REPORT OF THE COLORADO WORKSHOP ON HAZARD MITIGATION IN THE 1990s

TOWARD THE U.S. DECADE FOR NATURAL DISASTER REDUCTION

DNDR 1

REPORT OF THE COLORADO WORKSHOP ON HAZARD MITIGATION IN THE 1990s

TOWARD THE U.S. DECADE FOR NATURAL DISASTER REDUCTION

March 1989

DNDR 1

Prepared by
The Natural Hazards Research and
Applications Information Center

TABLE OF CONTENTS

PREFACE

William E. Riebsame
Director
Natural Hazards Research and
Applications Information Center
University of Colorado

A "Decade for Natural Disaster Reduction" could evoke the best efforts and highest ideals of the hazards community. The Decade has already garnered wide international attention, and U.N. agencies are moving forward at a brisk pace. The challenge to researchers and practitioners in the U.S., then, is to fashion a United States National Decade, one in keeping with the special hazardousness of a developed, industrialized country on a continent with large seismic zones, a chain of active volcanoes, thousands of miles of storm-prone coastline, large and small flood-producing river basins, and some of the most severe summer and winter weather anywhere in the world.

The U.S. Decade for Natural Disaster Reduction (USDNDR) is being formulated in several different circles, with the chief activity of relevant federal agencies and the National Academy of Sciences being the creation of a committee to establish the goals and objectives of the Decade, in keeping with the broad goals outlined in the Congressional resolution on the Decade. However, when workshop participants gathered in Colorado to generate ideas for the USDNDR, they had a clean slate and an opportunity to envision a program of any shape or size.

And envision they did. They suggested a process that was built from the bottom-up, based on state and local efforts and needs, supported by national agencies, integrated into the country's leading institutions, and able to focus the efforts of researchers, practitioners, and the private sector on the problem of reducing community vulnerability to disasters. They proposed the creation of new private-public partnerships in disaster reduction, called for a national mechanism to nurture coordinated disaster reduction efforts at multiple governmental levels, and identified the serious constraints – political, economic, and technical – that stand between these efforts and true disaster reduction.

Among these hurdles are difficulties in applying relevant expertise and knowledge, insufficient awareness among many segments of government and the general population, financial constraints to hazard mitigation, and, ultimately, the simple fact that national economic development is the root cause of increasing disaster potential. Participants recognized that until the institutions and forces that shape development become more sensitive to hazards, losses from natural disasters will not decrease.

The overall challenge of the Decade is to reduce natural disaster losses in the world while still nurturing social development. This goal must now be supported by new approaches and strengthened existing programs for hazard reduction. Realistically, however, we might consider the Decade successful if we can at least curb the growing losses associated with natural extremes. The value of the Decade is not just its potential for reducing hazard impacts by 1999, but its potential for doing so through predisaster mitigation rather than through greater efforts to intervene after a disaster has struck. It may well be that we will measure the success of the Decade by the number of hazard reduction efforts undertaken or strengthened rather than by actual hazard losses avoided. National development trends will almost certainly place more people and property at risk in the next ten years, and disasters may stay ahead of our efforts to alleviate their impacts in the 1990s. Nevertheless, a vigorous program in the 1990s may lead during the 2000s to the first period in human history marked by real reductions in losses due to natural extremes, a reduction that will rest on the foundation of the "Decade" we are about to begin.

EXECUTIVE SUMMARY

> Whereas the natural hazards of earthquakes, tsunamis, volcanoes, floods, hurricanes, typhoons, tornadoes, landslides, and wildfires have caused great loss of life, enormous property damage, and untold suffering in the United States and throughout the world;
>
> Whereas Congress, recognizing that natural and technological hazards may not be independent of one another in any given disaster . . .
>
> Now, therefore, be it Resolved . . .
>
> That Congress strongly endorses the establishment of a United States Decade for Natural Disaster Reduction as a means of supporting the goal of the International Decade for Natural Disaster Reduction to enhance existing cooperative efforts and promote new cooperative efforts to reduce the devastating impact of natural hazards in the United States and throughout the world.
>
> From legislation establishing the
> United States Decade for Natural Disaster Reduction
> 100th Congress, 2nd Session

Background

In 1988, the U.S. Congress passed legislation establishing the United States Decade for Natural Disaster Reduction (USDNDR) (H. Con. Res. 290, S. Con. Res. 131, 100th Congress, 2nd Session). In doing so, the Congress also endorsed the International Decade for Natural Disaster Reduction (IDNDR) established by a unanimously passed resolution of the 42nd Session of the United Nations General Assembly in December 1987.

The U.N. resolution urges each member nation to establish its own national program for a decade of hazard reduction within its boundaries and, unilaterally or multilaterally, with other member nations. The USDNDR, therefore, serves two purposes: 1) it focuses on natural hazard reduction within the United States and 2) it forms the framework in which the United States can cooperate with other U.N. member nations to reduce natural disasters throughout the world.

As spelled out in the U.N. resolution on the IDNDR, the goal of hazard reduction is to be accomplished through the application of extensive, existing physical science, social science, and engineering knowledge; through the identification of gaps in knowledge; through the implementation of mitigation measures, preparedness planning and hazard awareness; and through the timely and effective transfer of information and knowledge on hazard reduction.

In establishing the USDNDR, the U.S. Congress called for the enhancement of existing programs and new cooperative efforts between governmental and nongovernmental groups.

In mid-October of 1988, 40 hazards researchers, practitioners, and policy makers gathered near Estes Park, Colorado to generate additional ideas, to make recommendations for better cooperation through existing mechanisms, and to make suggestions for new cooperative efforts aimed at hazard reduction in the United States during the 1990s. The suggestions and ideas of these experts are described in this document.

Recommendations of the Workshop

Participants at the U.S. Decade workshop contributed to five working groups which examined: 1) Integration of Disciplines, 2) Social, Economic, and Political Constraints, 3) Technology Transfer, 4) Private Sector Role, and 5) State and Local Role

The goal of each working group was to suggest approaches, strategies, and goals for hazard reduction in the 1990s in the United States, keeping in mind the status of hazard reduction at present, trends that may affect future efforts, and short- and long-term hazard reduction goals. Detailed summaries of the working group findings are presented later in this report.

The workshop produced several cross-cutting suggestions and recommendations, including:

- That the USDNDR should identify a limited number of specific goals to be achieved by the end of the Decade, and that these goals should include:
  1) providing effective hazard mitigation at the state and local level;
  2) assessing the status of hazard research and applications to provide a baseline for the Decade; and
  3) assessing and strengthening existing programs that can contribute to the Decade.
- That the USDNDR will succeed only with broad, early, and concrete participation by state and local institutions with hazard responsibilities, and that it is at this level that implementation will have to occur;
- That the USDNDR must involve the private sector in all planning and implementation. The Decade offers a special opportunity to construct private-public partnerships for hazard reduction built on the incentive of long-term benefits rather than the disincentive of regulation or loss;
- That the USDNDR must rely on effective technology and information transfer from those able to generate information and research findings and those who know how to implement hazard reducing efforts;
- That the USDNDR needs an integrated plan from the beginning for monitoring and evaluating its progress, along with a set of criteria for measuring actual hazard reduction; and
- That the USDNDR should focus on domestic hazards and needs of U.S. regions and communities facing the most serious threats from natural extremes while complementing and supporting the International Decade for Natural Disaster Reduction where possible.

Next Steps and Goals

Several important next steps were identified at the workshop. Workshop participants urged federal agencies and the National Academy of Sciences to agree on an organizational structure for the U.S. Decade for Natural Disaster Reduction at the national level. The development of a process to keep hazard groups at different governmental levels and institutions informed of USDNDR program developments was also suggested. That process would also allow these entities to contribute to a nationally coordinated USDNDR effort.

The need to develop a set of broad goals in the U.S. for hazards reduction programs during the next decade was identified as another important "next step." A set of broad goals gives each level of government and all relevant institutions a focus, but allows each entity to organize a subset of goals and objectives to complement the national effort. Such program planning could include short-range (1-3 years) and long-range (5-10 years or more) horizons. The suggestions of workshop participants concerning such goals are presented in the main body of this report.

There were many suggestions for possible steps in the near future, including:

- Recognition by the executive branch of federal government in the form of an executive order or presidential proclamation;
- Establishment of a program to nurture state, local, and private sector contributions to the USDNDR;
- Creation of a national steering committee or advisory group broadly representative of the hazards field;
- Assessment of knowledge about and efforts being made in hazard reduction, including actual regional comprehensive hazard assessments; and
- Creation of local or regional demonstration projects.

INTRODUCTION

For two and one-half days in October 1988, 40 hazards researchers, practitioners, and policy makers gathered to generate ideas and make recommendations for a U.S. Decade for Natural Disaster Reduction. The workshop occurred at a propitious time: before formal institutional structures for the U.S. Decade were established and before the idea had been widely discussed within the U.S. hazards community. Since the Decade was still undefined, the participants had great opportunity to make suggestions for the USDNDR.

The discussions ranged from philosophical, theoretical, and applications perspectives on hazard reduction to details of institutional relationships and structures for the Decade. Tensions sometimes erupted over how to move the Decade forward; who should take the lead; where funding would come from; and what social, economic and political constraints needed to be overcome. Yet, the group agreed broadly that a U.S. Decade offered a rare and potentially fruitful vehicle for making great strides in hazard reduction, for raising consciousness about the problems posed by hazards, and for strengthening the sense of mission within the hazards community. The group also felt that the Decade needed quick and high-level support and steering from government, research institutions, and leaders in the hazards field as called for in the Congressional mandate. The participants also recognized that the Decade would succeed only through solid participation and implementation at the state and local level and through collaboration with the private sector; and that participants needed quickly to identify clear-cut, realistic program goals for the Decade. These and other key resolutions and general discussions are described in this report. A discussion of the early evolution of the Decade, and an assessment of hazards mitigation successes and problems in the United States, appear in Appendices 1 and 2.

BACKGROUND

The natural hazards community has been challenged by the proposal to make the 1990s a Decade for Natural Disaster Reduction – a period devoted to improved and invigorated efforts to reduce the toll of natural extremes on people and the built environment. The reasons for an International and U.S. Decade, as stated in a National Academy of Sciences (NAS) report, are that losses from natural hazards are rising, and that "heavy losses at the hands of nature are not inevitable." The NAS report goes on to state that

> experience demonstrates that we have enough knowledge already, if properly applied, to reduce both human and property losses substantially. . . . Progress in scientific and technical understanding of natural hazards, as well as in techniques to mitigate their effects, has led to the [Decade]. (From the NAS publication ***Confronting Natural Disasters***, pp. 1-2)

In the spring of 1988, the Federal Coordinating Council on Science, Engineering, and Technology (FCCSET) asked the Federal Committee on Earth Sciences to organize the federal government's participation in the International Decade for Natural Disaster Reduction. To accomplish this task the Committee on Earth Sciences formed the Subcommittee on Natural Disaster Reduction. The subcommittee is chartered to recommend an appropriate federal government mechanism for U.S. participation in the IDNDR; to increase awareness and understanding of federal science, information, and technology transfer programs; and to improve planning, coordination, and communication among federal agencies.

Currently, the subcommittee is negotiating a contract with the National Academy of Sciences for convening a committee to assess the relationship of the federal and national effort in natural disaster reduction to the International Decade, as well as to design a broadly inclusive organization to coordinate U.S. programs throughout the Decade.

The Decade for Natural Disaster Reduction is thus gaining momentum within the hazards field and beyond. A plenary session on the Decade at the 1988 Hazards Research and Applications Workshop in Boulder evoked numerous suggestions and offers of assistance from different elements of the hazards community, and the concept is being widely discussed at other meetings of hazards workers and professional societies.

