Chapter 5. IASPEI Program Organization

The practical organization and operation of an effective IASPEI program in IDNDR can be conceived at various levels of effort. The recommendations in this report entail a considerable increase in activities of major interest to IASPEI. If economic circumstances were particularly favorable even greater effort could be envisaged. The position taken at this initial stage is to formulate what might be regarded as a basic, if rather modest, program with the option of expansion as further opportunity arises.

As presently constituted, the Bureau of IASPEI devolves most organizational work to the Secretary-General. The present office of the Secretary-General is highly effective but limited in staffing, given the regular requirements of the organization. Detailed oversight of and development assistance to a significant additional IDNDR program appear out of the question. Neither would it appear that the Bureau itself could undertake the full operational responsibility for a program as extensive as outlined in this report. As a consequence, we recommend that the responsibility for administration of the IDNDR program of IASPEI be delegated to a special IDNDR secretariat with a separate budget. Even under this arrangement, however, it is likely that some additional resources need to be found for enhanced oversight activities by the Secretary-General and Bureau.

The recommendation of the committee is to set up a temporary Secretariat which would be charged with the administration and organization of the IDNDR program within IASPEI. The Secretariat would report directly to the Chairman of the Committee of the IDNDR of IASPEI and to the Secretary-General. Responsibilities would be (a) to develop liaison with all interested scientific organizations, (b) to keep up-to-date records of relevant IDNDR activities, (c) to act as Secretariat for the IASPEI Committee on the IDNDR, (d) to act as the administrative office for other Commissions for activities directly involving the IDNDR program and (e) to issue special IDNDR publications, including IASPEI manuals.

Several suggestions have been put forward for sites for the Secretariat. An essential criterion is the willingness of the host organization and country to supply space, office facilities, and staff without guaranteed cost by IASPEI. It is envisaged that the Secretariat would be (a) subject to review by the Bureau, and (b) maintained at the selected site for at least five years with a possibility of extension for the whole Decade. The Office would be set up under an agreement between the host organization and the Bureau of IASPEI.*

There is an invitation (December 1, 1990) for the new Secretariat to be situated in Beijing under the auspices of the PRC State Seismological Bureau.

The organization of the IASPEI program for the Decade should, even with the establishment of a Secretariat, be as flexible and decentralized as possible. IASPEI already has effective and focussed Commissions which undertake work closely related to the goals of the IDNDR (see Appendix B). The operational plan would be for overall policies to be formulated and nurtured by the IASPEI Committee for the IDNDR which contains membership from three main Commissions. However, most programs recommended would be developed with appropriate modifications by the relevant Commission. The Commission would then seek funds either independently or through the Secretariat, with assistance from the Committee on IDNDR. As well, individual and group seismologists will no doubt develop their own research programs as Principal Investigators. In order to avoid overlap in funding requests, information on Commission activity would flow through the Secretariat.

The IASPEI relations with the many other organizations (see Chapter 2) which have parallel interests such as IUGG, ICL, and UNESCO, would be maintained by the Committee of the IDNDR with the help of the IDNDR Secretariat. IDNDR-related meetings supported by IASPEI would be developed by the Committee with administrative work carried out by the IDNDR Secretariat.

In 1989, IASPEI and IAEE set up a joint committee to coordinate work for the IDNDR. The membership is G. W. Housner (USA-IAEE), Chairman, E. G. Kausel (Chile-IASPEI), J. Petrovski (Yugoslavia-IAEE), K. Toki (Japan-IAEE) and Li Li Xie (China-IASPEI). This Committee has not yet been active but with help of the Secretariat it could be most effective in integrating seismological and earthquake engineering research programs. (The IAEE Committee on the IDNDR, in conjunction with IASPEI, has under consideration for late 1991 a "Workshop on Recent Destructive Earthquakes," which would prepare a report on such earthquakes and the role of the IDNDR.)

IASPEI should also keep abreast of the many national, bilateral and regional initiatives related to the reduction of earthquake hazards. For example, scientific initiatives will result from the 1990 cooperative agreements between the USSR Academy of Sciences and the State Seismological Bureau of the People's Republic of China and an agreement between the USSR Academy of Sciences and the U.S. National Academy of Science on earthquake problems.

