FORENSIC DISASTER INVESTIGATIONS
The FORIN Project

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PREFACE

Our knowledge and understanding of the root causes of disasters and how to effectively manage disaster risks has grown considerably in recent years, but to judge by results remains seriously inadequate. Moreover, the considerable amounts of information that are available are not being adequately deployed, nor effectively used and implemented. A common approach to understanding the actual causes of a disaster would go a long way in supporting future evidence-based decision-making, as well as increasing accountability for responsible policy-making in disaster risk reduction. These widely accepted ideas have been reconfirmed by several international and interdisciplinary groups in a series of meetings and reports developed under the initiative of the International Council for Science (ICSU). In light of these deliberations, a new major programme of international collaborative research and related activities has been launched under the name Integrated Research on Disaster Risk (IRDR), with the co-sponsorship of ICSU, the International Social Science Council (ISSC), and the UN International Strategy for Disaster Reduction (UN-ISDR). This programme is described in *A Science Plan for Integrated Research on Disaster Risk: Addressing the Challenge of Natural and Human-Induced Environmental Hazards* (ISCU, 2008).

One of the initial research components to be developed within IRDR involves a set of case studies carried out under a project entitled "Forensic Disaster Investigations" (FORIN). This project, and the template designed to shape and guide the case studies, have been prepared by an *ad hoc* Working Group set up through meetings in Toronto (February 2010) and Geneva (October 2010) and approved by the Scientific Committee for IRDR (IRDR-SC) in Paris (April 2011). This document is a result of those deliberations and decisions.

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CONTENTS

1. Background

This document sets out the objectives, concepts and methodological guidelines and suggestions for the design and conduct of a set of internationally organized case studies of disasters—the Forensic Investigation of Disasters (FORIN)—as part of the Integrated Research on Disaster Risk (IRDR) Programme, newly launched by the International Council for Science (ICSU), the International Social Science Council (ISSC) and the UN International Strategy for Disaster Reduction (UN-ISDR).

One of the underlying questions that gave momentum to the IRDR proposal for a series of forensic investigations was the conundrum: why, when so much more is known about the science of natural events including extremes and when technological capacity is so much stronger, are large-scale disasters (as well as the impacts of small and medium scale ones – see ISDR, 2009) apparently becoming more frequent and the losses continuing to increase at a rapid rate (White, Kates and Burton, 2001)? There has been over the last 50 years a substantial expansion of knowledge about the potential magnitude and frequency of many natural events and the places in which they are more likely to occur. Often the growth in losses is attributed to increases in human population and material wealth, and their expansion into more hazardous locations. This is certainly part of the explanation. It is also true that scientific knowledge and modern technology are not uniformly distributed and that many developing countries have a low capacity to utilize or introduce the science and technology that is theoretically available due to institutional or human resource barriers or, more importantly, cultural and resource scarcity reasons. But the fact that major disasters continue to occur in developed countries suggests that there must be more to the explanation than access to science and technology, and choice of location, important though these factors undoubtedly are.

It might be expected that the effective application of new and better knowledge and stronger technology would allow for a decrease in losses or at least stabilization, even as population and wealth increase. To some extent this has happened in some developed countries, where it seems (subject to some serious limitations in available data) that losses have just about kept level with economic growth; in other words they are a more or less constant proportion of GDP. In many developing countries the "success" rate has been less satisfactory and there are clear indications that in the highly vulnerable and exposed countries at least, losses are increasing faster than wealth, and are an impediment to social and economic development. Single larger scale or a series of sequenced smaller scale events can sometimes set back years of economic and social development, foster political insecurity, and cause long-lasting environmental impacts. Where the environment has been severely degraded, as in Haiti for example, such events are likely to lead to greater human impacts as new socio-natural hazards are added to already existing "natural" ones, or in the context of Forensic Investigations those disasters triggered by natural events. In developed countries, disaster risks could be managed better. In developing countries, it is not enough to say that improvement is possible: it is an imperative.