At the same time, U.S. representatives are part of the U.N. group of experts dealing with the Decade. On the domestic scene, resolutions establishing a U.S. Decade for Natural Disaster Reduction were passed by both the U.S. House of Representatives and the U.S. Senate in 1988. Further, a few state programs have emerged. The Governor of Utah has declared the 1990s the Utah Decade for Natural Disaster Reduction, and the Governors of California and Tennessee have issued similar declarations. In sum, these efforts have brought us to the verge of a significant concerted effort in the United States – an effort that could involve greater recognition, philosophical support, and funding for hazard reduction.

THE COLORADO WORKSHOP

By late summer 1988, then, there appeared to be a growing need for ideas and energy to shape and inspire the U.S. Decade. A workshop of selected members of the hazards community, including representatives from federal agencies, states, communities, and research institutions, appeared to be a good vehicle for formulating and promoting ideas for the Decade. The Natural Hazards Information Center proposed such a workshop to the National Science Foundation and received support from that agency and the United State Geological Survey to hold a meeting in October.

The goals of the workshop were general: to assist representatives of the hazards field in sorting out ideas for a U.S. Decade, to allow principals from federal and state agencies and from research and practical institutions to meet and discuss the Decade, and to "brain-storm" new ideas to be presented in final a report. The workshops specifically focused on social, economic, and political aspects of hazard reduction rather than on an assessment of the techniques and knowledge available for accomplishing the goals of the Decade. The participants generally accepted the notion promulgated in the NAS report that there is a large gap, even in developed countries, between the "state of the art" and the "state of practice" in hazard reduction. One clear need, then, was to figure out ways to overcome barriers to applying what we know while generating new knowledge on identified weaknesses.

The workshop was held as a retreat near Estes Park, Colorado, and included both plenary and working group sessions. The first background plenary was particularly useful to participants – reminding them of how far the U.S. has come in hazard reduction over the past 20 years, as well as identifying problems yet to be solved (see Appendix 2). The initial plenary sessions were followed by a round of working groups to explore constraints to hazard reduction, possibilities for technology transfer, the integration of research and practice, and the potential private sector role in the Decade. The working groups reported back to the full group on the second day, and there followed a day of plenary discussions on topics ranging from agency contributions to innovative ways of promoting the Decade.

The deliberations at that workshop are reported below as key resolutions, working group reports, a set of unresolved issues, and needed next steps.

KEY RESOLUTIONS

Discussions at the workshop were far-ranging and eclectic, but a general consensus on several aspects of a model U.S. Decade for Natural Disaster Reduction emerged. Key resolutions were:

1) That the group accepts the goals of the Congressional resolution, and feels that the USDNDR should move ahead quickly and with great vigor to reduce natural and related technological hazards;

2) That the USDNDR is still an undefined idea in need of executive branch support, an infusion of substantive ideas, and steering mechanisms and guidance based on cooperation among federal agencies, the National Academy of Sciences, state and locals, the private sector, and research institutions;

3) That the USDNDR should identify a limited number of specific goals to be achieved by the end of the Decade, and that these goals should include:
    1) developing effective comprehensive hazard mitigation capabilities at the state and local level;
    2) assessing the status of hazard research and applications to provide a baseline for the Decade; and
    3) assessing and strengthening existing programs than can contribute to the Decade;

4) That the USDNDR will succeed only with broad, early, and concrete participation by state and local institutions with hazards responsibilities, and that it is at this level that implementation will have to occur;

5) That the USDNDR must involve the private sector in all planning and implementation. The Decade offers a special opportunity to construct private-public partnerships for hazard reduction built on the incentive of long-term benefits rather than the disincentive of regulation or loss;

6) That the USDNDR must rely on effective technology and information transfer from those able to generate information and research findings and those who know how to implement effective hazard reduction efforts;

7) That the USDNDR needs an integrated plan from the beginning for monitoring and evaluating its progress, along with a set of criteria for measuring actual hazard reduction; and

8) That the USDNDR should focus on domestic hazards and needs of U.S. regions and communities facing the most serious threats from natural extremes while complementing and supporting the International Decade for Natural Disaster Reduction where possible.

Many of these resolutions, and more detailed ideas and suggestions for the Decade came out of intensive working group sessions, as described in the next section.

REPORTS OF THE WORKING GROUPS

Introduction

Participants at the Colorado workshop contributed to five working groups: 1) Integration of Disciplines; 2) Social, Economic, and Political Constraints; 3) Technology Transfer; 4) Private Sector Role; and 5) State and Local Role.

Each working group addressed a key question concerning hazard reduction in the 1990s: 1) How can we better achieve integration of social, physical, and engineering approaches to hazard reduction? 2) What are the major social and economic constraints to achieving hazard mitigation and how can they be overcome? 3) How can the knowledge and technology to reduce hazards be transferred to groups, institutions, or individuals who can actually implement hazard mitigation? 4) What role can/should the private sector and other nongovernmental organizations (NGOs) play in achieving hazard reduction in the 1990s? and 5) What should the role of state and local government be regarding hazard mitigation in 1990s?

The goal of the working groups was to suggest approaches, strategies, and goals for hazard reduction in the 1990s keeping in mind the status of hazard reduction at present, trends that may affect future efforts, and short- and long-term hazard reduction goals. The working groups also were asked to make recommendations for a U.S. Decade for Natural Disaster Reduction.

Both specific and general recommendations were made by the working groups, and there was considerable similarity and convergence in their recommendations. Individual, detailed working group reports follow the summary presented below.

Summary of the Working Group Suggestions for a U.S. Decade for Natural Disaster Reduction

The Integration of Disciplines Working Group (#1) called for increased communication, rather than integration, among physical scientists, social scientists, and engineers. This increased communication is needed to overcome problems among the different groups involved in hazard reduction activities including the public, policy makers, and hazard research and applications experts. The working group suggested examining and evaluating a set of successful projects to determine the interrelationships that occur in the development, adoption, and implementation process. The group suggested a demonstration project to test the efficacy of the process and recommended an assessment be undertaken within the next three years. They felt that the U.S. Decade needs an action agenda, a research agenda, and a public information component and that strong federal leadership was necessary, but that involvement and leadership from a consortium of hazard related organizations–including local governments, private industry, and nongovernmental agencies–was crucial.

The Social, Economic, and Political Constraints Working Group (#2) suggested that constraints to hazard reduction can also provide opportunities for hazard reduction (for example litigation could result in stronger laws and/or regulation enforcement), and that these opportunities should be seized. In addition, the group agreed that sufficient technological knowledge exists concerning hazards to launch an effective mitigation program; the basic focus of a Decade for hazard reduction should be the *transfer* of knowledge and applications. Therefore, the group recommended applied research, demonstration projects, evaluative efforts, risk communication, and an emphasis on implementation. They suggested assessments of hazard reduction at present so that cross-cutting baselines concerning relative risk, potential for risk reduction, and progress to date could be established. These assessments would help to set priorities for the U.S. Decade.

The group called for a "short list" of definable goals and suggested that they might fall within several areas. For example, individuals who inform the public concerning mitigation should be made more aware of alternative responses, and their political acceptability and economic feasibility. The working groups suggested that with the involvement of the federal government (through a proposed

executive order for hazards reduction) and the support of relevant constituent groups (including those from government, the private sector, and nongovernmental organizations), the focus of the Decade should remain *sub*national–built on existing institutions and existing hazard reduction programs. The Decade, they felt, would have to work around constraints of insufficient knowledge, limited awareness, and limited financial resources.

The Technology Transfer Working Group (#3) developed several major suggestions for the U.S. Decade for Natural Disaster Reduction. The group recommended demonstration projects as well as the documentation and evaluation of efforts to transfer technology. They called for monitoring both the adoption and the effectiveness of technology in place, and they recommended financial incentives for and marketing of hazard reduction information.

The group also recommended that appropriate agencies launch efforts to institutionalize hazard reduction. Technology transfer, they said, should be tied to the normal work flow and oriented to specific user groups. In addition, since the group defined information transfer as technology transfer, they recommended continuing education for researchers, design professionals, the construction industry, public and private decisions makers, and the public.

The Private Sector Role Working Group (#4) called for significant private sector involvement in both the planning and implementation of the U.S. Decade for Natural Disaster Reduction. Consequently, the group also called for strong federal and state government support of public-private partnerships as well as the integration of activities and partnerships at the local level. The Decade–a nationally focused but locally applicable program–should, they said, use publicity, marketing strategies, and public relations to foster support for hazard reduction activities.

The group also recommended incentives to encourage hazard reduction in the private sector and suggested focusing on successful public-private partnerships already in place. Finally, the group suggested that specific, measurable goals in achievable time frames be established, that local and regional assessments of all hazards be performed, and that all efforts emphasize urban areas at risk.

The State and Local Working Group (#5) recommended active and effective participation in the U.S. Decade for Natural Disaster Reduction by governmental agencies from all states, counties, and communities facing significant risks due to natural hazards. The working group stressed that the success of the USDNDR will depend on what happens at the local level. They agreed that resolutions and declarations, such those of the U.S. Congress, California, and Utah, were necessary to increase public awareness and help build further support, and they suggested that other states and municipalities be encouraged to pass similar resolutions. The working group also recommended that national and regional hazards consortiums and public-private partnerships for hazard reduction be established. In addition, periodic reviews to assess and evaluate progress toward hazard reduction are crucial to the success of the effort. Initial and continual involvement of local agencies and individuals, "showcasing" political leaders or successful partnerships, and "marketing" hazard reduction techniques were all suggested by the working group to increase overall awareness. Hazard reduction, the group suggested, is a public-private effort, one that should combine regulation with incentives, and one that should have a multihazard focus and incorporate multiobjective planning.

Again, there was consensus among the five groups concerning the need for the support, involvement, and cooperation of all sectors of the population and levels of government in the planning and implementation of the USDNDR. There was convergence in their recommendations concerning the establishment of demonstration projects, the marketing of hazard reduction strategies and awareness, and the use of incentives to achieve hazard reduction. They also concurred in recommending the use of existing institutions and existing hazard reduction programs and in calling for the performance of baseline assessments of current hazard reduction efforts.

Working Group #1: Integration of Disciplines

Integration or Communication?

Working group #1 considered how to better integrate physical science, social science, and engineering disciplines to achieve more effective hazard reduction. While the group agreed with the goal of more effective hazard reduction, the members did not agree that integration is a possible, or even necessary, element of successful hazard reduction.

The discussion centered around several topics: 1) how to determine whether there is a need to integrate; 2) the role that communication and translation play in integration; 3) barriers to integration; 4) the role of integration in determining acceptable levels of risk; and 5) the possible need to refocus from integration to some other technique that might be more achievable and potentially productive.

The group decided it was more appropriate for them to address the development of approaches to achieving system effectiveness in hazard reduction. First, they recognized the barriers to system effectiveness among the various disciplines within the hazard research community and between researchers and practitioners. Those barriers include: 1) inaccurate perceptions of other groups; 2) incompatible attitudes between groups and individuals; 3) lack of understanding between disciplines; 4) vested interests as an inhibiting factor to integration and cooperation; 5) a lack of balanced contributions from physical scientists, engineers, and social scientists in the decision-making process, and 6) lack of effective communication and translation between the groups.

A resolution of these issues, according to the working group, can be brought about by focusing on *system effectiveness*. For example, each discipline or group involved in hazards will typically look out for its own interests and well-being, perhaps lessening the effectiveness of the entire system of hazard reduction. If communication is increased, factional interests can be overcome, and total system effectiveness can be increased. Therefore, communication among physical science, social science, and engineering disciplines, is, the group felt, more important and attainable than integration. The group discussed the elements of successful communication among physical science, social science, and engineering hazard researchers as well as communication between the research community and those in the operational or applications areas of hazard reduction.

