. This is partly because of the complex range and interaction of factors in disasters, and also because of the goal to pursue whatever explanations or safety conditions may offer the best opportunities for improvement. Specifically, the factors that are of particular importance are the following:

a. Causal analysis of hazards and the processes involved in human and asset losses with a view to identifying critical factors in the pre-disaster, impact, and post-disaster recovery phases. Also, identification of preventive measures that did or can apply to avoid, control, or limit the losses and for each process in the disaster risk sequence and identify those that caused harm or failed to offset it. If possible, engagement or consultation of a range of professional, technical, and local assistance in events.
b. Identification of the thresholds for failure or success points where damage occurred that could be prevented, eliminated, or reduced

Andrea Booher/FEMA

Fire ground crews work to contain the north and northeast side of the Chippy Creek Fire in Plains, Montana in August 2007. The fire consumed more than 90,000 acres of National Forest and Kootenai Tribal land.

In 2007, an 8.0-magnitude earthquake devastated Peru, creating many scenes like this one on the Pan-American Highway.

to an acceptable level in the face of a particular type of hazard.

c. Definition of critical limits—maximum or minimum values for factors in relation to the warnings, evacuations, building safety, etc.—to prevent, eliminate, or reduce loss to an acceptable level.
d. Establishment of monitoring requirements, which are necessary to ensure that the community, item, or process is constantly aware and protected at critical failure points.
e. Corrective actions that are appropriate to conditions and funding in given contexts, and that can be taken when monitoring indicates a deviation from an established critical limit. This will require a plan to identify corrective action if a safety limit is not met, and to reduce exposure and vulnerability to potentially damaging physical events.
f. Identification of proactive actions that could have been taken and enacted in order to guarantee that less risk was constructed in reality, such as land use planning, enactment, and enforcement of building norms and the like.

Used together and in association with the other approaches described, these six elements of critical cause analysis provide a basis for some confidence that forensic disaster investigations can break new ground.

Meta-Analysis

Meta-analyses are systematic reviews of the available literature that are used to identify and assess consistent findings across diverse studies. This analytical method offers potential for systematic investigation of disaster events. The findings of the case studies or research observations are coded and then statistically analyzed to look for causal linkages, the strength of relationships among factors (dependent or independent variables), and the effectiveness of interventions. The focus of such analysis may vary from a specific event or a hazard to "thematic attributes of disaster risk"–like the role of insurance in loss prevention to a differential impact of disaster loss on the poor, etc. For example, Rudel[8], in order to explain forest loss, did multivariate, statistically based meta-analysis of 268 empirical studies of deforestation that looked at causal factors. The meta-analysis is often used as a procedure for synthesizing the results of similar studies based on a consistent research design. This approach may be considered as the ex-post assessment, where the archival literature approach is the ex-ante. Examples of the ex-post meta-analysis include White's[9] pioneering work on hazard case studies ranging from local to global, and the comparative analyses of hazards in the world's megacities.[10]

Longitudinal Analysis

Longitudinal reconstruction allows repeated observations of the same items. In the context of disaster studies, these are detailed, place-based reanalyses of particular disaster events, and they are used to more fully understand the contexts and processes that expose people and their assets at risk. These reconstruc-

A worker surveys the damage caused by the fire in San Francisco's Marina District after the Loma Prieta earthquake struck in October 1989.

tions could be comparative geographically (e.g., two different but essentially comparable places with similar event characteristics, where the sequence of actions, decisions, policies, etc., leading to disaster risk and particular effects are cross-examined in comparative fashion) or comparative in situ (the same place, two temporally different events, repeat events, or the same place with two different perils). Among the better known disaster reconstructions are studies of the Buffalo Creek flood disaster[11] and the Peruvian earthquake in Yungay.[12]

The value of longitudinal reconstructions is that they provide in-depth understanding of the causes and consequences of disasters and the evolution of mitigation and/or risk reduction strategies. In the case of paired comparisons of a single place with multiple disasters, longitudinal reconstructions permit an analysis of which mitigation strategies worked, which ones could have worked if they had been implemented, the lessons learned, and the lessons not learned.

Scenarios of Disaster

This method retrospectively reconstructs and specifies the conditions, causes, and responses involved in particular destructive events. These are "forensic" in the sense that the process includes a wider area of coverage to trace out and assign causal explanation of losses, and the intervening conditions that increased or reduced losses.

It is inevitable that a major cyclone will eventually strike again in Southeast Asia or the Caribbean; that an earthquake will strike again in China, Turkey, Pakistan, Haiti, Japan, the United States, or South America; and there will be catastrophic flooding again in Mozambique, China, or Europe. The scenario should be science-based, and should be selected on the basis of a known hazard that represents a realistic and possibly inevitable future event. Potential scenarios may assess a historic disaster event if it were to reoccur in the near future, a hazard experienced elsewhere relocated to the study community, or a natural hazard viewed to be realistic for the study area.

