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A PROJECT TO STUDY URBAN EARTHQUAKE RISK WORLDWIDE

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ABSTRACT

In 1998, the Secretariat of the International Decade for Natural Disaster Reduction (IDNDR) and GeoHazards International (GHI) launched the Understanding Urban Seismic Risk Around the World (UUSRAW) project. The 18-month project established an internet network of 74 seismically active cities worldwide to compare their earthquake hazard and to share their experiences and resources in working to reduce the impact of future earthquakes. In each city, a local scientist or municipal officer gathered the information necessary to conduct the comparative assessment using the Earthquake Disaster Risk Index (Davidson, 1997), a composite index used to assesses risk based on several factors.

The comparative assessment and other project results, including a compilation of city profiles that systematically describe the key elements of each participating city's earthquake risk and its risk management practices, as well as a compilation of more than 60 risk management efforts from 27 cities, will be included in a final report published by the United Nations.

Although work continues in developing a technically sound, widely accepted assessment of the earthquake risk and risk management practices of cities worldwide, the UUSRAW project represents a significant first step in establishing a worldwide network of earthquake professionals and helping cities share experiences and learn from each other more effectively.

INTRODUCTION

Earthquakes are infrequent, so no single city has endured many earthquake disasters. Every city, therefore, has much to gain if all cities share their resources and experiences with earthquakes and earthquake risk management. To address the untapped potential of inter-city collaboration, in April 1998, the Secretariat of the IDNDR and GeoHazards International, a non-profit organization dedicated to reducing earthquake risk in the world's most vulnerable communities, launched the Understanding Urban Seismic Risk Around the World (UUSRAW) project. The UUSRAW study was implemented as part of the RADIUS initiative (www.geohaz.org/radius/understanding.html).

PROJECT OBJECTIVES

The objectives of the UUSRAW project were to 1) conduct a systematic comparative assessment of the magnitude, causes and ways to manage earthquake risk in cities worldwide, 2) identify cities around the world facing similar earthquake risk challenges and foster partnerships among them and 3) provide a forum in which cities can share their earthquake and

earthquake risk management experiences using a consistent, systematic framework for discussion.

PROJECT PARTICIPANTS

The United Nations IDNDR Secretariat invited seismically active cities around the world to participate in the UUSRAW project. The city governments of 74 cities from 50 countries expressed interest in participating. For each of the 74 member cities that applied to participate in the study, a responsible scientist served as the city representative.

City representatives

The city representatives held the key to the project's success. Using their knowledge and resources, they gathered the information required to develop an earthquake risk profile of their city. They formed partnerships and shared their feedback about the information gathering process, the proposed methodology and the project. Due to various reasons, only twenty of the 74 cities participated actively in all phases of the project, collecting the requested information and participating in the project discussion. These twenty cities are the following:

Algiers, Algeria; Bogota, Colombia; Bucharest, Romania; Dehra Dun, India; Dhaka, Bangladesh; Gilgit, Pakistan; Guadalajara, Mexico; Gyumri, Armenia; Kampala, Uganda; Kathmandu Valley, Nepal; Pimpri, India; Quito, Ecuador; Rome, Italy; San Juan, Argentina; San Salvador, El Salvador; Santiago, Chile; Skopje, TFYR Macedonia; Sofia, Bulgaria; Tehran, Iran and Ulaanbaatar, Mongolia.

Project coordinators

The project coordinators developed worksheets to gather information from the designated city representatives. They compiled and analyzed the requested information from each participating city, moderated an internet forum for the city representatives and international advisors, kept participants informed of the project's status and wrote the project final report and city profiles.

International advisors

Several international advisors also participated in the internet forum. They helped to answer questions and shared their experience and knowledge of earthquake risk.

PROJECT DESIGN

Systematic framework

The Earthquake Disaster Risk Index (EDRI) provided a framework for the UUSRAW project's worldwide comparative urban earthquake risk assessment. Introduced in 1997, the EDRI compares metropolitan areas according to the magnitude and nature of their earthquake disaster risk, which is analyzed using five main factors: "Hazard," "Vulnerability," "Exposure," "External Context" and "Emergency Response and Recovery."

"Hazard" measures the severity, extent and frequency of the geological trigger phenomena to which the city may be subjected. "Exposure" measures the size of the city, namely, number of people and physical objects and the amount and type of activities they support. "Vulnerability" measures how easily the exposed people, physical objects and activities may be affected in the short- or long-term. "External Context" measures how impact within a city affects people and activities outside the city. "Emergency Response and Recovery" measures how effectively and efficiently a city can reduce the impact of an earthquake through formal, organized efforts made specifically for that purpose.