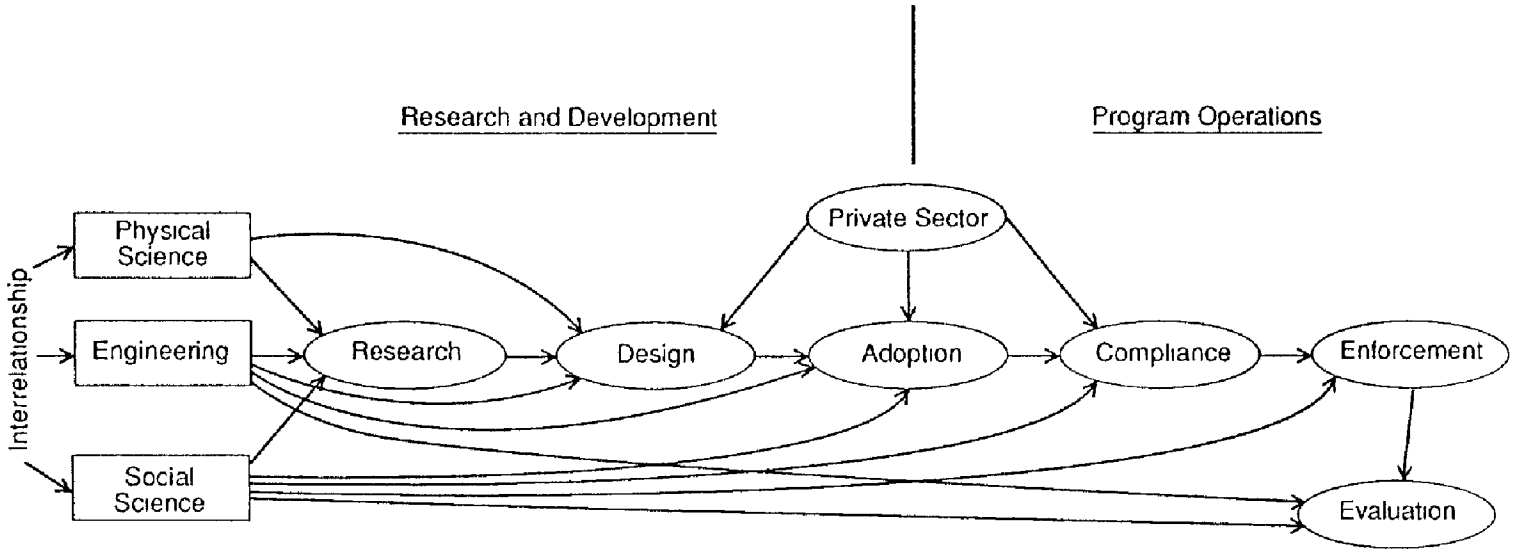
The working group posited several conceptual models for establishing better working relationships among the disciplines and various practitioner groups in order to promote total system effectiveness. One possible model for integrating physical science, social science, and engineering hazard researchers with the government, nongovernmental, and private sector organizations dealing with hazards was discussed (Figure 1).

A Natural Disaster Reduction Policy Act

The working group also recommended a "Natural Disaster Reduction Policy Act" (NDRPA) that would build upon, but not supplant, existing hazard reduction efforts by various disciplines, agencies, and groups already involved in hazard reduction (Figure 2). A NDRPA would mandate:

- An assessment of national risk due to natural disasters along with an identification of policy options for hazard reduction;
- Substantial augmentation of hazard reduction capabilities (as opposed to recovery activities) of federal agencies;
- A proactive component to agency hazard reduction activities;
- A long-range component to postdisaster recovery;
- Evaluation of the level of success of NDRPA efforts;
- Exploratory analysis and development of an integrated information system for decision makers;

FIGURE 1



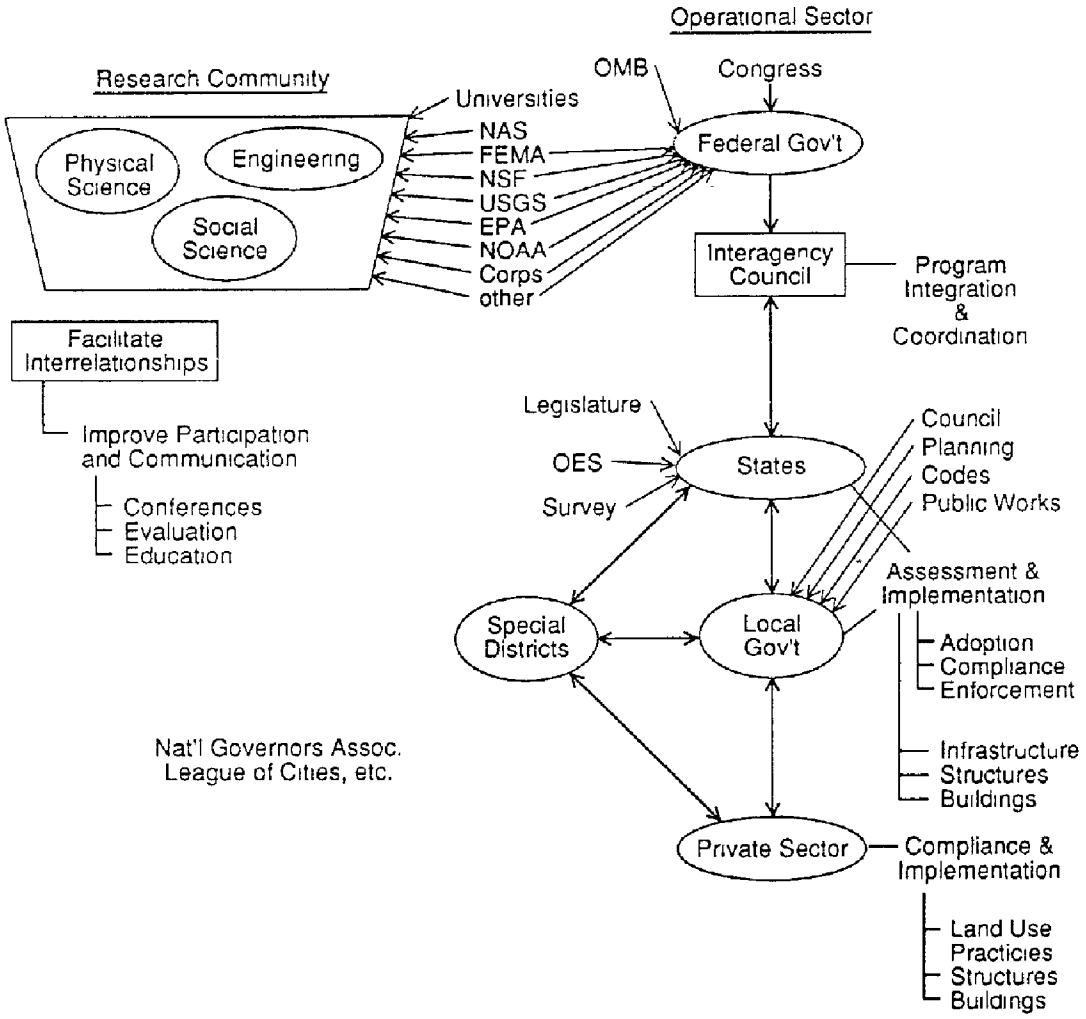
ACTORS

-NSF
-USGS
-NAS
-Universities
-Corps of Engineers
-Others

ACTORS

-Federal Agencies
-States
-Local Gov't
-Private Sector
  -Land Developers
  -Engineers
  -Individuals

FIGURE 2


Operational Sector
Research Community
OMB
Congress
Universities
NAS
FEMA
NSF
USGS
EPA
NOAA
Corps
other
Physical Science
Engineering
Social Science
Federal Gov't
Interagency Council
Program Integration & Coordination
Facilitate Interrelationships
Improve Participation and Communication
Conferences
Evaluation
Education
Legislature
OES
Survey
States
Council
Planning
Codes
Public Works
Assessment & Implementation
Special Districts
Local Gov't
Adoption
Compliance
Enforcement
Infrastructure
Structures
Buildings
Nat'l Governors Assoc.
League of Cities, etc.
Private Sector
Compliance & Implementation
Land Use Practicies
Structures
Buildings

- A strong program of public education;
- A sharing of information internationally.

The working group suggested examining and evaluating a set of successful projects to determine the nature and strength of interrelationships that arise in the development, adoption, and implementation of hazard reduction programs. Projects for evaluation could be nominated by an interagency council and by federal, state, and local governments.

The group also recommended the development and implementation of a demonstration project to study these processes. An examination of barriers to achieving effective interaction and communication among disciplines and among the research, hazards application, and policy-making communities could be undertaken as part of such a project. The working group recommended an assessment be undertaken during the next three years.

Other Recommendations

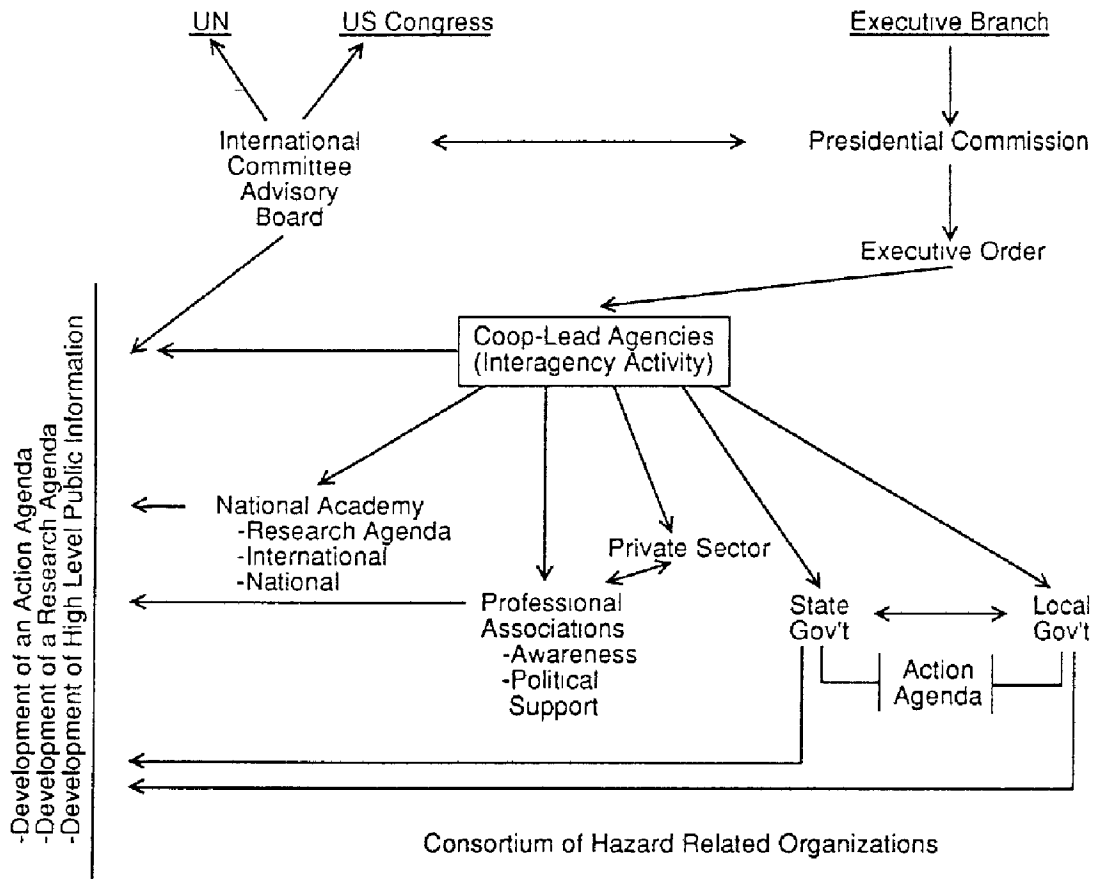
To achieve hazard reduction, the working group stressed the importance of overcoming inaccurate perceptions among the different groups in the hazard reduction research and applications field as well as among the public, policy makers, and those dealing directly with hazards. The participants stressed the importance of balancing hazard reduction and economic viability when presenting the issue of hazard reduction to policy makers and the public.