After a major disaster event it often happens that an enquiry is made or new research undertaken into the causes and consequences. When such investigations are conducted (and there have been many), they typically focus heavily on either the geophysical or atmospheric processes or the technological and structural aspects of the damage. Emergency preparedness and the disaster relief and rehabilitation response are also often examined. Sometimes an enquiry may extend to the effectiveness of existing policy and make recommendations for future policy

improvements. These efforts rarely seem to probe very deeply into the underlying and sometimes longer-term causes of the disaster, although excellent examples of this are to be found (Oliver-Smith 1999; Maskrey (Ed.), 1996). Nor are the enquiries necessarily carried out at arms-length from those most intimately involved and responsible. This is understandable to the extent that those consumed in disaster response and on the spot have the most knowledge of just what occurred, but not necessarily why or how. One consequence appears to be that enquiries tend to leave many questions unanswered or even not asked. Is it also the case, as some would argue, that in the aftermath of a disaster when many are suffering materially and physically and from post-traumatic stress disorder that there may be reluctance to risk creating more distress by probing too deeply into the causes.

2. Why forensic investigations?

IRDR has concluded that more penetrating investigations – developed and enacted in a more explicitly designed, multidisciplinary, standard framework with a common set of fundamental questions – could and should be made as part of the early phase of the IRDR programme. Such studies will search for additional, wider and more fundamental explanations for the current rise in disaster losses. These might extend from gaps in scientific knowledge in some instances to the ineffective application of available knowledge. Commonly identified in previous investigations are poor building standards, planning and design of infrastructure and human settlements. Less frequently addressed are questions concerning how and why decisions were made and management options chosen. This applies not only to major policy choices but to the many everyday incremental decisions and social and cultural practices that shape the resilience and vulnerability of communities. Investigations should explore these questions as well as new forces that may be emerging through the evolution and proliferation of communication and other technologies or the globalization of the world economy. The IRDR research initiative is therefore aimed to conduct investigations of these and other hypotheses and ideas at a greater depth and with more rigour than has previously been achieved. The use of the term "forensic" investigations should not be taken to imply that lessons and insights and new understandings can only be derived from "failures" or cases where mistakes can be identified. Here, we use the word "forensic" to signify systematic, probing and dispassionate investigations, rather than suggest links with morbidity, post-mortems or criminal detective work.

It is also important to conduct forensic investigations in places where extreme events have occurred with much less serious or highly variable consequences to help accumulate evidence of good practices and other success factors. An examination of good practice and low impact, as opposed to bad practice and high impact, can be achieved with different results by looking at the impacts of the same kind of event on different areas and sectors and different events on the same types of problem and sector. Clearly the forensic approach as briefly described requires more elaboration and the development of guidance for its implementation. The wider utility of such an exercise will depend on its interdisciplinary design and the non-partisan and professional integrity with which it is executed. The status and reputation of ICSU and its partners in ISSC and ISDR gives reason to believe that there are good prospects that such ambitions can be met.

As one of the initial activities under IRDR, FORIN is designed to address several ideas concerning disaster risk. Four basic hypotheses have been formulated in the following statements:

New and more probing research and understanding of the reasons for growth in public vulnerability and wider exposure would enable and stimulate improved disaster risk reduction. This is contingent upon greater accountability, visibility and transparency of risk reduction processes being employed (the risk reduction hypothesis).

As was indicated above, much of the research and management of disasters have focussed on geophysical events and their magnitude, frequency, distribution and causal mechanisms, largely considered by practitioners of the natural sciences. Alternately, the disaster events themselves have been studied as issues about the largely operational problems of emergency response, relief, rehabilitation and reconstruction, or analyses of research limited to disaster impacts and recovery efforts. FORIN case studies therefore need to be directed more emphatically towards the intermediate area or middle ground between the geophysical "trigger" events and the response. They will necessarily focus on the decision-making processes involved in the group, organizational, and institutional arrangements in existence prior to the disaster occurrence. It is arguably these pre-disaster issues of awareness, knowledge and management capabilities which are most in need of further understanding. On the state of this knowledge rest the risk reduction activities which have seemingly been unable to curtail the rising risks and growth in exposure and vulnerability.

New and more integrated and participatory research is required to yield more useful and effective results (the integration hypothesis).