In the UUSRAW project, the EDRI methodology offered a helpful structure with which to conduct a systematic, easily accessible discussion of earthquake risk that includes issues related to all disciplines, to academicians and practitioners and to all regions of the world.

Data collection, compilation and analysis

The project coordinators developed worksheets requesting: (1) the earthquake risk information necessary to determine the cities' EDRI values, (2) information about earthquake risk management efforts that have been undertaken in each city and (3) feedback on the experience of gathering the requested data, the form and usefulness of the EDRI and the project design and management. The worksheets were distributed to the city representatives who then completed and returned them, mostly via e-mail. The project coordinators compiled the requested earthquake risk information into a database, carried out the comparative analysis and distributed the database and analyses results to city representatives for their feedback. Project coordinators also compiled a database of the requested earthquake risk management information and the feedback on the EDRI methodology and the project, which, along with the results of the analysis, will be included in the project's final report.

Internet forum and web page

Throughout the project, an established internet forum provided a way for city representatives, project coordinators and international advisors to share questions and comments about the information gathering process, the proposed methodology and urban earthquake risk and risk management in general. A page on the worldwide web was also established to provide information about this project to non-participants.

PROJECT FINAL REPORT

The deliverables of the UUSRAW project will be included in the project final report (Cardona, Davidson, Villacís, in press), which will be published and disseminated by the United Nations, and will include (1) a summary of the assessments of earthquake risk and risk management in the participating cities, (2) a compilation of the city profiles, (3) a compilation of specific risk management efforts undertaken in the participating cities and (4) a summary of the feedback received from the project participants throughout the course of the project.

Earthquake risk and risk management assessment

The report will provide comparative assessments (see Fig. 1) of the earthquake risk of the participating cities and the relative contributions of each EDRI factor to each city's risk and the state of risk management in each city. Because the information for each city was gathered using the same worksheets, it was possible to provide descriptions of the key elements of a city's risk and risk management efforts in a consistent, systematic way.

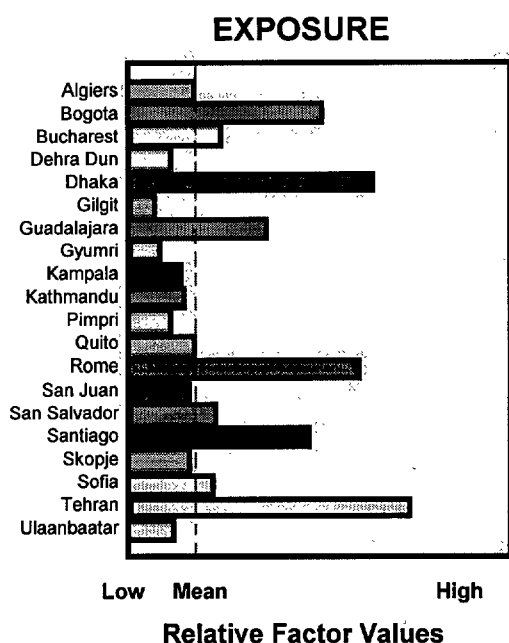


Fig. 1. Sample results of relative Exposure factor values for the 20 cities actively involved in all phases of the project

City profiles

For each of the participating cities, project coordinators developed a two-page profile of the city's earthquake risk, its causes and efforts that have been undertaken to reduce it. Each city profile includes basic information about the city, a comparative analysis that describes the city's earthquake risk in relation to other cities worldwide and a list of earthquake risk management agencies efforts undertaken to reduce the city's earthquake risk.

Risk management effort case studies

The final report also includes a compilation of more than 65 risk management effort case studies from 27 cities. A wide variety of efforts are included in this compilation which were implemented by different groups (e.g., government agencies, the private sector), target different groups (e.g., schools, small businesses) or needs (e.g., emergency response planning, infrastructure strengthening), use different forms of implementation (e.g., establishing an organization, passing legislation) and cover different areas (e.g., local, state, national).