With regard to the U.S. Decade for Natural Disaster Reduction, the working group proposed an integrated program that stresses:

- The development of an action agenda;
- The development of a research agenda;
- The development of a public information component.

Figure 3 shows a possible organizational model for the U.S. Decade that includes organizational and leadership elements considered important by the working group. For example, the establishment of a presidential commission in the federal executive branch was considered important to the Decade because strong leadership from the federal government is necessary for the success of the program. By the same token, vital sectors such as private industry, nongovernmental agencies, and local governments are also included in the organizational scheme. The working group deemed this consortium of hazard-related organizations vital to the overall success of the U.S. Decade for Natural Hazards Reduction.

FIGURE 3


UN
US Congress
Executive Branch
International Committee Advisory Board
Presidential Commission
Executive Order
Coop-Lead Agencies (Interagency Activity)
National Academy
-Research Agenda
-International
-National
Private Sector
Professional Associations
-Awareness
-Political Support
State Gov't
Local Gov't
Action Agenda
-Development of an Action Agenda
-Development of a Research Agenda
-Development of High Level Public Information
Consortium of Hazard Related Organizations

Working Group #2: Social, Economic, and Political Constraints

Working Group Assumptions

The social, economic, and political constraints working group identified potential constraints to hazard reduction, assessed the importance of those limits, and suggested means for lessening the constraints. The group recognized that constraints are relative notions, and that constraints can be opportunities in some cases.

In discussing social, economic, and political constraints to hazard reduction, the working group assumed they were working within a time frame of one decade, that no substantial increase in federal funding would occur in that time, and that their deliberations should take a national perspective. They examined two dimensions regarding constraints:

- Factors that constrain hazard mitigation generally; and
- Factors that constrain development of a U.S. Decade.

Hazard Reduction Constraints

In looking at the numerous constraints to hazard reduction, it is perhaps significant that hazard reduction has occurred. However, the working group's review of various constraints showed that few of them, if any, are absolute barriers. They can be overcome, although doing so may be difficult within the time frame and resources available for the U.S. Decade for Natural Disaster Reduction. Table 1 indicates the range of potential constraints that were identified, the potential limiting factors of the constraints to hazard reduction efforts, and the prospects for overcoming the constraints.

The working group discussed each of these categories and identified key issues that relate to hazard reduction. These are summarized in the following sections.

Cross-cutting Constraints. Cross-cutting constraints reflect the limitations imposed by the way governmental and nongovernmental roles are defined in relation to hazard reduction. These constraints broadly limit and define possible approaches to a U.S. Decade. Regardless of the definition of these constraints, it is important to recognize that hazards are a national problem. The key issues raised by these constraints are whether or not there are new and better ways to conceptualize hazard reduction and to conceptualize the roles to be played by the various groups involved.

Governmental Constraints. These constraints reflect the limits of federal, regional, state, and local governmental entities. The key issue arising from these constraints is the extent to which national and, particularly, subnational capabilities to initiate and implement hazard reduction efforts can be increased over the next decade.

Nongovernmental Constraints. These constraints reflect the limits to private entities, academic institutions, professional associations, nongovernmental organizations and interest groups in initiating or carrying out hazard reduction efforts. The key issues here concern the ability to mobilize and coordinate nongovernmental attention to hazards.

Legal, Economic, and Behavioral Constraints. These constraints reflect various factors affecting individual and organizational decisions about hazard reduction. These are the most difficult constraints to address because of the subtleties and difficulties of understanding and altering human behavior. Design of appropriate and effective incentives to undertake hazard mitigation is clearly an important aspect

The working group noted that their list does not contain several factors sometimes identified as barriers to hazard reduction. In some respects, each of these factors reflects assumptions that have developed about hazard reduction. Each of the following are, in some ways, constraints, but not nearly to the extent commonly believed.

Knowledge. The working group agreed with the basic premise of the National Academy of Sciences that a sufficient amount of technical knowledge exists to launch effective Decade reduction programs. More research may be necessary for closing gaps in knowledge, but the basic constraint is that of

knowledge/applications transfer, not lack of knowledge itself. This can be remedied through applied research, demonstration projects, and evaluations of the use of scientific information, risk communication, implementation, and so on.

Awareness. As the hazard reduction community has learned, public awareness of risk is an especially complex area to address. The working group identified a key future effort as increasing individual hazard reduction awareness – demonstrating the range of options and emphasizing alternative responses.

Funding. Insufficient funds are often identified as the major impediment to effective hazard reduction. While any organization is subject to funding limits, the lack of funding for hazard reduction in part reflects the low priority of such efforts. It also reflects the inability of hazard researchers and practitioners to "sell" hazard reduction effectively to policy makers and the public. The working group reiterated that hazard reduction must be politically acceptable and economically feasible to both these groups.

The working group pointed out that some of the constraints listed in the table can be viewed positively. For example, multiple entities at subnational levels may complicate implementation, but they may also present multiple options for hazard reduction initiatives. Another example concerns the issue of governmental liability. Legislators often view liability as a reason for not undertaking hazard assessments, fearing they will document a risk. Yet, liability can also be viewed as a positive factor, since effective reduction efforts reduce potential governmental liability. The threat of being liable may be an impetus for action.

It is also important to recognize that many of these constraints have been addressed in some fashion by existing hazard reduction efforts that address floods, hurricanes, earthquakes, and other hazards. The Decade effort can build upon models established by the "Unified National Program for Floodplain Management" or the constituency building activities of the FEMA-led National Earthquake Hazards Reduction Program.

U.S. Decade Constraints

A second discussion among working group participants focused on the more immediate issue of constraints to the development and initiation of a U.S. Decade. The working group discussed immediate "design problems" that presumably can and will be resolved prior to, or early in the development of, a U.S. Decade for Natural Disaster Reduction. If these problems are not resolved, they will become continuing issues that will undermine the ultimate success of the effort. These constraints include:

- A lack of goals or focus;
- Limits to federal leadership;
- A weak mandate for federal agency involvement;
- A lack of "baseline" measures of current reduction efforts;
- Insufficient constituency support.

The Decade needs a short list of definable goals that will provide a focus for the effort. If appropriately framed, these goals will serve as a basis for gaining federal agency, subnational, and private support for the effort. In order to set priorities, measure progress, and generate support for a hazard reduction effort, the working group recommended that a clear assessment of the existing situation be initiated. While pieces of such an assessment exist, it is difficult to specify what a comprehensive effort should entail. The inability to make cross-hazard statements about relative risk, potential for risk reduction, and progress to date makes it difficult to set priorities for a U.S. Decade program. Thus, the working group recommended a baseline assessment as an important component of the U.S. effort, but cautioned that it should be a quick and timely synthesis rather than a major piece of primary research.

Although there appears to be agreement concerning the need for federal leadership for the Decade, there are real limits to such potential leadership. In part, this is because federal agencies have funding limitations and insufficient staff to devote to the effort, and lack top-level endorsement for the Decade.

This constraint may be lowered by the creation of a federal-level interagency coordinating process that emphasizes a multihazard approach to the Decade and hazard mitigation. A strong mandate within the executive branch would certainly help, and executive orders or directives, such as the one establishing hazard mitigation teams, would also increase the saliency of the Decade at the federal level.

Along with constraints to federal support, there may be limits to the support available from other constituencies as well. The working group recommended that a concerted effort be made to involve a range of professional associations, organizations, and private entities including industry, nongovernmental organizations, and other hazard reduction constituencies. The working group suggested a consortium for the Decade which might, as a first step, undertake a baseline assessment.

The working group also discussed practical factors that constrain the launching of the U.S. Decade for Natural Disaster Reduction. Those practical realities that must be confronted immediately include short lead time, insufficient staff, and a lack of priorities. The working group cautioned that there is little time to resolve the constraints to the Decade effort and develop a detailed plan for a U.S. Decade. Qualified staff are needed to develop a plan, build additional constituency support, and engage in other activities to launch the Decade.

Few, if any, of the factors discussed are absolute constraints to launching a U.S. Decade for Natural Hazard Reduction or to making progress toward hazard reduction in general. The constraints can be overcome, but doing so may require more time, effort, and agreement than it is possible to achieve within the 1990s.

The detailed recommendations from this discussion call for finding ways to address both the immediate problems and longer-range constraints. As immediate steps, the group suggests: providing focus, establishing federal leadership, undertaking a baseline hazards assessment, developing "constituency" support among relevant groups, and seeking a stronger mandate for federal agency participation. The detailed, longer-range suggestions are listed in the right-hand column of Table 1.

In addition, four guidelines for designing the U.S. Decade were suggested by the working group: 1) focus the effort at subnational/private levels; 2) build on existing organizations; 3) build upon existing hazard reduction programs; and 4) work around the constraints of insufficient knowledge, limited awareness, and limited funds.

Ultimately, there is a dual problem. One must obtain commitment for the Decade and, at the same time, build the capacity to carry out such an effort.

TABLE 1

HAZARD MITIGATION--SELECTED CONSTRAINTS

CONSTRAINT	HOW AFFECTS MITIGATION	PROSPECTS FOR CHANGE
Cross-Cutting		
Time: 10 years	Limits what can be accomplished	LOW: defined as a decade effort
Views about government role	Helps define appropriate governmental role – limits to federal intervention	UNCERTAIN: values and preferences change over decade(s)
Disciplinary/ Specialist Blinders – think in terms of specific hazards & disciplines	Myopic efforts, dissipates efforts	SOME: efforts to establish integrative program(s) are contemplated
Lack of constituency for hazard reduction	No focused constituency – multiple constituencies, limits commitment to integrated effort	SOME: build on existing constituencies, coordinate efforts
Bias toward technological "fixes"	-May create undesirable distributive impacts -May simply lead to postponement of large disasters because of false sense of security	SOME: increase attention to distributive effects
Governmental - Federal		
Federalism: Intergovernmental fragmentation	Intergovernmental implementation problems	LOW: need to accept and work through intergovernmental mechanisms
Intragovernmental fragmentation: -multiple agencies -multiple committees	Myopic focus, dissipates energies	SOME: look for coordinating mechanisms; define leadership role and authority
Mixed legacy of federal leadership in hazard mitigation	Limits mobilization potential	SOME: look for ways to enhance federal leadership for the Decade effort

HAZARD MITIGATION--SELECTED CONSTRAINTS (continued)

CONSTRAINT	HOW AFFECTS MITIGATION	PROSPECTS FOR CHANGE
Governmental - Federal (Continued)		
Limited federal capacity–personnel funding, travel $, etc.	Limits potential for federal partnership and/or assistance	LOW: unlikely to expand; look for opportunities to use leverage; target efforts
Weak federal mandates for hazard mitigation	Limits federal credibility and leverage	SOME: Congressional resolutions; potential executive order or OMB directive for multihazard mitigation
Governmental - Subnational		
Intragovernmental fragmentation -many entities -overlapping jurisdictions	Dissipates energies; linkage unclear	LOW: look for co-ordinating mechanisms; use existing channels
Limited subnational capacity–personnel, funding, travel $, etc.	Limits potential for sub-national partnership and/ or assistance	SOME: look for opportunities to use leverage; target efforts; fund hazards specialists at local levels
Nongovernmental - Private Entities		
Fragmentation: -many entities or associations -competing interests	Dissipates energies; linkage unclear	SOME: look for co-ordinating mechanisms; target efforts; create consortium
Professional groups as intermediaries: planners, code authori-ties, etc.	Professional practices take time to change	SOME: professional education efforts have had success

HAZARD MITIGATION--SELECTED CONSTRAINTS (continued)

CONSTRAINT	HOW AFFECTS MITIGATION	PROSPECTS FOR CHANGE
Legal		
Liability concerns (gvmnts, businesses)	Undermines willingness to recognize hazard	SOME: model acts, increase attention to costs of not taking action
Constitutional restrictions	Limits "taking," requires due-process actions	LOW: will not change, but not much of a problem
Economic or Financial		
Opportunity costs may outweigh benefits of mitigation	Makes it difficult to justify mitigation (e.g, hazardous bldgs)	LOW: particularly in already developed areas
Costs increasing: -insurance premiums (flood and earthquake) -cost-sharing requirements	Limits participation and undermines compliance	SOME: alter costs with subsidies, new rates
Behavioral - Individuals		
Hazard misperceptions	Limits willingness to take actions	LOW: has proved difficult to alter
Expected value of losses low, some likelihood of governmental assistance	Limits willingness to take action or buy insurance	LOW: can affect indirectly by altering disaster assistance practices
Knowledge of "what to do"	Limits ability to act	SOME: some success in providing educational materials
Compliance limitations	Undermine regulations	SOME: alter enforcement and incentives to comply

Working Group #3: Technology Transfer

Impediments to the Transfer of Technology and Information

The third working group identified major impediments to technology transfer. First, the group recognized that technology, like science, does not sell itself. Therefore, the transfer of technological information must be purposely directed from the research and development communities to users and decision makers. Technology transfer must be, then, a very active, deliberate process.