Much of the previous research into natural disasters has been conducted in fragmentary fashion by natural scientists, social and economic experts, engineers, public health specialists, emergency planners, humanitarian relief organizations and many others, acting in their own relative professional isolation. Review of the causes of disasters is carried out either from a sectoral perspective or from the perspective of a specific component of the cause of impact, i.e., the lack of early warning systems. Typically these analyses have also been increasingly conducted with stakeholders as providers or receivers of information, but not necessarily as active participants in the research process. This record of research and investigations has not resulted in a sufficiently integrated and comprehensive understanding of disasters in either preceding or resulting disaster risk management. Nor has it generally led to a sense of commitment and responsibility on the part of decision makers involved. FORIN case studies therefore need to involve a wide range of disciplines and specialists working closely together and with civil society in pursuit of more comprehensive and fundamental explanations.

Responsibility for the continued growth in vulnerability and exposure is locally specific and diffuse over individuals, organizations, jurisdictions, and over time. This diffuse responsibility is not something planned or methodically organized but has simply evolved or grown up in this way. It is now postulated that more precise identification and structuring of responsibilities are needed, especially if these responsibilities can be made visible and transparent (the responsibility hypothesis).

There are many actors and decision makers who have a hand in the creation and/or the prevention of the growth of vulnerability and exposure. These range across many governmental and civil society organizations and institutions and are spread from household and local levels to the national, regional, multinational, and global. FORIN investigations therefore involve a focus on responsibilities, in the expectation that their more precise recognition would lead to improvements in disaster risk reduction.

The knowledge that exists about disaster risk reduction has not been communicated effectively. This is because the intended recipients are insensitive to the insights or resistant to the knowledge and information and may feel threatened by it (the communication hypothesis).

To tell experts, managers, and decision-makers that they are failing in their task (to reduce disaster risk) is not likely to be welcome news, and some resistance or denial is to be expected. The communication hypothesis suggests that new and better ways of communicating scientific understanding about disaster risk reduction are required if the practice of DRR is to become more effective. It is also more than a matter of communication. To be informed about a risk (for example to critical infrastructure) in circumstances where those responsible are powerless to take action is to invite denial.

None of these four hypotheses are new, nor are they a comprehensive set of potential explanations for the weaknesses of disaster risk reduction and management in practice. However, they do provide a useful starting point on specific defined areas of enquiry for the FORIN case studies. It is to be expected that as the research progresses the hypotheses will be refined and new ones added.

In summary, the essential elements of the disaster forensics approach as envisaged by IRDR are as follows:

a. To investigate the circumstances, causes and consequences of losses in disasters and to identify conditions that have limited or prevented loss.

b. To operationalize and test a series of hypotheses of damage causality (including primary and secondary hazards, settlement, land use, the built environment, development paths and others).

c. To identify especially key factors in the expanding numbers or losses in disasters during the past few decades and to show just how they enter into risk and disaster.

d. To investigate the use of existing scientific knowledge in disaster risk assessment and management

3. The Objectives

The FORIN investigations have multiple objectives driven by the common hypothesis that neither the past nor the current, local, national and global programmes and activities are being guided or supported by a sufficiently strong, in-depth and profound knowledge about environmental hazards and disasters and their underlying root causes. The diverse range of objectives that could be attained through the effective implementation of FORIN investigations are summarized below:

Policy objectives	• To experiment with multi-disciplinary and multi-stakeholder inputs • To encourage participation by decision makers as they develop public policy • To guide policy across and involving all key disciplines • To guide public and private investments that reduce risk
	• To focus attention on the link between research findings and improved policy application • To develop a reference bank of high-quality case studies to be placed on the IRDR website for wide availability to interested parties • To effectively communicate the causes of disasters
Scientific research objectives	• To advance methodological diversity • To test existing theories and concepts • To implement science-based results • To build a strong, interdisciplinary, 'in-country' capacity of young researchers
Development objectives	• To substantiate that generic causes have local manifestations: "*one size solutions do not work everywhere"* • To promote a 'learning culture' amongst all stakeholders • To advance understanding of how the causal factors of disasters can be major impediments to development • To identify situations where development initiatives can become causal factors in disasters • To guide recovery and reconstruction efforts