Collapsed and heavily damaged apartment buildings in Leninakan, Armenian Earthquake, December 7, 1988.

Chapter 6. Major Proposals for IASPEI

IASPEI's interests in earthquakes and physics of the Earth span geology, fault mapping, geodesy, seismology, rock mechanics, mathematical modelling, instrumental development, observational analysis, wave effects on soils and structures, to name only a few. Further, there is little doubt that almost all these aspects bear on man's ability to reduce earthquake risk.

For example, from the point of view of geology, it is essential that during the IDNDR, a maximum effort in mapping of Quaternary faults should be undertaken in areas where the surface geology is clearly intimately related to the occurrence of large earthquakes. Such areas of the world are now well known, including the western United States, parts of Japan, China, the Soviet Union, North Africa, Central and South America and India. Yet basic information is often still lacking or inaccessible.

In order not to dissipate the main initiatives of the first half of the Decade, in this section those aspects of the recommended IASPEI program that the Committee believes should dominate the initial IASPEI effort are outlined. We stress, however, that the existence of the IDNDR as a special program in fact affects all aspects of IASPEI's work because all research on earthquakes has eventually some influence on the reduction of earthquake risk. As already indicated, many seismological programs supported by IASPEI in the past can be counted as contributions to this end. Nevertheless, it is useful to separate those programs which could be thought of as additional or special efforts which in aggregate give a more vigorous approach to the risk reduction aspect of seismological work.

1. Manuals and Guidebooks

When one thinks of risk minimization on earthquakes, there are often complaints that the relevant work in seismology is not integrated with that of engineering and social scientists. The work with strong motion records is one example. Three decades ago, strong motion instrumentation was thought largely to be a matter of engineering concern with little interest to seismological research. The situation is now changed with many basic seismological studies being conducted using strong motion accelerograms.

It remains true that although interaction between disciplines has improved, the transfer of information is still not continuous and effective. For this reason, it is proposed that manuals forming a set of volumes dedicated the IDNDR be produced by various Commissions through workshops and other means, including the IASPEI Committee for the IDNDR. The titles of these volumes should be made more explicit during the next few years but the following are examples.

(i) Manual on Microzonation. A state-of-the-art manual would be developed from materials presented at the Fourth International Conference on Seismic Zonation to be held at Stanford University, California, in August 1991. Permission has already been given by the conference Advisory Board that authors presenting papers can be approached on a selected basis for material for a special IDNDR manual. The goal and scope of the manual will be to provide up-to-date guidance for planners around the world on the use of zonation as a tool to reduce seismic hazards.

(ii) Manual on Seismic Hazard Assessment. Activities of the IASPEI Working Group on Assessment Techniques (see Appendix B), in close collaboration with the European Seismological Commission, has already begun on this work. Such a manual would summarize various methods, describe computer programs available, and give case histories.

(iii) Manual on Management of Short-Term Prediction. This would include discussion on necessary legislation, monitoring organization, public education, information, cooperation of the mass media, and examples of educational materials.

(iv) Manual of Economic Aspects of Seismic Risk. An inexpensive published report would provide guidelines on the use of seismological information for investors, development planners, land-use planners, and insurance.

(v) Manual on the Methodology for Post-Earthquake Seismological Surveys. The Commission on Earthquake Hazard and Prediction would be charged with this task. It has been seen in recent significantly damaging earthquakes, such as the 1988 Armenian earthquake, that numerous scientific, engineering and social sciences reconnaissance teams are likely to visit such an area, many to assist the local groups at recovery efforts, but also to learn firsthand how to mitigate earthquake dangers elsewhere. Monographs and reports are now often published on these activities but IASPEI guidelines summarizing scientific goals, field opportunities and procedures would be of great value in providing smooth and constructive interactions, both for the host country, which is under extreme pressures and the visiting seismological teams. Collaboration with IAEE is needed.

(vi) Manual on Strong Motion Networks. This would contain information on the latest instrumentation, on data reduction, including digitization and first-level processing, on the data banks available, and on access. The compilation could also be done in cooperation with IAEE.