The working group identified and discussed a number of reasons for the failure to transfer technology, anticipating that by doing so, they could identify successful strategies for such transfer. Although the working group focused on technology transfer for hazard reduction, identifying reasons for failure to transfer all types of technology proved useful. The group felt that in the United States, the priority for basic research and development is greater than that for applications work. Therefore, the transfer and dissemination of valuable research often does not occur or occurs ineffectively.

Another reason for the failure to transfer technology is the lack of adequate follow through by information producers. Generally, the group agreed that there is a lack of knowledge and skill concerning how to effectively transfer technology. In addition, rewards and incentives for technology transfer are often missing. For example, Japanese builders are given financial incentives from the Japanese government for employing state-of-the-art construction practices for earthquake hazard reduction. Nothing comparable exists in the United States.

In sum, the group thought that technological information was usually packaged poorly. As an example, they cited the traditional use of reports, rather than demonstration projects, to disseminate information.

Other reasons for the failure of technology transfer included:

A) Failure to monitor the effectiveness of technology in place. For example, some state-of-the-art design practices implemented after World War II have proved inadequate for even moderate earthquake-induced ground shaking, yet it has taken large numbers of building failures and loss of life in earthquake after earthquake to effect any changes in building codes. As the working group suggested, there is an over-reliance on old, generalized solutions for the transfer of technology.

B) Using inappropriate technologies; using the wrong technology for a specific case or a specific locale. For example, some structural measures to defend against floods (such as levees) have actually created increased risk or contributed to greater flooding.

C) Inappropriate timing of the introduction or application of the technology.

Recommendations for Improved Transfer of Technology

After assessing these reasons for the failure to transfer technology, the working group recommended methods to increase the success of technology transfer in the future. These recommendations included:

- The identification of promising and appropriate technology;
- The adaptation of technologies to future opportunities and needs;
- The use of innovative, cost-effective techniques for integrating technologies;
- The development of strategies for implementation;
- The monitoring of the adoption process;
- The monitoring of the effectiveness of the technology.

The working group also suggested that technology transfer had to be pursued with greater persistence and tenacity, and further, that incentives be established for the continuing education of researchers, design professionals, the construction industry, public and private decision makers, and the

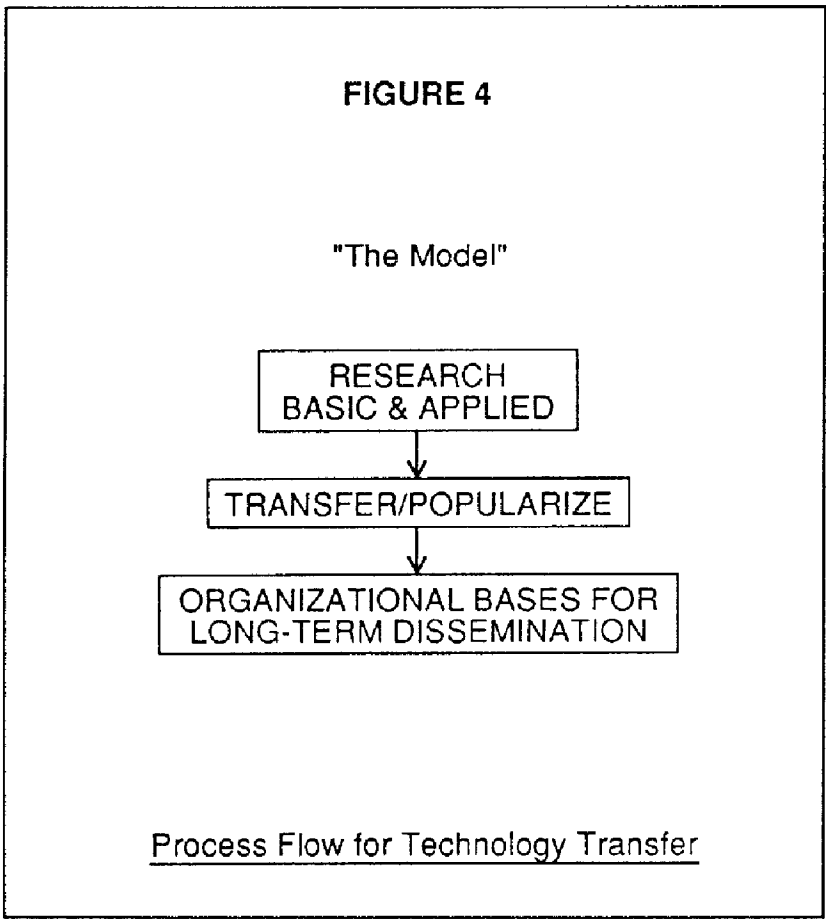
public. For technology transfer to be effective, the effort must be maintained and the interest sustained.

The transfer of technology also must be customized to reach specific users. The group recognized that it was critical that efforts to transfer technology be documented and evaluated. The participants saw technology transfer as a dynamic process and developed a scheme for describing the procedure (Figure 4).

In translating and communicating technological information, the working group suggested that information about specific technologies be oriented toward user needs. To do this, the group recommended establishing user-oriented frameworks and broader user applications. They also recommended that the transfer of technology be part of everyday work and operations, *but* that it also capitalize on "windows of opportunity" such as reconstruction and recovery after disasters. The group recommended demonstration projects, financial incentives, and the development of marketing techniques for hazard reduction.

The group also recommended institutionalizing technology transfer in key organizations, using existing processes for technology transfer, and mandating dissemination of technology as part of the research and development process. As an example, the group cited the technology extension service component of the 1987 Technology Transfer Act.

In summary, this working group recommended many ways and means for applying the practical information gained from research in the hazards field. However, they pointed out, one must recognize the real need for the political acceptability and economic sustainability of these processes if they are to be feasible. The group strongly felt that by using effective educational and marketing techniques, along with incentives, the technology transfer process for hazard reduction could be greatly enhanced.



Working Group #4: Private Sector Role

Role of the Private Sector in Hazard Reduction

The objective of the private sector working group was to determine what role the private sector could play in achieving the goal of increased hazard reduction in the 1990s and beyond. The group focused on identifying players who can contribute to the hazard reduction effort. Incentives to encourage greater private sector and nongovernmental organizational participation in hazard reduction were also identified.

The working group felt that initially public-private partnerships for hazard reduction should exist at and focus on the national level in order to publicize the goals of the U.S. Decade for Natural Disaster Reduction. Strong federal and state governmental support of public-private partnerships was cited by the group as necessary to encourage significant private sector participation. However, the group stressed that real success will only be achieved at the *local* level.

The working group outlined private sector roles, suggested possible incentives for private sector involvement in hazard reduction, and suggested possible private sector players (Table 2). In order to reduce hazards, all these groups need to be involved in the planning and implementation phases of the U.S. Decade for Natural Disaster Reduction or any other programs to reduce hazards. The working group made several recommendations for integrated private sector participation in such efforts.

Recommendations for Private Sector Participation

First, the working group recommended that there be greater private sector participation in program definition and planning for the U.S. Decade. The issue of strong leadership for the U.S. Decade was discussed, and several recommendations were made concerning possible liaison activities to encourage public-private interaction. Those activities could include:

- Keeping the private sector up-to-date on planning and implementation activities;
- Providing mechanisms for the private sector to actively participate in planning and implementation activities;
- Facilitating sponsorship and funding activities required in developing cooperative partnerships between the public and private sectors.

The working group suggested that leadership for the liaison activities be specifically designated. For example, a member of the U.S. national committee for the Decade or other funded facilitator(s) would develop contacts with the private sector. The working group envisioned that a major task for this person (or persons) would be the transfer of different types of hazards reduction information to public educational programs at the national and local level. Techniques to get the information into use would include publicity, marketing, and public relations.

The working group envisioned two phases for such a project. In Phase I, a prospectus describing the U.S. Decade for Natural Hazard Reduction would include a prominent section on public-private partnership as part of the activities for the Decade The prospectus would feature nationally focused and locally applicable activities for private sector and nongovernmental organization involvement as well as build the case for strong public-private partnerships. The working group felt it was important to point to examples of successful partnerships and activities already in place such as the Hurricane Hotline, the Alert Development and Implementation project, Cooperative Interpretative Weather Services, and the General Mills Weather Package. These examples, and others like them, should be promoted and expanded with the development of additional hazard reduction partnerships.

Phase II would involve the development of a model for state- and local-level committees or commissions organized to deal with natural hazard mitigation, preparedness, and response efforts within existing regional councils of governments. The working group felt that local committees would be most effective if formed under the aegis of local governments. Again, in stressing the public-private

partnerships, the working group suggested that the local committees or commissions include the following:

- Local emergency service agencies;
- Local planning and/or building regulatory agencies;
- Local utility companies;
- Local major private corporations;
- Local civic and/or business groups;
- Local news media;
- Local volunteer service organizations and groups;
- Local offices of federal and state agencies;
- Local university experts.

Again, the working group recognized that hazard reduction will continue to take place principally at the local level, and it was there that the group suggested integrated activities and partnerships must take place. Despite that reality, the working group recognized the need for strong national support of the U.S. Decade for Natural Disaster Reduction.

TABLE 2

PRIVATE SECTOR ROLES

1) Sponsorship (funding)
   Increasing Awareness
      Public Education
      Training
      Cooperative Funding of Technology
      - demonstration projects
      - market and sell Decade

2) Providing Expertise
3) Public/Private Partnership
   Standard Setting
   Dissemination
   Postdisaster Relief

PLAYERS

Insurance Industry
Banking Industry
Construction Industry
   heavy - infrastructure and high rise
   light - home
Trade Associations
Professional Societies
Media: Print, Radio, TV
Architects

Communications Industry:
- Hurricane Hotline
- active wake-up system

Materials and Equipment:
- structural materials vendors
- gas shutoff valves
- shatterproof glass

Voluntary Organizations
Engineers

INCENTIVES TO INVOLVE INDUSTRY

Self interest - industry will reduce own risk
Profits
Liability concerns - could be barrier
Good will
Positive public relations
Attribution
Community spirit
Employees and their families
New business ventures due to hazard mitigation (e.g., Alert system, consultants).
External Incentives (Tax incentives, etc.)

LOCAL LEVEL SOLUTIONS

Targets of opportunity
Illustrate positive and tangible results to sell concept of Decade.

RECOMMENDATION

Private sector should participate in formulating Decade activities.

Working Group #5: State and Local Role

The State and Local Role

The fifth working group considered goals for state and local agencies during the U.S. Decade for Natural Disaster Reduction (USDNDR), and the means for ensuring active and effective participation at the state and local level. The group discussed the importance of effective communication and promotion of Decade goals and stressed that implementation of the Decade will depend on what happens at the local level. Recognizing the need not just to inform, but to motivate local agencies and individuals, the working group addressed implementation strategies before talking about specific measures to be implemented.