For example, the city of Gilgit, Pakistan reported on its Disaster Mitigation and Management program, implemented since 1996 by the Aga Khan Housing Board for Pakistan and FOCUS-USA, with the overall objective to mitigate the effect of natural and man-made disasters. The needs the program meets are creating awareness about the dangers of natural and

man-made disasters, educating people on precautions to take to mitigate the effects of disasters, enhancing the capacities of communities/NGOs/Government Departments to respond to and manage disaster situations, influencing the growth of settlements in such a way that the dangers from natural and man-made disasters are minimized and promoting the construction of less-vulnerable houses and institutional buildings. The program targets communities, NGOs and other government departments and is implemented on a regional level.

Among other efforts, the city of Tehran, Iran reported on its effort to develop and improve the fire station network, a locally implemented initiative that increased the number of fire stations in the city from 26 in 1994 to 46 in 1998 and attempted to seismically strengthen existing stations.

The compilation of risk management initiatives, which can be expanded and updated over time, can provide city representatives with specific risk management ideas and contact information should they wish to learn more about a particular effort.

Feedback

The report will also summarize the feedback that city representatives provided throughout the project. The input was compiled from responses to a worksheet designed especially to solicit feedback, the discussion that took place through the internet forum and the in-person meeting held during the RADIUS International Symposium, the final culmination of the RADIUS initiative which took place in October of 1999 and for which most of the actively participating representatives were present. The input relates to the EDRI methodology, the project design, potential uses and users of the study's results, global earthquake risk assessment in general and the potential for conducting related work in the future.

USES OF UUSRAW RESULTS

An important use of the UUSRAW project was to help to raise awareness in the cities that participated actively. For example, the city of San Salvador, El Salvador held a Radius Press Launch, which was covered by local media, in order to educate its newly elected city officials on the risk of the city and, hopefully, prompt action against this risk. The city of Sofia, Bulgaria used the project and their participation to publish articles in their local newspapers. Awareness was also raised internationally through the announcement and posting of reports by city representatives on the project homepage.

Another equally important contribution of the project was the development of a new network of earthquake professionals that spans more than 70 cities and 50 countries of the world. The professionals represent a variety of disciplines and cities with diverse earthquake risk and risk management situations.

Already, this network has proven to be an important resource for formal projects, for both following up the UUSRAW project or for similar future work. It has also provided valuable contacts for informal interaction.

PROJECT CONCLUSIONS

The UUSRAW Project involved 74 member city representatives working worldwide via the internet amidst a variety of challenges in order to gather information that would help participants better understand the magnitude and different causes of their city's risk as well as compare these results with those of the other participating cities.

Challenges

The UUSRAW project was a first step in global earthquake risk and risk management assessment through which, in spite of the project's systematic framework and methodology, several challenges were faced. One of the biggest challenges of the project was obtaining data, even directly from city representatives who had access to local sources. For example, several cities in the sample are undergoing periods of social and economic transition; thus, it was especially difficult to find reliable and consistent economic data for these cities. Furthermore, varying degrees of available and accurate data were inherent to the interesting combination of cities that participated.

In addition, due mostly to the nature of the project's application process, it was difficult to ensure that all 74 representatives participated actively in all phases of the project, especially since the city representatives participated voluntarily in the project.

Finally, though the internet helped in lowering costs because it cut down on the need to travel, not all participating cities had free and unlimited internet access; hence, their participation and discussion were limited accordingly.

Achievements

Despite the challenges faced during the project, there were many achievements as well. For example, although the use of the internet imposed limitations on some cities, for the most part, participants agreed that the internet was a good vehicle for the implementation of projects such as this one since it allowed for more frequent interaction and communication among participants.

By providing a forum in which project participants could voice their ideas about the project, the proposed methodology and earthquake risk and earthquake risk management in general, an active internet discussion flourished amongst earthquake professionals worldwide.

Another notable achievement was the vast amount of information collected throughout the project. In addition to the earthquake risk data collected for and shared among representatives, the information gathered on earthquake risk management activities sparked interest in city representatives who would like to learn more about one another's work. The project also helped raise awareness in several of the participating cities.

FUTURE WORK

The UUSRAW project represents a significant step in helping cities share experiences and learn from each other more effectively, but challenges, as learned through this project, remain to improve, expand and apply the UUSRAW risk assessment methodology and to capitalize on the network of earthquake professionals that was established.

There is still work to be done in developing a technically sound, widely accepted assessment of the earthquake risk and risk management practices of cities worldwide. Efforts must be undertaken to actually use the global comparative risk assessment to try to raise public awareness, motivate mitigation efforts among government officials and help international development organizations improve the efficiency of their strategic planning and resource allocation. The authors of this paper are continuing work towards these objectives.

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