2. Estimation of Seismic Hazard in Different Regions.

IASPEI has traditionally, and more recently through its Commission on Earthquake Hazard and Prediction, been involved in this aspect of seismology. An especially dedicated program is now appropriate. This program would include studies of seismicity, detection and exploration of seismogenic faults and compilations of maps of such faults at different scales. Discrimination and modelling of dangerous segments of faults such as locked parts, bends, offset sections, large asperities etc. would be undertaken and the study of stress-strain states by different methods pushed to a higher level.

Worldwide standardized investigation is needed of paleoseismic dislocations and development of techniques for their discrimination, including trenching across fault ruptures of recent earthquakes. Repetition of precise geodetic measurements, especially near and across active faults, using space and ground techniques to estimate slip-rates and areas of strain accumulation, should be encouraged. Additional observations and modelling of tsunami sources are needed.

3. Nature of the Seismic Source Process.

More quantitative study of focal mechanisms and moment tensors, earthquake source, roughness distributions, and fractal properties is needed. Physical and digital 3-D modelling and correlation between earthquake source and ground motion characteristics should be intensified with emphasis on specific earthquake models in different geotectonic conditions. Scenarios of seismic energy release should be modelled for engineering input to structures.

Also needed are transferability of information from one seismogenic region to another; densification of near-field networks of broadband seismic stations; work on the problem of network optimization with attention to the financial point of view.

4. Earthquake Initiation and Inter-occurrence Time Prediction.

Here we list some of the topics that should be included in the IDNDR research program. Space-time variations of seismicity and related geophysical fields. Definition of earthquake preparation stages. Mechanism of precursors. Laboratory study of fracturing and accompanying changes in physical properties. Critical study of all types of precursors. Discrimination of foreshocks. Expert systems for detection of precursors and issuing of earthquake alarms in real-time, based on combined parameters. Use of statistical prediction theory for better estimation of the place, time, magnitude and probability of future earthquakes. Study of triggering effects. Induced seismicity and methods to decrease the danger of damaging man-made earthquakes.

5. General Actions Needed on the Program Proposals

PR 1. Compile all available information related to disastrous earthquakes in special volumes, if possible in digital form, including foreshock and aftershock activity, deep crustal structure, geotectonic features, maps of the geophysical field, etc. Acquire reasonable funds for such work. Spitak and Iranian earthquakes would be good candidates to begin.

PR 2. Encourage studies of induced seismicity for understanding the seismic source process and reducing seismic hazard. Detailed studies of seismicity, crustal deformation, hydraulic pressure and chemical activity and other parameters are needed for a complete description of the initiation process. Appropriate sites near the high-level dams could be selected for international investigations.

PR 3. Upgrade the seismographic network around the Pacific region with broadband seismic instruments and develop the methodology for rapid determination of source parameters to discriminate tsunami-genic earthquakes. Installation of special seismographic networks, with remote satellite-base recording around active volcanoes.

PR 4. Organize interdisciplinary working groups, including seismologists, seismic engineers and geologists to develop the criteria and the list of parameters needed to define adequately each significant seismic hazard.

Chapter 7. IASPEI Resources Required

It is clear from the scope of the program outlined in the previous section that an increase in IASPEI funding for the IDNDR is essential for major success. Historically, IASPEI has been able to assist, support and even undertake, many important scientific and educational programs with very limited funds. These accomplishments were possible through either pro bono work of its scientific members, and free space, postage, and clerical contributions from many scientific organizations, universities, institutes and national groups. In addition, crucial but modest funds have been forthcoming from numerous organizations, for example UNESCO (and in recent years from the U.S. National Academy of Science for activities related to UNESCO's Natural Hazards Program), and from private companies associated with earthquake studies.* Some modest funds have also been available from income from IASPEI-sponsored publications and activities generated at the various assemblies and workshops.