Disaster risk reduction objectives	• To promote sustainable risk management and risk reduction through science-based research and findings • To guide the implementation of the Hyogo Framework and to present key case studies on the 2015 HFA target date • To give a priority focus on reducing human consequences, (social and economic vulnerability) with a secondary concern for physical or environmental losses • To change paradigms, by shifting responsibility from nature, the physical environment or even from "government" itself and distributing it accordingly to real circumstances and conditions involving all sectors of society including the individual and the collective. This entails increasing responsibility for all stakeholders in managing risk (individuals, households, communities, local government, etc.) • To develop case studies that illustrate 'risk-drivers'

4. Research methodology

Four approaches have been identified as offering different and complementary modes of analysis for application in a series of core investigations of events of particular concern in given places, regions, or contexts where existing explanations seem insufficient or are contested and/or where there are some prospect of bringing exceptional or recurring losses under greater control. These might centre upon Critical Cause Analysis (CCA), and this can in turn draw upon other approaches including meta-analysis, longitudinal analysis and scenarios.

It is the sense of the Working Group that despite great advances in many aspects of science applied to disasters, there are rarely investigations sufficient to base a full and comprehensive assessment of the causal factors. Geophysical and geotechnical understanding is rarely brought together with social profiles of risk and response. There are deaths and damages in a range of recent disasters about which there is no mystery. The immediate and proximate causes of the collapse of schools and hospitals in Gujarat, Sichuan and northern Pakistan are well understood. So are the reasons for the collapse of buildings in Mexico City in 1985 or Izmit, Turkey in 2006. It is also clear why casualties among women and the elderly were disproportionate in the Kobe earthquake of 2004, and why exceptional losses were recorded among the elderly, the disabled, and poor African-Americans during the 2005 Katrina events in New Orleans. Moreover, within all the disaster zones of these events there were cases of schools, hospitals, high-rise blocks, groups of women, children and the elderly who survived unharmed or were able to recover quickly mainly thanks to effective social and economic protection measures that others did not have. Thus there is a good deal of evidence that suggests losses were not the inevitable consequence of the earthquakes or storms, but of the failure to learn lessons from past events, the lack of applied normative behaviour, diverse decision making failures, poorly managed recovery and reconstruction following them amongst other humanly induced or promoted factors. It is a remarkable fact that very few places where recent major

disasters have occurred lack a history of disasters, or events than can be shown to threaten major losses when they recur.

Forensic investigations are partly about looking more broadly at the conditions and profiles of risk and losses, more sophisticated analysis to identify causal relations of how, where and to whom losses occur; not ignoring where they do not occur and why. The point is to identify those causes about which something can be done, which in itself requires social, cultural and economic sensitivity to the type of society being considered and its opportunities and limitations; to find the best evidence of what was done, and if nothing could have prevented or withstood the forces involved, then what other options there are for avoidance and the use of more risk averse practices; and saving lives if not property. To the extent possible, FORIN investigations will seek to emulate what a range of professional investigations have achieved in other fields such as industrial accidents, transportation safety, fire, and disease prevention: that is to identify key hazards or forms of endangerment that can be acted upon to limit or prevent harm and economic losses.

The Template for the FORIN Investigations, (Section 6) is intended to be more than a guide for "case studies" in a narrow scholarly or scientific sense. The objective is to look more deeply into the causes of disasters by integrated, comprehensive, transparent, and investigative or forensic means. The intent of the FORIN project is that the studies will be designed to be policy-relevant and will aim to provide policy options and evidence-based prescriptions and alternatives for improved disaster risk reduction, including decision making and management.

It was agreed at an early stage in the IRDR deliberations that the term "natural" would not be used in relation to the disasters under study. The subtitle of the IRDR Programme refers to "the challenge of natural and human-induced environmental hazards". It is assumed that the separate and interactive roles of natural and human drivers are still not adequately understood. As long ago as 1945 Gilbert White wrote, "Floods are 'Acts of God' but flood losses are largely acts of man". More recently the second national assessment of natural hazards in the United States, "Disasters by Design" (Mileti, 1999), also signifies some level of human responsibility. Yet recognition and acceptance of these broad conclusions in the scientific community have not yet resulted in sufficient advances in public understanding or changes in practice. Disaster events continue to be described as "natural" and losses continue to rise at an accelerating rate in both developed and developing countries. It is the intent of FORIN investigations therefore to ask in specific circumstances and places "what acts of man?" and "what designs?" are complicit in increasing the severe effects of disasters.