This type of "forensic" work could possibly be referred to as "projective or predictive forensic," as it projects loss and its causes into the future as opposed to examining and explaining real loss in the past. The ShakeOut Scenario is an example of this form of forensic investigation. More than 300 experts from academia, industry, and the public sector assessed the impact of the potential 7.8 magnitude earthquake on the San Andreas Fault near Los Angeles, California. The ShakeOut study estimates that the earthquake may cause 1,800 deaths and US$213 billion of economic losses.[13]

Elaboration of Problem Dimensions

The collective efforts of the research approaches and methods described above help to establish a medium and

The town of Murfreesboro, Tennessee, suffered severe damage from a tornado in April 10, 2009.

The debris from Pass Christian Middle School in Mississippi before (above) and after cleanup. The school was destroyed by Hurricane Katrina in 2005.

a mechanism for developing better comparative understandings of the root causes and underlying process that lead to disaster risk in diverse socioeconomic, cultural, national, regional and local settings. In addition, the methods will achieve an understanding of the processes by which risk reduction policies and instruments are, or are not, laid out on the ground in specific but comparable disaster risk contexts. However, a series of groups of fundamental probing and critical questions should be clarified and in part resolved through the integration of results. In short, the questions relate to (i) disasters in the context of everyday life; (ii) knowledge creation, communication, and relationships with decision-making; (iii) responsibilities and governance; (iv) measurement of outcomes and differential impacts; and (v) attribution of cause and effect by social actors.

Next Steps

Since the report of the ad hoc Working Group was accepted by the Scientific Committee for the IRDR in April 2010, we are hopeful that progress and next steps can begin quickly. We will establish a more formal Working Group, and an initial meeting is planned to be held in Geneva in October 2010, with subsequent meetings to be held later in Japan and China. Among the tasks for these meetings will be (i) to prepare an template or study design for FDIs; (ii) specify minimal criteria by which any proposed FDI can be accepted as part of the family of the initial FDIs within the context of IRDR; and (iii) advance plans for the selection, management, reporting, financial and logistic support, and formal authority for the initial set of FDIs.

For these objectives to be realized in timely fashion, the participation of many hands, minds, and pockets will be required. Interested parties are directed to the newly established IRDR International Programme Office in Beijing.[14]

The idea for Forensic Disaster Investigations, as laid out in the ad hoc Working Group report, is ambitious—even visionary. In accepting the report, the IRDR Scientific Committee stated its view that the whole IRDR program is a fresh and innovative approach to disaster risk research. This is an important requirement because impacts of disasters continue to grow, despite substantial growth in the geophysical science knowledge and greatly enhanced forecasting and warning capacity in some instances, as well as major improvements and potentials in materials science and infrastructure design.[15] The growing integration of the global economy and communications also means that the consequences of disasters are less and less confined and have more impacts in places far removed from the disaster "site." The social context of disaster events is also changing. Economic development continues to fall short of sustainability. Population growth, inequality, and settlement expansion mean that more people and communities are at risk. The nature of society–hazards interactions is increasing in complexity. Added to these changes is the challenge of climate change, with its combination of changes in the character of acute and extreme climatic events, as well as the slower and incremental changes in climate regimes and sea level rise.

An aerial view showing damage in Dade County, Florida, from Hurricane Andrew, one of the most destructive hurricanes in America's history. One million people were evacuated and 54 died in this hurricane, which struck in August 1992.

The timing of the planning for Forensic Disaster Investigations is therefore opportune and necessary. Disasters are emblematic of both the troubles and opportunities of the era in which we live. Only if disaster risk management is substantially improved will there be renewed hope to more people and across the wider spectrum of risks.

Ian Burton is an Emeritus Professor at the University of Toronto and a Scientist Emeritus with the Meteorological Service of Canada. He has worked for many years in the natural hazards and disasters field and was one of the first to take up the challenge of adaptation to the impacts of climate change. He is currently a Coordinating Lead Author for the IPCC Special Report in preparation, "Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation". He is a Fellow of the Royal Society of Canada, and has recently worked as a consultant to the World Bank and the Secretariat of the United Nations Framework Convention on Climate Change.

NOTES

1. Participants in the meeting of the ad-hoc working group were as follows: Ian Burton (Chair), Susan Cutter, Ken Hewitt, Paul Kovacs, Allan Lavell, Gordon McBean (Chair SC IRDR), Brian Mills, Caroline Rodgers, Tarik Islam, and Dan Sandink.