Due consideration must be given to an annual minimum budget for the additional administration and travel expenses by the IDNDR activities of IASPEI. Some financial provision should be envisaged for additional expenses in the IASPEI executive, and at the special IDNDR Secretariat (see recommendation RA6 in Chapter 8). Such funding, although essential, should amount to a small proportion of the significant new research funds generated by the IDNDR program.

It is contemplated in the recommendations that one of the major projects for IASPEI for the Decade will be publication of special volumes dealing with state-of-the-art problems in seismic risk reduction. These volumes will be sold throughout the world with a marginal royalty to IASPEI. Income would accrue to a special IDNDR account within IASPEI to be used to subsidize further activities.

During the IDNDR, there is an opportunity for IASPEI to increase donations from private sources for earthquake studies. Because of the great economic losses incurred in earthquakes, there is a clear benefit/cost ratio which results from hazard mitigation measures. For these reasons, approaches to private groups such as the insurance industry, the construction industry, geophysical instrument manufacturers, computer hardware and software manufacturers, banks and foundations should be made after the establishment of the special Secretariat. A reasonable goal is to raise amounts of the order $100,000 per year from 1992.

---

*From 1987 through 1990 the NAS grant income was $135,000 (U.S.) and UNESCO grants and contracts $48,000 (U.S.) in a total grant income of $171,321 (U.S.)

Funds of the same order should also be forthcoming for specific IASPEI projects and workshops from ICSU, UNESCO and the Geneva U.N. Secretariat of the IDNDR.

Finally, this report recommends that the budgeting of IASPEI activities take account, through overhead charges on the income for IASPEI projects on the IDNDR, of the administrative costs to be covered. Overhead costs of at least 15% are normal for most scientific grants to Universities at the present time. This percentage might be used when bilateral arrangements are being made between IASPEI and grant organizations. These overheads would be used to strengthen the staff of the Bureau and the Secretary-General and provide some subsidy for the additional cost of IDNDR activities.

Chapter 8. Recommendations

The following paragraphs list the main recommendations for IASPEI activities during the IDNDR. Section A concerns the activities of IASPEI as an organization representing the science of seismology worldwide. Section B lists recommendations which are addressed more generally to the IASPEI family of scientists, engineers, and social scientists who are interested in research on earthquakes, their description, and the mitigation of risk.

Section A

RA 1. It is the belief of IASPEI that losses of life, property and economic well being from earthquakes can be greatly reduced by additional research and by the application of the scientific and technological advances in seismology and earthquake engineering of the last half century.

RA 2. IASPEI intends to make seismic risk reduction a top priority during the decade of the 1990's. It calls upon seismological groups in member countries and individual earth scientists to participate in the effort to reduce the great danger from earthquakes in many places around the world.

RA 3. IASPEI intends to expand and intensify its programs to study the main hazard attributes of earthquakes and to disseminate globally knowledge on earthquakes to governments, engineers, planners and the public.

RA 4. IASPEI will participate fully in the IDNDR through bilateral and multilateral programs, cooperation with regional and nongovernmental organizations, and support of the United Nations organizational arrangements and program activities.

RA 5. IASPEI will endeavor to construct its Decade activities largely upon the existing organization of the Association. The appropriate Commissions of IASPEI will be charged with carrying out the relevant research and information transfer so that administrative structures can be kept to a minimum.

RA 6. The responsibility for overall policy and direction for IASPEI efforts on the IDNDR should reside with the Bureau through the Secretary-General. In order, however, to coordinate and administer the IDNDR special programs, a special IDNDR Secretariat, funded from additional sources, should be set up which would assist the oversight work of the IASPEI Committee for the IDNDR and other Commissions in their IDNDR activities.

RA 7. IASPEI should initiate a program of compilation of all available information related to large and great earthquakes. Special volumes summarizing this information (if possible in digital form) should be prepared and published.

RA 8. There is a crucial need for continuous maintenance and upgrading of existing seismological and strong motion networks. The Commission on Practice, in cooperation with IAEE, should explore effective ways of their improvement, both technically and financially, with emphasis on mutual support between groups and countries.

RA 9. IASPEI should set up a group of experts at an early stage to compile and publish a study of expected losses in large cities exposed to earthquake activity around the world. These results are essential for transmission to government, national and regional governments so that the orientation of government officials and administrations and planning mitigation measures will improve.