First, the working group recognized that the development of any plan for hazard reduction must begin with, and must continually include, involvement by state and local governmental agencies and other local entities. Enabling legislation at county or municipal levels was considered vitally important.

Recommendations

Assessments of past hazard reduction successes and failures should be used to develop additional strategies for a Decade for hazard reduction that has specific, measurable goals within achievable time frames. Such a plan, according to the group, should call for local and regional assessments of all hazards. For example, multihazard mapping should be carried out in vulnerable areas throughout the United States, with the emphasis on urban areas at risk. In addition, mechanisms for disseminating risk information to local communities should be instituted and refined. Major initiatives for increased training of community leaders should also be undertaken.

The working group also suggested that to increase awareness of hazards and hazard reduction, the Decade program should call for and promote declarations (similar to the resolutions of California and Utah) by all states and many local entities. The awareness and political support generated by these declarations would help create a platform on which further support could be built among the constituencies necessary for successful of hazard reduction.

This constituency building could also take place through regional and local workshops in which hazard research and applications experts could work with local groups and policy makers. The group stressed that existing hazard reduction knowledge could be utilized in these workshops, and that political leadership was necessary for regional and local hazard planning. The group agreed that officials who have been personally involved in disasters are generally effective in community disaster planning. Additionally, the working group suggested the formation of more local/regional organizations similar to the Southern California Earthquake Preparedness Project (SCEPP), the Bay Area Regional Earthquake Preparedness Project (BAREPP), and the Central United States Earthquake Consortium (CUSEC). Other regional partnerships involving agencies at all levels of government, private enterprise, and volunteer, public service, and other nongovernmental organizations should also be established. In this regard, the working group noted the success of the Business and Industry Council for Emergency Planning and Preparedness (BICEPP) in Southern California, and the potential benefits of involving the banking and insurance industries.

Besides the partnerships with the private sector, the USDNDR should promote the utilization of other local resources such as colleges and universities and other research centers. For example, professional education and skill enhancement, both by universities and by continuing education programs, should be promoted; the USDA agricultural extension service was suggested as an appropriate model for such activity.

In addition to these suggestions, the working group recommended that the USDNDR include components that promote the exchange of information and expertise between cities and towns facing similar problems both within the U.S. and between the U.S. and other countries. For example, suggestions were made to share hazard reduction information through sister-city arrangements.

The working group also suggested that once in place, the USDNDR should include periodic reviews to assess and evaluate progress toward the goal of disaster reduction. The evaluation should take place

on a regularly scheduled basis, perhaps as often as every two years, and planning should begin immediately for the first of these evaluations.

Besides suggestions for goals for the USDNDR, the working group discussed the means to implement the goals. The consensus of the group was that the simple distribution of research reports on hazard reduction was not adequate and probably would not result in hazard reduction. Again, the working group emphasized that effective communication and promotion of the goals of the USDNDR were as important as the goals themselves. The members noted the tremendous problems of translating information into action at the local level, and in order to facilitate such transfer of information, recommended:

- Development of a plan with the initial and continual involvement of local agencies and individuals;
- "Showcasing" political leaders who do take an active interest in hazard reduction;
- Using "Madison Avenue" techniques to develop promotional products that increase awareness about hazards and hazard reduction;
- Identifying audiences for various types of information, including policy and decision makers, the general public, and children;
- Promoting hazard awareness in other educational curricula, e.g., geography;
- Promoting hazard reduction within the context of multiobjective planning; and
- Utilizing existing national associations and organizations with local chapters or groups to disseminate information.

The state and local working group recognized that there are other means through which the goals of the Decade could be implemented. For example, legislation could provide regulatory authority for hazard reduction. However, the group also recognized that nation-wide hazard legislation may not provide adequate hazard protection for *local* hazard conditions and that state and local regulations also must be promulgated. Similarly, incentives could also help accomplish hazard reduction. However, the group identified political will and public support as perhaps the two major components to any hazard reduction program. Therefore, they emphasized educational and promotional activities to create a more informed group of policy makers and a more aware public.

SOME UNRESOLVED ISSUES

Despite two and one-half days of long and intense discussions, and despite a sense that significant progress had been made in generating ideas and enthusiasm for the Decade, several important and some very critical questions concerning the USDNDR remained unresolved. This section briefly discusses those issues and attempts to convey some of the quality of the discussions while recognizing that absolute consensus was not reached.

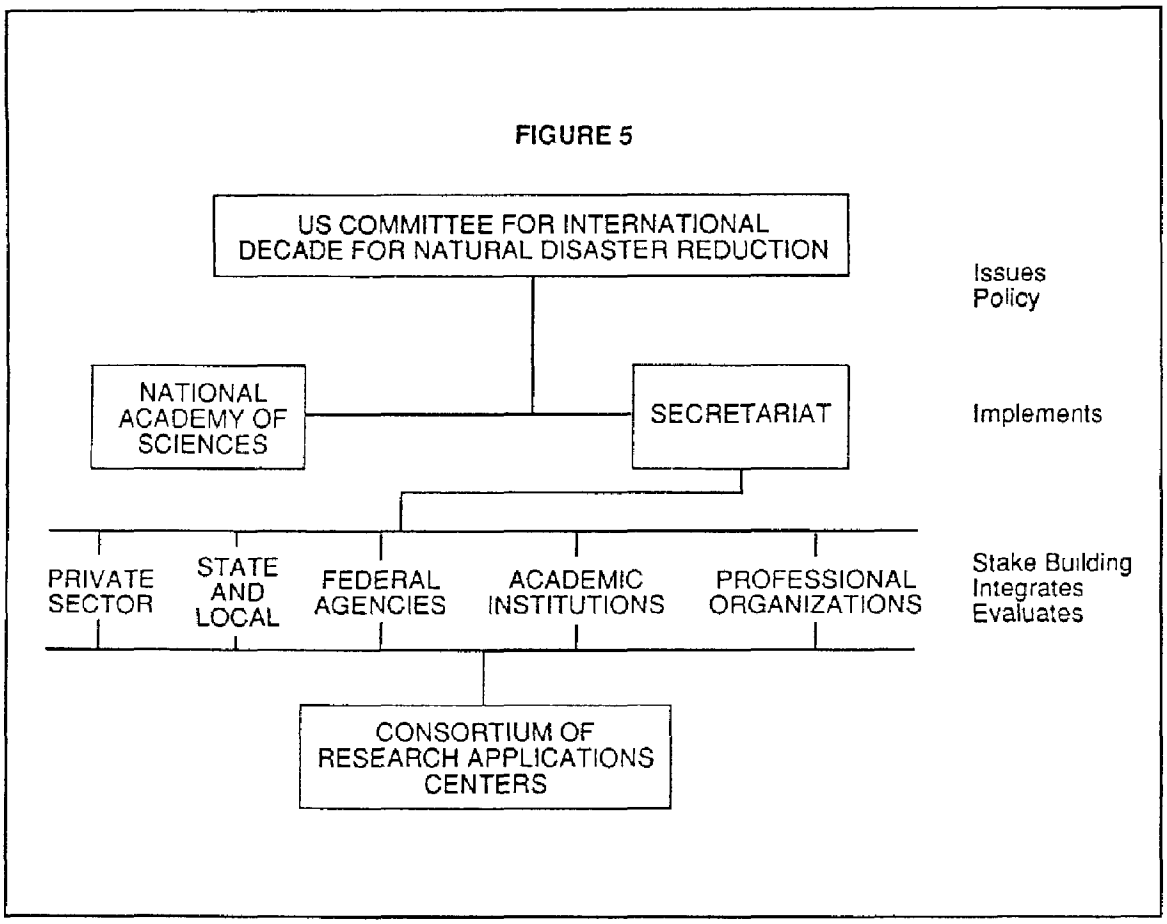
Structure, Leadership, and Organization

No other issue evoked more concern than the question of leadership and organizational structure for the Decade. Discussants argued that without good leadership and the development of an organization to receive ideas, link programs, and look to for inspiration, the Decade might flounder and become ineffective.

Discussions on organization gave birth to a rash of flow charts and organization diagrams, some of which are shown in the working group reports. Another organizational suggestion, formulated in discussions between federal agencies and the NAS after the workshop, is shown in Figure 5.

In keeping with the sense of the workshop that the Decade needed coordinated leadership at a national level, but would succeed or fail based on the ability of regional, state, and local programs to

FIGURE 5



make an observable difference, there remains a need to design an organizational structure that nurtures both national and local efforts. There was a strong call for creation of some formal structure soon so that emerging grass-roots, local, and state programs could point to a national program in support of their efforts. Again, existing programs needed to be recognized and incorporated into the Decade; some could quickly be turned into "showcase" efforts.

As suggested earlier, several participants noted the need for a show of executive branch support for the Decade in keeping with the Congressional resolution.

The Need for a National Assessment

Participants noted that the Decade needed a base of information and knowledge with which to operate and against which to measure future progress. Several participants proposed an initial assessment of hazards research and applications to set the stage for the Decade. They noted that assessments of selected hazards had been conducted in the past few years, and that a valuable step toward the Decade would be to pull these together, fill in the gaps, and prepare a full national assessment of the state of the art and practice in hazard reduction. This could be accomplished by identifying programs, trends, successes, failures, and emerging knowledge. It was suggested that the assessment could be accomplished quickly and efficiently through a consortium of hazards institutions collaborating to pull together existing assessments of sub-fields and to identify gaps in knowledge and applications.

The Nature of State and Local Programs

There was little disagreement with the proposition that state and local governments should be at the focus of Decade implementation efforts, and several good ideas for accomplishing this were offered. (Both a state (Tennessee) and a local (Boulder, Colorado) Decade effort were first conceived during the workshop.) The participants also discussed the creation of links between communities and the sharing of personnel and projects. One participant suggested a series of "circuit-riding" hazard reduction advisors who would make rounds of communities designing new programs, or a new hazards "extension service."

It is at the state and local level that the private sector is most likely to be effectively involved, and it was pointed out that it is at this level that several other organizations which should be a part of a Decade effort, such as the National Governors' Association, the League of Cities, and other similar entities, should be included. However, without some sort of leadership to provide guidance or a focal point, state and local as well as private efforts for the Decade may be uncoordinated and potentially ineffective and costly.

The Need to Quickly Enlarge the Audience for Decade Discussions

Participants identified several organizations that needed to be brought quickly into the Decade planning and implementation process, such as the National Governors Association, the International City Management Association, and Council of State Governments. Special presentations at upcoming meetings of professional societies and civic organizations were suggested, and again, some frustration was voiced concerning the need for a central statement and organizational theme and structure for the Decade.

Nevertheless, discussions ensued about the possibility of a national conference on the Decade, and about sending speakers to several different upcoming meetings, developing a market-oriented brochure, and sending letters to various organizations and government entities.

NEXT STEPS

The key next step identified at the workshop was for the federal agencies involved in hazards and the National Academy of Sciences to agree on an organizational structure at the national level, and for mechanisms to be developed whereby hazard groups at different governmental levels and other institutions could keep abreast of Decade development, and contribute to it as they see fit. The chart in Figure 5 emerged from discussions after the Colorado workshop.

Another important "next step" was identified as the creation of a set of broad goals for U.S. hazards programs to focus on over the next ten years. Several such "goal statements" were suggested, including, for example:

- Creation of a full multihazard reduction capability in each of the 50 states and all SMSAs;
- Institutionalization of mechanisms to continually monitor and evaluate U.S. hazard reduction programs;
- Development and maintenance of programs to ensure adequate educational opportunities for hazards and emergency management professionals;
- Integration of hazard management programs with other growth and environmental management programs as well as with economic development efforts.

A set of broad goals like these gives each level of government and all relevant institutions a focus around which to organize subset goals and objectives to complement the national effort. Such program planning could include short-range (1-3 years) and long-range (5-10 or more) horizons, with regular evaluations that can later be integrated at the national level to assess the progress of the Decade.