2. ICSU-ISSC-UN ISDR, Report of the Ad Hoc Working Group IRDR Forensic Investigations (Toronto: International Council for Science, the International Social Sciences Council, and the International Strategy for Disaster Reduction).

3. Membership of the Scientific Committee for the International Research on Disaster Risk programme is as follows:

CARDONA, Omar Darío, National University of Colombia, Manizales, Colombia—earthquake engineering and risk mitigation

CHAN Kin Sek, Raymond, Civil Engineering and Development Department of Hong Kong, China—civil engineering, landslide mitigation

CUTTER, Susan, University of South Carolina, USA—hazards & vulnerability

EISER, Richard, University of Sheffield, UK—psychology, perception of risk

JOHNSTON, David, Massey University, New Zealand—earth sciences, disaster management

LAVELL, Allan, FLACSO, Costa Rica—social and developmental aspects of risk and disasters

McBEAN, Gordon, Inst. for Catastrophic Loss Reduction, University of Western Ontario, Canada—CHAIR

MODARESSI, Hormoz, BRGM, Orléans, France—geohazards, remote sensing

PATEK, Maria, Vienna, Austria—avalanches, torrents

RENN, Ortwin, University of Stuttgart, Germany—environmental sociology

TAKEUCHI, Kuniyoshi, ICHARM, Japan—hydrology, civil engineering

VOGEL, Coleen, University of the Witswatersrand, South Africa—geography, environmental studies

WIRTZ, Angelika, Geo Risks Research, Munich Re, Germany—economic data on disasters

Ex-officio:

GUO, Huadong, Center for Earth Observation and Digital Earth, CAS (CEODE), Beijing

HERNES, Gudmund, International Social Science Council (ISSC)

MASKREY, Andrew, UN International Strategy for Disaster Reduction (UNISDR)

MOORE, Howard, International Council for Science (ICSU)

ROVINS, Jane, Executive Director, IRDR. IPO. Beijing.

4. ICSU (International Council for Science), *A Science Plan for Integrated Research on Disaster Risk: Addressing the Challenge of Natural and Human-Induced Environmental Hazards* (Paris: ICSU, 2008).

5. G. F. White, G. F. *Human Adjustment to Floods: A Geographical Approach to the Flood Problem in the United States*, Research Paper No. 29 (Chicago, IL: Department of Geography, University of Chicago, 1945).

6. D. S. Mileti, D. S. *Disasters by Design: A Reassessment of Natural Hazards in the United States* (Washington, DC: Joseph Henry Press, 1999).

7. K. Hewitt, *Interpretations of Calamity from the Viewpoint of Human Ecology* (Boston: Allen & Unwin, 1983); K. Hewitt, *Regions of Risk: A Geographical Introduction to Disasters* (London: Addison Wesley Longman, 1997).

8. T. K. Rudel, "Changing Agents of Deforestation: From State-Initiated to Enterprise Driven Processes, 1970–2000," *Land Policy* 24, no. 1 (2007): 35–41.

9. G. F. White, ed. *Natural Hazards: Local, National, Global* (Oxford: Oxford University Press, 1976).

10. J. K. Mitchell, "Megacities and Natural Disasters: A Comparative Analysis," *GeoJournal* 49, no. 2 (1999): 137–142; J. K. Mitchell, ed., *Crucibles of Hazard: Megacities and Disasters in Transition* (Tokyo: United Nations University Press, 1999).

11. K. T, Erickson, *Everything in Its Path: Destruction of Community in the Buffalo Creek Flood* (New York: Simon and Schuster, 1976).

12. T. Oliver Smith and S. Hoffman, eds., *The Angry Earth: Disaster in Anthropological Perspective* (New York: Routledge, 1999).

13. USGS Circular 1324/California Geological Survey Special Report 207. *The ShakeOut Earthquake Scenario—A Story That Southern Californians Are Writing* by Suzanne Perry, Dale Cox, Lucile Jones, Richard Bernknopf, James Goltz, Kenneth Hudnut, Dennis Mileti, Daniel Ponti, Keith Porter, Michael Reichle, Hope Seligson, Kimberley Shoaf, Jerry Treiman, and Anne Wein, 2008. http://www.shakeout.org/scenario.

14. Integrated Research on Disaster Risk, International Programme Office, Dr. Jane Rovins, Executive Director. c/o CEODE, CAS. 14F Kedian Building, No. 9 Beiyitiao road, Zhongguancun, Beijing, 100190, China. irdr.beijing@gmail.com.

15. G. F. White, R. W. Kates, and I. Burton, "Knowing Better and Losing Even More: The Use of Knowledge in Hazards Management," *Environmental Hazards: Human and Policy Dimensions* 3, nos. 3–4 (2001): 81–92.