RA 10. IASPEI should review the availability of teaching materials in various languages on earthquakes and their hazards. When necessary, it should take responsibility for the collection of existing materials and, after review, organize the preparation in various languages of suitable materials, such as posters, instruction booklets, mass media, videos and school programs.

Section B.

RB 1. A prime need is for additional earthquake monitoring of appropriate advanced types around the world. Efforts should be made, on a national and international basis, to develop plans for optimal low cost systems of sensitive seismographs and strong motion instruments and funding for installation and long-term continuous operation of these systems.

RB 2. Studies should be made on ways to improve the timely and effective dissemination of warnings of earthquake hazards and occurrence through coordinated efforts of scientists and private enterprise and industry. New technologies, such as advanced telecommunication capability, should be incorporated. A greater effort should be made to collect systematically data expected on seismic intensity, as well as the social and health aspects of earthquake disasters. This data should be shared so that it can be incorporated into policy and practice.

RB 3. Special attention should be given in the IDNDR program to protection from earthquake damage of cultural heritage resources such as historic buildings, monuments and works of art.

RB 4. Special programs to understand better the genesis of landsliding in earthquakes should be undertaken and a study made of the way to mitigate the ground deformation and damage to structures, particularly through a sounder scientific basis for landslide zoning and stabilization techniques

RB 5. Additional innovative studies of volcano-related and induced seismicity are required for understanding the source processes around large reservoirs and for reducing the related seismic risk by forewarning and otherwise.

RB 6. The seismic observations of large earthquakes around the Pacific region should be improved by the interconnection of broadband instrumentation networks and the improvement of a reliable methodology for rapid determination of source parameters. This is needed to better discriminate earthquakes that generate tsunamis.

RB 7. Interdisciplinary working groups should be organized to develop criteria to define p. rameters needed to map adequately seismic hazards and to zone densely populated areas.

RB 8. Basic research is needed to improve knowledge of earthquake sources and source processes. The work entails more realistic models (e.g. use of finite element 3-D structures). Realistic processes of energy release and the preparation stages of earthquake sources must be understood.

RB 9. Priority should be given to education and training of seismologists in developing countries. This involves cooperative efforts with engineers for the joint organization of courses for technicians and university students in basic seismology, geology, and earthquake engineering.

RB 10. The establishment of earthquake prediction evaluation committees is recommended in every earthquake-prone country. Membership should include geologists, seismologists, engineers and emergency planners. The committees should exchange information with similar committees in other countries so they can cope with emergency situations during periods of increased earthquake activity and act as advisory bodies to governments.

RB 11. Further work is needed, particularly water-wave modelling with actual bathymetry, on the exposure and vulnerability of coastlines to tsunamis in the Pacific Ocean and the Caribbean, the Mediterranean and other Seas.

RB 12. Available proven methods in seismology related to earthquake locations, calculation of earthquake size and estimation of other basic parameters should be compiled and arrangements made for direct transfer, at cost, between countries and organizations. Listings should contain a detailed description of the methods, should standardize documentation, and offer the possibility of expert advice on a method. The IASPEI Secretariat for the IDNDR could serve as an intermediary in this technology transfer.

APPENDIX A

BENCH MARKS OF IASPEI PROGRAM ACTIVITIES

1. August 1989	IASPEI Committee for IDNDR formed
2. August 1990	Working meeting of above in Lisbon
3. August 1991	IASPEI Report and Recommendations for IDNDR presented at Vienna Assembly
4. October 1991	Special IASPEI Secretariat for IDNDR established
5. Autumn 1992	Special IASPEI-sponsored IDNDR workshop (South America)
6. January 1994	Major symposium on IDNDR activities at IASPEI Assembly, New Zealand
7. Autumn 1994	Second special IASPEI-sponsored IDNDR workshop (Southeast Asia)
8. Autumn 1995	Second symposium on IDNDR activities at IUGG Assembly

APPENDIX B

CONTRIBUTIONS OF IASPEI COMMISSIONS

Group	Relevance
European Seismological Commission	Numerous subjects e.g. seismicity hazards, microzoning, mechanisms, observatory practice.
Commission on Practice	Many relevant working groups e.g. historical seismograms and earthquakes, estimation of seismic energy, digital seismometry
Commission on Wave Propagation	Effects of nonlinearity, scatterers and damping on intensity variation computation
Commission on Strong Motion Seismology	Computation of strong shaking of the ground and near field source effects.
Commission on Earthquake Hazard and Prediction	All aspects, as shown below.