The vision of FORIN case studies also goes further. Answering questions about responsibility and governance requires a paradigm shift or a transformational change in the ways in which disasters are conceived and understood. This goes beyond only technical research and its publication and wider dissemination of results. It requires that FORIN case studies be used as a step in motivating changed behaviour through better understanding of disaster causes. There are important differences in the way environmental hazards such as floods, droughts, tropical cyclones, earthquakes are approached and socially constructed from the way in which technological hazards such as oil spills, structural failures, industrial, nuclear and transport accidents are investigated. The latter events are routinely subjected to probing investigations and *post facto* risk analyses, with the results of these enquiries fed back into revised laws, regulations, and practices in the public and private sectors. Further, compliance is then stipulated and ideally closely monitored.

How might such a process of future anticipated risks, improved management and governance be developed in the case of environmental hazards? How might the public sector and international dimensions be taken into account? Forensic investigations represent an attempt to move in such directions. They can be regarded as a preparatory step or a proof-of-concept exercise. Case studies of the kind that this template encourages will document another beginning.

FORIN investigations will differ in at least three important ways from most previous disaster case studies:

First, the investigations 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 ten 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."

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. FORIN investigations 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 FORIN investigations 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. 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 FORIN investigations 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. The investigations 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. People and their homes and livelihoods are affected, as well as the environment and all its inhabitants.

5. The FORIN framework

A conceptual framework for the FORIN investigations is shown diagrammatically in Figure 1. This is derived in part from the Hyogo Framework for Action, which guides the work of the UN International Strategy for Disaster Reduction (UN-ISDR).

The top level identifies governance as the primary factor in driving disaster risk reduction within a state. The shared aim of the Hyogo Framework and the UN-ISDR and of the FORIN studies is to achieve significant improvements in the governance and management of disaster risk. The 2009 *UN-ISDR Global Assessment Report on Disaster Risk Reduction* (GAR) and the newly released 2011 GAR Report both strongly emphasize governance as a critical element. A second essential element is risk assessment, made up of causal agents, social systems and infrastructure. Then comes understanding and awareness of underlying causal processes and outcomes and impacts in terms of sectors, spatial distribution and susceptible populations. The results of the application of the framework and its concepts are intended to lead to the identification of "risk drivers" and opportunities for risk reduction and resilience enhancement.

Figure 1. A conceptual framework for key questions.

This framework is intended as a guide to the development of FORIN investigations.

6. The FORIN template

There are various approaches for addressing the core questions, depending on different contexts or motivating interests involved, but they are all guided by the same overall objectives outlined above. The selection of the appropriate research methodology for a specific event or set of risk conditions is a function of the expertise of the research groups conducting the studies as well as the nature of the case study itself. Four of the more salient approaches are briefly described here. These are intended to be suggestive, and neither comprehensive nor limiting. The FORIN investigations should be objective and of substantive content.

A. Critical cause analysis

This is a class of investigative methods that seeks to identify the root causes of the disaster events. It is based 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 multi-disciplinary 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 to remain open to pursue whatever explanations or safety conditions may offer the best opportunities for improvement. The following tasks are identified:

i. Identify critical causal factors and the locally specific processes in the pre-disaster, impact, and post-disaster recovery phases through causal analysis of hazards and the processes involved in human and asset losses. Also, identify preventive measures that did or can apply to avoid, control or limit the losses, and for each process in the disaster risk sequence identify those that caused harm or failed to offset it. Engage, or consult with a relevant range of professional, technical personnel, and those providing and local assistance in events.

ii. Identify the thresholds for failure or success points where damage occurred that could be prevented, eliminated or reduced to an acceptable level in the face of a particular type of hazard.

iii. Define 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.

iv. Establish monitoring requirements necessary to ensure that the community, item or process is constantly aware and protected at critical failure points.

v. Correct 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.

vi. Identify 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, or enactment and enforcement of building norms.