Other "next steps" are described in the working group reports. Several possible steps need quick action to benefit from the momentum currently building for the Decade. For example, a need for some sort of executive branch recognition and endorsement of the U.S. Decade was recognized, and the creation of a "transition paper" to inform the incoming administration about the Decade concept was proposed. Similarly, a program that tracks and nurtures state and local contributions to the Decade should be established quickly to provide focus to such efforts.

Additional "next steps" discussed at the workshop include:

- Creation of a national steering committee or advisory group broadly representative of the hazards field;
- An assessment of progress to date in hazard reduction, including a roster of existing programs, impact trends, and research progress since the last major assessment in the early 1970s, and identification of gaps in both knowledge and practice;
- A national, high-visibility conference on the Decade, as well as a plan to "market" the Decade's purposes goals;
- Designation of local or regional "demonstration projects" that can be brought under, or newly created as part of, the Decade;
- The creation of a consortium of institutions with expertise in hazard reduction to provide advice and assistance with such efforts as the creation of links between research and practice and the monitoring of its progress.

ATTACHMENTS

A WORKSHOP ON HAZARD MITIGATION IN THE 1990s

AGENDA

TUESDAY, OCTOBER 11

4:00 p.m.	First van departs Stapleton Airport (Meet at Door #3, lower level near United Baggage claim)
6:00 p.m.	Last van departs Stapleton Airport
8:00 p.m.	Welcome and Ice-Breaker

WEDNESDAY, OCTOBER 12

7:00 - 8:30 a.m.	Breakfast served in the Dining Hall
8:30 - Noon Longs Peak Room (Break at 10:00)	Plenary Session: Introduction to the Decade Update on the U.S. Decade Status and Assessment of Hazard Mitigation Trends in the 1990s Formation of Working Groups
Noon - 1:30 p.m.	Lunch served in the Dining Hall
1:30 - 4:30 p.m. (Break at 3:00)	Working Groups Integration of Disciplines Social, Economic, Political Constraints Technology Transfer Private Sector Role State and Local Role
4:30 - 7:00 p.m.	Additional Working Group writing time, free time or hike Twin Sisters Mountain Trail (weather permitting)
7:00 - 9:00 p.m	Campfire Cookout (weather permitting, otherwise, dinner served in the Dining Hall).

THURSDAY, OCTOBER 13

7:00 - 8:30 a.m.	Breakfast served in the Dining Hall
8:30 - 10:00 a.m.	Working Groups reconvene to develop final reports and recommendations.
10:00 a.m.	Break
10:30 - 12:30 p.m.	Plenary Session: Working Group Chairs will report to the full group.
12:30 - 2:00 p.m.	Lunch served in the Dining Hall.
2:00 - 4:30 p.m. (Break at 3:00)	Plenary Round Table Discussion
4:30 - 7:00 p.m.	Working group writing, free time, hiking (weather permitting)
7:00 - 9:00 p.m.	Dinner served in the Dining Hall

FRIDAY, OCTOBER 14

7:00 - 8:30 a.m.	Breakfast served in the Dining Hall.
8:30 - 11:00 a.m. Longs Peak Room (Break at 9:45)	Plenary Session: Next steps for the U.S. Decade Wrap-up
11:15 a.m.	First van departs for Stapleton
11:30 - 12:30 p.m.	Lunch served in the Dining Hall
12:45 p.m.	Second van departs for Stapleton

PARTICIPANT LIST

William A. Anderson T
National Science Foundation
1800 G Street, NW
Washington, DC 20550
(202) 357-9780

Stephen O. Bender I
Organization of American States
Department of Regional Development
1889 F Street, NW
Washington, DC 20006
(202) 458-6295; 458-3005

David Bush I
Department of Geography
Duke University
Box 6729 College Station
Durham, NC 27708
(919) 684-4238

David L. Butler SL
Natural Hazards Center
Campus Box 482
University of Colorado
Boulder, CO 80309-0482
(303) 492-6818; 492-4180

Arthur Chiu T
Department of Civil Engineering
University of Hawaii @ Manoa
Holmes Hall 383
2540 Dole Street
Honolulu, HI 96822
(808) 948-7170

Riley Chung C
National Academy of Sciences
2101 Constitution Avenue, NW
MH 286
Washington, DC 20418
(202) 334-3312

David Diggs * I
Department of Geography
Campus Box 260
University of Colorado
Boulder, CO 80309-0260
(303) 492-3248

Robert P. Fletcher I
U.S. Army Corps of Engineers
CECW-OE-P
20 Massachusetts Avenue
Washington, DC 20314
(202) 272-0453

Robert D. Gale T
USDA Forest Service
Fire and Aviation Management
P.O. Box 96090
Washington, DC 20090-6090
(703) 235-8666

Michael Gaus
National Science Foundation
1800 G Street, NW
Washington, DC 20550
(202) 357-9780

Edward M. Gross P
NOAA/National Weather Service
8060 13th Street, Room 421
Silver Spring, MD 20910
(301) 427-7258

Richard Halgren P
Executive Director
American Meteorological
Society
45 Beacon Street
Boston, MA 02108
(617) 227-2425

Spenser W. Havlick SL
Department of Environmental Design
Campus Box 314
University of Colorado
Boulder, CO 80309
(303) 492-7711

Walter W. Hays SL
U.S. Geological Survey
905 National Center
Reston, VA 22092
(703) 860-6471

William H. Hooke I
NOAA/Office of Chief Scientist
14th & Constitution Avenue, NW
Room 5808
Washington, DC 20230
(202) 377-8565

Richard W. Krimm C
FEMA, Natural & Technological Hazards
500 C Street, SW
Washington, DC 20472
(202) 646-2871

Jon Kusler T
J.A. Kusler Associates
P.O. Box 2463
Berne, NY 12023
(518) 872-0588

Larry A. Larson SL
Association of State Floodplain Managers
P.O. Box 7921
Madison, WI 53707
(608) 266-1926

Mary Lystad C
National Institute of Mental Health, Room 7C-02
5600 Fishers Lane
Rockville, MD 20857
(301) 443-4735

James Makris SL
Environmental Protection Agency
Office of Hazard Response
401 M Street, SW
WH-562A
Washington, DC 20460
(202) 475-8600

Shirley Mattingly SL
Los Angeles Office of Emergency Management
Rm 300, City Hall East
200 North Main Street
Los Angeles, CA 90012-4190
(213) 485-6400

Peter May C
Department of Political Science
DO-30 Stop 4412
University of Washington
Seattle, WA 98195
(206) 543-2780

Sarah Michaels * T
Natural Hazards Center
Campus Box 482
University of Colorado
Boulder, CO 80309-0482
(303) 492-6818

Dennis Mileti C
Hazards Assessment Laboratory
202 Aylesworth Hall
Colorado State University
Fort Collins, CO 80223
(303) 491-5951; 355-3031

Mary Fran Myers * P
Natural Hazards Center
Campus Box 482
University of Colorado
Boulder, CO 80309-0482
(303) 492-2150

Sherry Oaks C
AAAS/AGU Congressional Science and Engineering Fellow
Office of Congressman George Brown
2188 Rayburn
Washington, DC 20515
(202) 225-6161

Risa Palm
Dean of Graduate School
Campus Box 26
University of Colorado
Boulder, CO 80309-0026
(303) 492-2890

Jelena Pantelic C
National Center for Earthquake Engineering Research
State University of New York-Buffalo
Red Jacket Quadrangle
Buffalo, NY 14261
(716) 636-3391

William Petak I
Institute of Safety & Systems Management
ISSM 108
University of Southern California
Los Angeles, CA 90089-0021
(213) 743-5060

Stephen Rattien P
National Academy of Sciences
2101 Constitution Avenue, NW
MH 280
Washington, DC 20418
(202) 334-2308

William E. Riebsame * C
Natural Hazards Center
Campus Box 482
University of Colorado
Boulder, CO 80309-0482
(303) 492-6312

Claire B. Rubin T
Graduate Program in Science,
Technology, and Public Policy
George Washington University
Gelman #714
Washington, DC 20052
202-994-7405

Eleonora Sabadell I
National Science Foundation
1800 G Street, NW
Washington, DC 20550
(202) 357-9780

Clement F. Shearer T
U.S. Geological Survey
106 National Center
Reston, VA 22092
(703) 648-4425

Lacy E. Suiter SL
Tennessee Emergency Management
Agency
National Guard Armory
3041 Sidco Drive
Nashville, TN 37204-1502
(615) 252-3300

Frank H. Thomas C
FEMA/Federal Insurance
Administration
500 C Street, SW
Washington, DC 20472
(202) 646-2717

Susan K. Tubbesing I
Earthquake Engineering
Research Institute
6431 Fairmount Avenue, Suite 7
El Cerrito, CA 94530-3624
(415) 525-3668

Robert D. Vessey P
American Red Cross
18th and D Streets, NW
Washington, DC 20006
(202) 639-3393

Clive Walker P
USDA Soil Conservation
Service
P.O. Box 2890
Washington, DC 20013
(202) 382-8766

Donald R. Wernly SL
NOAA/National Weather Service
8060 13th Street, Room 1326
Silver Spring, MD 20910
(301) 427-8090

*Staff

The letter following the name indicates in which working group the individual participated:

I = Integration (#1)
C = Constraints (#2)
T = Technology Transfer (#3)
P = Private Sector (#4)
SL = State & Local (#5)

APPENDIX 1

Evolution of the International and National Decades

In the summer of 1984 at the Eighth World Conference on Earthquake Engineering, Frank Press, President of the National Academy of Sciences (NAS), called for an International Decade for Natural Hazard Reduction (IDNHR). He envisioned a decade that would take advantage of recent scientific and engineering advances to reduce the growing toll of natural events such as earthquakes and floods. Subsequently, in early 1986, the NAS convened 48 experts with diverse viewpoints to consider the merits and likelihood of a joint international program to minimize the impacts of natural hazards. Six of the 48 attendees formed an ad hoc working group which produced a proposal, entitled ***Toward a Less Hazardous World***, to establish an International Decade for Natural Hazard Reduction. The ad hoc committee proposed three interlocking goals for the Decade:

1) The creation and dissemination of scientific and engineering knowledge pertinent to the reduction of losses from natural hazards;
2) The development of new institutional mechanisms and new societal strategies for applying that knowledge to the reduction of losses from natural hazards; and
3) The actual use of that knowledge and those mechanisms and strategies to achieve reductions in losses.

The National Research Council (NRC) Advisory Committee on the IDNHR was formed in the spring of 1987. Building on the working group's recommendations, the Advisory Committee produced its own report, ***Confronting Natural Disasters***, which has become a central document in the creation of an International Decade for Natural Disaster Reduction. It calls for a broad, interdisciplinary program involving three basic steps: risk assessment, disaster preparedness, and mitigation. The report identifies rapid-onset hazards such as floods, landslides, and earthquakes as the focus of the Decade because:

> Their occurrence is easily identified geographically. They occur frequently enough, globally, that we now have a large body of data on them and considerable experience in alleviating their effects. And we can reduce their impacts with a common set of skills, including immediate warnings, construction techniques, land use planning, and emergency relief (p. 9)

The report proposes a "Hazard Reduction Process" in which geophysical science, engineering, ecological and social science approaches are fully integrated; the process includes building to withstand hazards, predicting their occurrence, land use planning, public awareness programs, and economic loss-sharing strategies.