Subcommissions

1. Earthquake Hazards
2. Working Group on Effects of Surface Geology (joint with IAEE)
3. Assessment Techniques
4. Earthquake Risk
5. Modelling the Earthquake Process
6. Earthquake Prediction
7. Time-Dependent Seismic Hazard
8. Seismicity Patterns
9. Crustal Deformations
10. Earthquake Alarms Based on Combined Parameters

APPENDIX C

COMPLIMENTARY INTERNATIONAL PROGRAMS

1. United Nations - IDNDR Secretariat
   (Neelam Merani, Director)
   Palais de Nation
   CH-1211 Geneva 10, Switzerland

2. UNDP-UNDRO
   Project de Cooperation pour la Reduction des Risques Sismiques
   dans La Region Mediterraneenne (SEISMED)
   Castello D'Albertes
   Dogali 18-16126 Genes, Italy

3. UNESCO
   (a) Natural Hazards Programme
   Medium Term Plan (1990-95)
   Paris, France
   (b) Memorandum of understanding between USGS and UNESCO for cooperation in IDNDR
   (signed April 1990)

4. U.S. National Research Council
   Commission on Engineering and Technical Systems
   Washington, D.C.

5. International Association of Volcanology
   and Chemistry of the Earth's Interior
   (IAVCEI)
   (see Bull. Volcanol. Soc. Japan **35**, 80, 1990)

6. The International Lithosphere Commission (ICL)

7. The International Union of Geological Sciences (IUGS)

8 Japanese Government Headquarters for the IDNDR
   Secretariat National Land Agency, Tokyo
   (1990 budget 144 million yen).

9. Regional Center for Seismology for South America (CERESIS)
   Lima, Peru

10. International Union of Geodesy and Geophysics (IUGG)
    Committee for IDNDR
    (Chairman: V. I. Keilis-Borok IASPEI representative B.A. Bolt)

11. International Association of Earthquake Engineering
    Secretary-General T Katayama
    Institute of Industrial Sciences
    Tokyo University, Tokyo, 106, Japan

12 International Council of Scientific Unions (ICSU)
   Executive Secretary
   51 Bld. de Montmorency
   75016 Paris, France

APPENDIX D

LISBON IASPEI/IDNDR MEETING

Participants

B. A. Bolt (Chairman)
Seismographic Station
Room 499 Earth Sciences Building
University of California
Berkeley, California, 94720
U.S.A. (FAX: 415 643-5811)

M. Hashizume
Division of Earth Sciences
UNESCO
B.P. 3.07 Paris
FRANCE

V. Karnik
Czechoslovakia Akademia Ved
Geofyzikalni Ustav
Bocni II - CP. 1401
14131 Praha 4, Sporilov
Prague
CZECHOSLOVAKIA

E. Kausel
Departamento de Geologia Y Geofisica
Universidad De Chile
Blanco Encalada 2085
Casilla 2777
Santiago
CHILE

S. Mueller
Institut fur Geophysik
ETH - Hoenggerberg
CH-8093 Zurich
SWITZERLAND

M. Ohtake
Geophysical Institute
Tohoku University
Sendai 980
JAPAN

C. Oliveira
Laboratorio Nacional de Engenharia
Civil
Avenida da Brasil, 101
1799 Lisboa Codex
PORTUGAL

G. Sobolev
Institute of Physics of the Earth
Bolshaya Gruzinskaya, 10
Moscow 123242
USSR

Li Li Xie
Institute of Engineering Mechanics
Academia Sinica
Harbin
THE PEOPLE'S REPUBLIC OF CHINA