B. Meta-analysis

Meta-analyses are systematic reviews of the available literature carried out to identify and assess consistent findings across diverse studies. This analytical method offers potential for systematic investigation of disaster events where the findings of the case studies or research observations are coded and then statistically analysed 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 the thematic attributes of disaster risk such as the role of insurance in loss prevention or differential impact of disaster loss on the poor. So for example, Rudel (2007) undertook multivariate, statistically-based meta-analysis of 268 empirical studies of deforestation looking at causal factors used to explain forest loss.

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 (1975) pioneering work on hazard case studies ranging from local to global, and the comparative analyses of hazards in the world's megacities (Mitchell, 1999a, b).

C. Longitudinal analysis

Longitudinal reconstruction allows for repeated observations of the same events. In the context of disaster studies, these are detailed, place-based re-analyses of particular disaster events and are used to more fully understand the contexts and processes that expose people and their assets to risk. These reconstructions can be geographically comparative (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* (same place, two temporally different events, repeat events; or the same place with two different perils). Among the most well-known disaster reconstructions are Kai Erickson's Buffalo Creek disaster (Erickson, 1976); and Anthony Oliver-Smith's work on the Peruvian earthquake in Yungay (Oliver-Smith and Hoffman, 1999).

The value of longitudinal reconstructions is in providing 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, this approach permits an analysis of which mitigation strategies worked, which ones could have worked if implemented, the lessons learned and the lessons not learned.

D. Disaster scenarios

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

It is inevitable that a major cyclone will sooner or later strike again in South or Southeast Asia, or the Caribbean; that an earthquake will strike again in the following (and other) places: 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, 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 likely to reoccur in the near future, assessment of a hazard experienced elsewhere relocated to the study community, or the impact of 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" given that 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 a potential 7.8 magnitude earthquake on the San Andreas Fault near Los Angeles, California. The ShakeOut study estimates that such an event may cause 1,800 deaths and US$213 billion of economic losses (Jones et al., 2008).

7. FORIN questions

A series of questions has been formulated to serve as the central structure of the FORIN investigations. These are grouped into 20 core questions to be directly addressed in each of the case studies according to the specific circumstances. They are followed by a set of 10 generic questions which will be used to help design the project synthesis report.

A. Core, case-specific questions

1. What were understood to be the immediate, proximate causes of the disaster or the initiating event(s)?
2. What was the state of scientific knowledge about the event (or category of events)?

   2a. Was this event(s) forecast or predicted?
3. Was the existing knowledge widely available and accessible?
4. Were there any decision-makers, other actors, stakeholders or victims (or those at direct risk) who were unaware of the information (or less aware than they might have been)?
5. How long had the scientific knowledge been available and had it significantly changed or improved in the recent past?
6. What was the past record of the occurrence of this particular type of initiating event?
7. How was the risk of this event (and/or similar events) perceived and understood by all the categories of stakeholders?
8. What strategies, laws, policies or measures had been considered to prevent the impact of the event or reduce its consequences? (It may be appropriate here to distinguish between those policies or measures related to existing risk – e.g., retrofitting hospital and schools or relocating communities – and those that will have sought to avoid new risk – e.g., public investment decisions taking into account risk factors; higher safety standards for the construction of infrastructure; or land use planning to avoid exposure.

   8a. Were any options rejected?
9. To what extent had strategies, policies or measures considered under Question 8 actually been implemented and put in place?
10. Where disaster risk prevention or reduction measures had been put in place or adopted in pre-event conditions, were they effective? How and to what extent?
11. Provide a detailed description of role and actions of key personnel and agencies for emergency response, specifically in relation to the effect on future levels of risk or disaster risk reduction.

    11a. Provide a detailed description of the role of key personnel and agencies for long-term recovery, specifically in relation to future levels of risk or disaster risk reduction.
12. Provide a list of the impacts of the disaster in qualitative and quantitative terms specifying in detail according to a breakdown such as: mortality with cause of death; morbidity with kinds and numbers of injuries; direct economic damages and losses by sector, property losses,

business disruption and discontinuity; losses covered by insurance and not covered; and other losses.