Soon after the advisory committee's report was published, the 42nd Session of the United Nations General Assembly, in December 1987, designated the 1990s as an International Decade for Natural Disaster Reduction (IDNDR). The U.N. Resolution (#42/169) states that:

> the objective of this Decade is to reduce through concerted international actions, especially in developing countries, loss of life, property damage and social and economic disruption caused by natural disasters . . . and that its goals are: (a) To improve the capacity of each country to mitigate the effects of natural disasters expeditiously and effectively, paying special attention to assisting developing countries in the establishment, when needed, of early warning systems; (b) To devise appropriate guidelines and strategies for applying existing knowledge, taking into account the cultural and economic diversity among nations; (c) To foster scientific and engineering endeavors aimed at closing critical gaps in knowledge in order to reduce loss of life and property; (d) To disseminate existing and new information related to measures for the assessment, prediction, prevention and mitigation of natural disasters; (e) To develop measures for the assessment, prediction, prevention and mitigation of natural disasters through programmes of technical assistance and technology transfer, demonstration projects, and education and training, tailored to specific hazards and locations, and to evaluate the effectiveness of those programmes.

In the resolution, the General Assembly of the U.N. created the mandate for the U.S. Decade for Natural Disaster Reduction by calling on governments "to establish national committees, in co-operation with the relevant scientific and technological communities, with a view to surveying available mechanisms and facilities for the reduction of natural hazards, assessing the particular requirements of their respective countries or regions in order to add to, improve or update existing mechanisms and facilities and develop a strategy to attain the desired goals."

In May 1988, Congressman George E. Brown, Jr. of California introduced legislation, House Concurrent Resolution 290, which endorses the establishment of the U.S. Decade for Natural Disaster Reduction as a means of supporting the international initiative. In his remarks, Brown urged better coordination among federal agencies to improve existing programs such as the National Earthquake Hazard Reduction Program. In July, Senator Orrin C. Hatch of Utah introduced a companion bill, Senate Concurrent Resolution 131, establishing a U.S. Decade for Natural Disaster Reduction. To formally address hazard reduction, Hatch, in his introductory remarks, called for the active involvement of member states, as well as relevant scientific, technical, academic, and other nongovernmental organizations, in the development, dissemination, and application of future and existing knowledge. In the fall, just prior to adjourning, the resolutions in both houses of Congress were passed and became law.

In 1988 the National Research Council's Advisory Committee produced ***Reducing Disaster's Toll: The United States Decade for Natural Disaster Reduction***. The report recommends a broad program similar to the IDNDR, ranging from efforts to reduce the strength of the natural events themselves (e.g., cloud seeding), to programs to reduce social vulnerability (e.g., land-use restrictions). The committee sees the U.S. Decade as a vehicle to achieve nationally agreed upon goals by assessing, realigning, augmenting and linking existing independent hazard management programs in an integrated hazard reduction system which will act as the focus of a vigorous and well-funded effort. The advisory committee recommends that a national committee be set up for the Decade to provide leadership, seek support from all levels of government and other pertinent organizations, and coordinate U.S involvement in the IDNDR.

APPENDIX 2

These notes are from Susan K. Tubbesing's presentation at the first plenary session. Ms. Tubbesing is Executive Director of the Earthquake Engineering Research Institute.

Natural Hazard Reduction in the U.S.: A Brief Assessment

In looking ahead toward a decade of natural hazard reduction, a historical perspective may be useful. It is important to consider the accomplishments of the past decade as well as to identify emerging and remaining problems. Surprisingly, much has been accomplished in the area of disaster reduction in the short period of the last decade; these accomplishments provide hope for success in future efforts.

The response of the federal government to hazard reduction has been substantial (Table 3). Numerous programs including the National Flood Insurance Program, the National Earthquake Hazard Reduction Program, the Federal Disaster Relief Act, and the Coastal Zone Management Act have been aimed at reducing risk and providing relief from natural hazards. While there was little in the way of interagency cooperation ten to fifteen years ago, the past decade has seen a dramatic increase in such interaction. For example, the use of interagency postdisaster hazard mitigation teams has become increasingly prevalent after floods, earthquakes, and other disasters.

TABLE 3

NATURAL HAZARD MITIGATION FEDERAL PROGRAMS

FEDERAL DISASTER RELIEF ACT OF 1974
NATIONAL FLOOD INSURANCE PROGRAM - MAPPING, REGULATION
FLOOD HAZARD EXECUTIVE ORDERS 11296, 11988
INTERAGENCY POSTDISASTER HAZARD MITIGATION TEAMS - FLOOD, EQ
NATIONAL EQ HAZARD REDUCTION PROGRAM
INTERAGENCY HURRICANE EVACUATION PROGRAM
COASTAL ZONE MANAGEMENT ACT
NOAA'S SLOSH MODELS & DOPPLER RADAR
NWS HURRICANE, TORNADO & OTHER SEVERE STORM PUBLIC EDUCATION MATERIALS
USGS HAZARD WARNING PROGRAM
THE FEDERAL DAM SAFETY PROGRAM
USGS/FEMA EQ AWARENESS WORKSHOPS
FEMA/BSSC EQ HAZARD REDUCTION SERIES
FEMA'S PUBLIC EDUCATION MATERIALS: CTW, REGIONAL EQ INFORMATION PROGRAMS, ETC.
NIMH EDUCATION AND TRAINING MATERIALS FOR DISASTERS WORKERS
USGS PARKFIELD EXPERIMENT

Significant technological advances also have resulted from the efforts of the federal government. The development of the SLOSH model and Doppler radar by the National Oceanic and Atmospheric Administration or the U.S. Geological Survey Hazard Warning Program have been and will continue to be invaluable tools for hazard mitigation.

Many federal government ventures in hazard reduction also have been aimed toward public education. Educational materials on hurricanes, tornadoes, and other severe storms have been developed by the National Weather Service. The Federal Emergency Management Agency's public education materials provided through such outlets as the Children's Television Workshop have been very successful.

In addition, several cooperative endeavors between the federal government and state and local entities have been established. The Southern California Earthquake Preparedness Project (SCEPP), the Bay Area Regional Earthquake Preparedness Project (BAREPP), and the Central United States Earthquake Consortium (CUSEC) exemplify such ventures. The Tennessee Valley Authority Floodplain Management Program and Utah's County Geologist Program are other examples of highly successful intergovernmental cooperation.

State and local governments also have developed programs addressing regional hazards. Earthquake hazard reduction programs, hurricane set-back regulations, delineation of hazard zones, fault mapping, strong ground motion instrumentation, and hazard scenario development have been carried out in many states. A few states, notably California, have developed seismic safety commissions. Numerous local governments have enacted building codes and zoning regulations aimed at hazard reduction. Local entities have also installed flash flood warning systems, accomplished hazard zone mapping, developed evacuation plans, and pushed for floodproofing and seismic retrofitting. As at the national level, public education has played a significant role in state and local hazard mitigation efforts.

Although great strides have been made in hazard reduction, problems remain. Life loss has been reduced, but economic losses, along with the resultant social disruption, continue to mount at a staggering pace. In the United States, for example, there are $4 billion a year in flood losses as well as millions of dollars lost due to hurricanes that do not even make landfall. Moderate-sized earthquakes, such as the Whittier Narrows event in 1987, cause hundreds of millions of dollars damage. Two primary reasons contribute to these increased losses. First, our mitigation programs are enacted after the fact instead of ahead of time before a natural disaster occurs, and second, mitigation programs have been aimed primarily at life loss reduction with reduction of property loss a secondary consideration.

Problems associated with increasing losses include other factors as well. Funding is rarely available to sustain implementation programs at any level of government. Due to other economic and social demands, local government has generally been unable to resist economic pressure to develop or redevelop in unsuitable areas. Support from government for land-use regulation, acquisition, relocation efforts, or retrofitting of existing hazardous buildings has been consistently insufficient. Instead, support has been channeled into technological "solutions" which have saved lives, yet do little to prevent development in areas of risk. In some cases, development in high-risk areas has been encouraged by the technological mitigation tools available.

Thus, although they may increase vulnerability, technological solutions are often undertaken because they are distinct and identifiable. Technological measures provide an option for action that avoids the more complicated issues associated with population growth and economic development. For example, the availability of federal, state, and local governmental resources to help reduce risk of rapidly growing populations inhabiting unreinforced masonry buildings and structures never intended for human habitation, such as tilt-up warehouses, are limited, and incentives for such action in the private sector are virtually nonexistent. This also holds true for reducing risk for poor and elderly persons living in mobile home parks located in highly developed floodplains and flash flood areas.

Present day structural solutions—warning systems, vertical evacuation, floodproofing, fire-resistant building materials, seismic design for new construction, and building codes—do little to reduce the increasing population and economic development in high-risk areas. We may not be building new dams, but populations continue to grow below the old ones we have already built. Many design and construction innovations affect only new construction, and retrofitting technology, although considerable, has been inadequately applied to existing building stock in this country. Therefore, while technological

developments have been responsible for reducing the lives lost in some cases, economic losses and social disruption continue to escalate. Technological adjustments are valuable and should be pursued in many cases, but it should be recognized that such solutions are often too costly to maintain and do, in fact, contribute to increased vulnerability. In the future, a powerful hurricane may change course or a flash flood may develop in an alternative location, placing people and property in great jeopardy despite the technological mitigation in place. It is important, therefore, that other hazard reduction strategies be integrated into society as well.

Population trends indicate that 30 to 40 million people will soon reside in coastal areas of the United States. Another 25 to 30 million are now at risk in highly developed floodplains. The population also continues to grow in areas of seismic hazard, and development continues on unstable slopes and in other marginal places. In addition, large numbers of highly vulnerable populations – such as the poor and elderly – continue to inhabit unsafe structures in high-hazard areas. Not only has the potential for catastrophe increased, but it has done so with increased disparity. Disasters in the future are more likely to affect the poor and underprivileged because of mounting pressures from population and economic development, but no single segment of society will be spared the costs of reconstruction and recovery. Some segments of society will be permanently displaced, but others will pay an increasingly higher price in terms of the economic burden for the total losses.

In looking ahead toward the International Decade for Natural Disaster Reduction, and to our own U.S. Decade, it is essential that we apply the knowledge we have gained. In the past, there has been little effort to assess the effectiveness of existing mitigation programs. We need evaluations to determine whether recommendations by postdisaster hazard mitigation teams are useful, or even to see if the recommendations have been implemented. We need to determine the relative success of other hazard reduction strategies as well. For example, we need to determine if insurance can be an effective mitigation tool.

Again, it is clear that population and development pressures are defining the nature of hazard reduction for the future; therefore, these issues must be addressed. In addition, several crucial areas are vital to future hazard reduction. We must encourage greater public awareness of hazards. The media can be an effective tool for "selling" hazard reduction to our citizens. Incentives for building owners to retrofit their structures must be provided. We also have to provide incentives for communities to change hazardous land uses and to deal with existing hazardous structures.

Finally, the many research accomplishments of the past several years must be utilized. Areas and populations at risk need to be better identified. The production and distribution of effective technical and nontechnical hazards information to target audiences must be increased. Effective interagency and multijurisdictional cooperation must be fostered to a greater extent. Existing institutional networks such as professional associations, volunteer organizations, and religious groups must be used for hazard reduction strategies to be acceptable and successful. Public/private partnerships need to be extended greatly since the task of hazard reduction is too great for any one entity. We must also provide technical assistance at the local level. Proven technology transfer approaches should be used. We need to incorporate what we know about risk communication and behavioral change into locally relevant methods. With these strategies in mind, hazard reduction focus on specific, measurable goals. Scientific and technological information need to be applied as part of an integrated program that includes our state-of-the-art knowledge not only about the physical aspects of hazards, but about their human components as well.

ACKNOWLEDGEMENTS

The Natural Hazards Research and Applications Information Center gratefully acknowledges the assistance and support received in holding the Colorado Workshop on Hazard Mitigation in the 1990s. The Center received support from the National Science Foundation and the U.S. Geological Survey, as well as from the many individuals who traveled to Colorado using their own funds. More importantly, the Center is deeply grateful to each of the participants who contributed their time, energy, and wisdom to this important task.

This report was compiled and edited by Sherry Oaks with help from Mary Fran Myers, William Riebsame, and David Butler.