13. Identify the nature and effectiveness of disaster response measures in terms of the need to provide shelter for the homeless, rescue those trapped, and to assist in evacuation or relocation. What proportion of these needs was it possible to meet, and over what time scale?
14. Identify the nature and effectiveness of the long-term rehabilitation and reconstruction.
15. What was the economic/social status of the community immediately before the event and how did it change subsequently?

    15a. What had been relevant development trends over the previous ten years?

    15b. How has the community been affected in the aftermath (short, medium and long term depending on the time since the disaster occurred)?

    15c. What is the nature of community recovery? For example how fast was the recovery process; which parts of the community recovered first and fastest; and which members of the community or social groups recovered more quickly and effectively?

    15d. Have pre-disaster trends been continued, exacerbated or reversed? What are the major factors that explain this?

16. Assess the distribution of losses (impacts) within the community in terms of the following: socioeconomic status; occupation/employment; education; location; size of household /family unit; access to information and communication
17. Were there groups or individuals in the community (or outside the community) who clearly benefited from the disaster event?
18. Was there any sense of unfairness or discrimination in the community before, during or after the disaster? If yes, describe and explain.
19. What is the social and political power structure in the community?

    19a. Has this changed pre- to post- disaster?

20. Is there an overall or prevalent community shared view of the disaster? Alternatively, are there contrasting or conflicting views? Describe and explain.
21. How did one initial hazard create or lead to another and propagate disaster from one form to another? (GEJET)
22. How did the network of access to resources (electricity, water, transport) break down and propagate from one stage to another?
23. What were the consequences of network break down in each stage? In particular what were the consequences of stoppage or malfunctioning of electricity supply, water supply, sewerage, transportation, communication lines, retail shops, wholesale, economic activities, health services, education activities, industrial production, community administration, etc.?
24. What alternative actions were taken or not taken to compensate the network break in access to resources?
25. How did the network break in access to resources recover and come back to normal?

B. Generic questions

G1. What conditions or factors limited or prevented losses?

G2. What key factors affected or caused the major damage (e.g., primary and secondary hazards, settlement, land use, and the built environment)?

G3. What were the critical transitions in recent history (preconditions) that increased and changed the distribution of impact?

G4. How did culture and societal norms influence the disaster risk?

G5. How did economic and political status influence the disaster risk?

G6. Were there secondary or tertiary "disasters"? If yes, what were they (for example, during and after relief and recovery)?

G7. What were the drivers of disaster prevention/resilience by broad categories: social characteristics, economic activity and livelihoods, levels of investments that reduced risk, institutional and governance structures, environment, infrastructure (critical infrastructure and residential environments), community competence (including prior experience with events, social cohesion, and social networks).

G8. Were there barriers to disaster risk reduction? If yes, what were they (for example, culture, class, religion, ethnicity, and language)?

G9. Were there national and international ramifications to the localized disaster impacts? If yes, what were they (for example, political, economic, institutional, and geo-strategic)?

G10. Identify the key aspects of local and national disaster risk contexts developed over time that influenced the outcome (for example, through preparedness, vulnerability and exposure for hazard).

These sets of core and generic questions may be grouped according to the part of the conceptual framework to which they are most applicable. The allocation is shown in Figure 2.

TABLE 2. Cross classification of key and generic questions within the conceptual framework

Category/level	**Questions**
Governance/Priority	8, 11, 11a, 18, 18a, 19, G10
Risk assessment	1, 2, 2a, 6, 7
Understanding/awareness	3, 4, 5, 6, 7, 20
Outcomes/impacts	12, 13, 14, 15, 16, 17, G2, G6, G9
Risk reduction	9, 10, G1, G4, G5, G8
Enhancing resilience	15, 15a, 15b, 15c, 15d, G3, G7

C. Additional questions to be considered as core

A small number of additional questions emerged in discussions about the Template. The following five could be considered by research teams.

C1. Were the private and public social actors responsible or participating in the construction of risk conditions explicitly identified and analysed and the nature of their historical pre-impact gains, economic or otherwise, clearly specified?

C2. How did the actions of the social actors creating or contributing to the construction of risks relate to the development model in the respective countries?

C3. How was risk and disaster construed and institutionalized as a practice in the different locales (communities, regions, provinces, states, countries) and other government levels, and is there any relationship between different institutional set-ups and the nature of impacts?

C4. To what extent did internationally financed infrastructure or other developmental project activities affect the risk environment in the area?

C5. Were there critical thresholds that were exceeded (infrastructure capacity, institutional capacity, timing/magnitude of the event), resulting in greater impacts than would normally be the case?

8. The selection of FORIN investigations

The use of this document as an aid in the design and execution of research into disaster risk is not restricted. No intellectual property rights are claimed. What is reserved is the recognition of forensic investigations as an approved and integral part of the FORIN project within the IRDR Programme. Research groups and organizations who wish to contribute their research to the project are invited to submit proposals to the Chair of the FORIN Working Group in the first instance. The Working Group will assess proposals and make recommendations to the IRDR Scientific Committee on the basis of five main criteria:

- the proposal directly addresses a significant number of the key questions listed and described below,
- the proposal accords with the spirit and intention of this FORIN Template,
- the proposed case study will have the potential to be compared and integrated with other studies in such a way as to contribute to an overall project report and assessment,
- the proponent group has access to the required research funds (or is in a position to make proposals for funding) and has the capacity to carry out one or more case studies in terms of its expertise, research record, and organizational and institutional status.
- there is evidence of commitment to the objectives of the FORIN project with the promise and potential of significant contributions to the project and its results.

It is expected that an initial group of studies be set up to provide proof of concept and to test the Template.

We can distinguish four types of studies, dealing with:

- specific events (e.g., the Hanshin earthquake, Japan);
- recurrent events (e.g., floods in Mozambique);
- thematically important dimensions (e.g., school and hospital safety, trans-boundary risks, etc.);
- risk drivers (e.g., management, poverty, governance, etc.).

A balanced set of studies will therefore be selected in order to cover all four types. The selection process must also take account of the need for a balanced coverage of geographical regions and disaster types for these case studies. Typically, the broad schema of the FORIN initiative can be shown in the following table:

	Specific event	Recurrent, chronic and persistent events	Thematic issues	Risk drivers
Critical cause analysis				
Meta-analysis				
Longitudinal analysis				
Scenarios of disasters				

Plans are being made to organize project meetings to share progress reports, preliminary findings and related issues and questions. At a later stage, details will be worked out for the production of an integrated report (or reports), and their wide dissemination under the IRDR Programme, including but not limited to web-based materials. This will not constrain their further publication or distribution in other forms by individual research groups if they so wish.

9. The evolution of FORIN research

The idea of forensic disaster investigations has been imagined in two phases. First, as outlined in this framework and template document, there is a need to mount some preliminary and proof-of-concept experimental and pilot case studies. This includes the development of "narratives" prepared on the basis of existing knowledge and studies of specific disasters re-examined in light of the FORIN project. Information on recent disasters that have been reported in great detail such as Hurricane Katrina or Hurricane Mitch, or earthquakes in Haiti, or Christchurch, New Zealand might be re-examined from a FORIN perspective. It would be helpful to know what new insights or knowledge might be expected to emerge from such a thought experiment even in the absence of new empirical research and data collection. It is to be expected that these studies will contribute in important and insightful ways to the advancement of disaster risk reduction and management. The cause to which this work is directed is complex and not susceptible to easy or quick resolution. This FORIN research is undertaken in the knowledge that to bring about the transformational changes and paradigm shift required is a long-term process. There is considerable confidence that the direction in which to move is understood. The ordered means to accomplish that remains much less clear.

A longer term vision is that the use of more forensic investigatory approaches to what have been commonly referred to as “natural” disasters can be used to create a more critical approach that will lead to containment and eventually a reduction of disasters and disaster losses. Such an aim has hitherto eluded the best efforts of the research, policy, and practitioner communities. Better results can be achieved. Only time will tell how much forensic disaster investigations can contribute towards this goal.

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